Wildlife Services

Protecting People
Protecting Agriculture
Protecting Wildlife

Protecting through Scientific Research

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Notable Examples of Significant Research

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The National Wildlife Research Center (NWRC) is a world leader in providing science-based solutions to complex issues of wildlife damage management. As the research arm of the Wildlife Services (WS) program, NWRC works with WS operations staff to provide Federal leadership and expertise to resolve wildlife conflicts related to agriculture, livestock, human health and safety (including wildlife diseases and aviation), invasive species, and threatened and endangered species.

Wildlife Services (WS) is a science-based program that relies on research and other independent reviews to assess the need for wildlife damage management, the potential impacts of field work, and the costs and benefits associated with program work. Below are a several notable studies compiled by WS and partners that highlight the importance and need for WS' assistance in resolving wildlife conflicts.

Potential economic costs to Hawaii of invasive brown tree snakes.

SHWIFF, S. A., K. GEBHARDT, K. N. KIRKPATRICK, AND S. S. SHWIFF. 2010. Potential economic damage from introduction of brown tree snakes, *Boiga irregularis* (Reptilia: Colubridae) to the islands of Hawaii. Pacific Science 64:1-10.

The brown tree snake *(Boiga irregularis)* has caused ecological and economic damage in Guam, and the snake has the potential to colonize other islands in the Pacific Ocean. This study quantifies the potential economic damage if the snake were translocated, established in the state of Hawaii, and causing damage at levels similar to those on Guam. Damages modeled included costs of medical treatments due to snakebites, snake-caused power outages, and decreased tourism resulting from effects of the snake. Damage caused by presence of the brown tree snake on Guam was used as a guide to estimate potential economic damage to Hawaii from both medical- and power outage–related damage. To predict tourism impact, a survey was administered to Hawaiian tourists that identified tourist responses to potential effects of the brown tree snake. These results were then used in an input-output model to predict damage to the state economy. Summing these damages resulted in an estimated total potential annual damage to Hawaii of between $593 million and $2.14 billion. This economic analysis provides a range of potential damages that policy makers can use in evaluation of future prevention and control programs.

Detecting chronic wasting disease.

NICHOLS, T. A., B. PULFORD, A. C. WYCKOFF, C. MEYERETT, B. MICHEL, K. GERTIG, E. A. HOOVER, J. E. JEWELL, G. C. TELLING, AND M. D. ZABEL. 2009. Detection of protease-resistant cervid prion protein in water from a CWD-endemic area. Prion 3:1-13.

Chronic wasting disease (CWD) is the only known transmissible spongiform encephalopathy affecting free-ranging wildlife. Although the exact mode of natural transmission remains unknown, soil and surface water contaminated with urine, feces, saliva, blood and decomposing carcasses from prion infected animals have been implicated as possible transmission vehicles for CWD prions. A prion is an infectious protein particle considered to be the agent responsible for CWD. Detecting vanishingly small traces of prions in environmental samples has not been possible with traditional prion detection techniques. Serial protein misfolding cyclic amplification (sPMCA) holds promise as a new technique for ultrasensitive prion detection. Here NWRC researchers and colleagues show for the first time that sPMCA can detect minute concentrations of protease resistant cervid prion protein (PrPCWD) in experimental samples and in environmental water samples. These results demonstrate the detection of very low levels of PrPCWD in the environment is possible and suggest persistence and accumulation of prions in the environment that may promote CWD transmission.

Repellants for birds.

WERNER, S. J., J. C. CARLSON, S. K. TUPPER, M. M. SANTER, AND G. M. LINZ. 2009. Threshold concentrations of an anthraquinone-based repellent for Canada geese, red-winged blackbirds, and ring-necked pheasants. Applied Animal Behaviour Science 121:190-196.

Wildlife repellents provide an additional approach or managing bird depredation to agricultural crops. For the purpose of developing of an effective avian repellent, NWRC researchers established repellency thresholds of an anthraquinone-based repellent for Canada geese *(Branta canadensis),* red-winged blackbirds *(Agelaius phoeniceus),* and ring-necked pheasants *(Phasianus colchicus)* in captivity. Anthraquinone, which occurs naturally in some plants, produces a laxative effect when eaten. Results showed 80 percent repellency was produced with threshold concentrations of 1450 ppm anthraquinone for geese, 1475 ppm anthraquinone for blackbirds, and 10,450 ppm anthraquinone for pheasants. This data provide a reliable basis for planning future field applications of anthraquinone-based bird repellents for protection of agricultural crops, property, and related natural resources. Supplemental field efficacy studies are necessary for registration of anthraquinone-based repellents for managing agricultural depredation caused by wild birds.

Immunocontraceptive vaccine for white-tailed deer.

GIONFRIDDO, J. P., J. D. EISEMANN, K. J. SULLIVAN, R. S. HEALEY, L. A. MILLER, K. A. FAGERSTONE, R. M. ENGEMAN, AND C. A. YODER. 2009. Field test of a single-injection gonadotrophin-releasing hormone immunocontraceptive vaccine in female white-tailed deer. Wildlife Research 36:177-184

The development and use of safe, effective and practical wildlife contraceptive agents could reduce reproduction in locally overabundant deer populations. GonaCon Immunocontraceptive Vaccine (the commercial name for a particular gonadotrophin-releasing hormone [GnRH]-based emulsion) was tested in adult female white-tailed deer in a fenced herd near Silver Spring, Maryland. After receiving one injection of GonaCon, 88 percent of treated deer did not become pregnant during the first year and 47 percent did not become pregnant during the second year after vaccination. NWRC researchers are continuing to investigate ways to reduce localized injection site reactions in vaccinated deer. Treatment with GonaCon can be a safe and effective means of inducing temporary infertility in wild white-tailed deer. Ultimately, the management value of GonaCon will be determined by natural-resource professionals who use it to manage deer reproduction.

Understanding raccoon genetics to prevent the spread of rabies.

ROOT, J. J., R. B. PUSKAS, J. W. FISCHER, C. B. SWOPE, M. A. NEUBAUM, S. A. REEDER, AND A. J. PIAGGIO. 2009. Landscape genetics of raccoons (Procyon lotor) associated with ridges and valleys of Pennsylvania: implications for oral rabies vaccination programs. Vector-borne and Zoonotic Diseases 9:583-588.

In the United States, raccoons (*Procyon lotor*) are reservoirs for the raccoon rabies virus variant, which can infect humans and other wildlife species. To combat this threat, Wildlife Services conducts a cooperative oral rabies vaccination (ORV) program in many eastern States. In this study, NWRC, WS' Pennsylvania State office , and the Centers for Disease Control and Prevention determined the genetic structure of raccoons in Pennsylvania and the geographic features (e.g., ridges and valleys), if any, that may hinder or enhance raccoon gene flow (i.e., movement) and the movement of rabies virus by this mammal. Results indicated that there was little genetic differences among the raccoon populations sampled. However, geographic distance was found to impact some of the genetic differences, which suggests that adequate widths of ORV zones are critical for success. The researchers concluded that geographic features within this landscape influence gene flow in raccoons only to a limited extent, and geographic features such as ridges are not substantial long-term barriers to the spread of rabies virus. These results may be of value to inform future ORV efforts in Pennsylvania and other eastern States with similar landscapes.

Avian influenza in mammals.

VANDALEN, K. K., S. A. SHRINER, H. J. SULLIVAN, J. J. ROOT, AND A. B. FRANKLIN. 2009. Monitoring exposure to avian influenza viruses in wild mammals. Mammal Review 39:167-177.

Avian influenza (AI) viruses primarily circulate in wild waterfowl populations and are occasionally transmitted to domestic poultry flocks. However, the possible roles of wild mammals in AI virus ecology have not been adequately addressed though wild mammals on farms have been identified as a risk factor for AI outbreaks in North America. Currently, serological tests are used to assess domestic poultry, domestic swine and human exposure to influenza A viruses, but these tests have not been validated for use in wild mammals. In this paper, NWRC researchers review existing serological techniques and evaluate their potential usefulness in AI surveillance of wild mammals.

Impacts of invasive frogs to Hawaii.

BEARD, K. H., E. A. PRICE, AND W. C. PITT. 2009. Biology and impacts of Pacific Island invasive species: *Eleutherodactylus coqui*, the Coqui frog (Anura: Leptodactylidae). Pacific Science 63:297-316.

Beard et al. provide an overview of the biology and impacts of the invasive coqui frog *(Eleutherodactylus coqui)* to Hawaii. This nocturnal, terrestrial frog is endemic to Puerto Rico and was accidentally introduced to Hawaii via nursery plants in the late 1980s. Over the past two decades, the coqui frog has spread to the four main Hawaiian Islands, and a major campaign was launched to eliminate and control it. One of the primary reasons this frog has received attention is its loud mating call (85–90 decibels at 0.5 m). Many homeowners do not want the frogs on their property, and their presence has influenced housing prices. In addition, the coqui frog has indirectly impacted the floriculture industry because customers are wary of purchasing products potentially infested with frogs. The frog attains extremely high densities in Hawaii, up to 91,000 frogs per hectare, and can reproduce year-round. Although the coqui has been hypothesized to potentially compete with native insectivores, the most obvious potential ecological impact of the invasion is predation on invertebrate populations and disruption of associated ecosystem processes. Multiple forms of control have been attempted in Hawaii with varying success. The most successful control available at this time is citric acid. Currently, the frog is established throughout the island of Hawai'i but may soon be eliminated on the other Hawaiian Islands via control efforts. Eradication is deemed no longer possible on the island of Hawaii.

Determining allowable take of migratory birds.

RUNGE, M. C., J. R. SAUER, M. L. AVERY, B. F. BLACKWELL, AND M. D. KONEFF. 2009. Assessing allowable take of migratory birds. Journal of Wildlife Management 73:556-565.

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Legal removal of migratory birds from the wild occurs for several reasons, including subsistence, sport harvest, damage management, and the pet trade. A more reliable method is needed to determine how many birds can be removed from a wild population without endangering the future sustainability of the population. In this study, researchers from the NWRC, U.S. Geological Survey and U.S. Fish and Wildlife Service advance a simplified version of the standard harvest theory as a useful method for assessing take, and demonstrate this approach with a case study involving the control of black vultures *(Coragyps atratus)* in Virginia. The formula includes an estimate of the minimum size of the animal population, its maximum growth rate, and a variable by wildlife managers, based on how much they need to reduce population size. Precisely estimating local vulture populations is difficult, due to uncertainties about their lifespan and breeding habits. The researchers relied on annual bird-count data from the Breeding Bird Survey and studies of radio-tagged vultures. This method can be adapted for use with other species and situations, such as the incidental take of depleted species, sport harvest, or nuisance control, and can provide a framework for improving communication and coordination among regulatory agencies and their constituencies.

Evaluating cormorant management.

DORR, B. S., A. MOERKE, M. BUR, C. BASSETT, T. ADERMAN, D. TRAYNOR, R. D. SINGLETON, P. H. BUTCHKO, AND J. D. TAYLOR II. 2010. Evaluation of harassment of migrating double-crested cormorants to limit depredation on selected sport fisheries in Michigan. Journal of Great Lakes Research 36:215-223.

The interior population of double-crested cormorants *(Phalacrocorax auritus)* has shown a substantial resurgence over the past 35 years, from approximately 32,000 breeding pairs in the mid-1970s to more than 226,000 breeding pairs (including the Great Lakes States and Canadian provinces) by the mid-1990s. Diverse management techniques are used to mitigate conflicts between humans and cormorants, including harassment (e.g., pyrotechnics) supplemented by lethal removal. In this study, NWRC scientists evaluated impacts of cormorant harassment programs on the walleye *(Sander vitreus)* fishery in Brevoort Lake, MI, and the yellow perch *(Perca flavescens)* and walleye fisheries at Drummond Island, MI. Cormorant foraging declined significantly at both locations after managers and scientists initiated harassment programs in the spring. Overall, harassment deterred 90 percent of cormorant foraging attempts, with less than six percent of the cormorants taken lethally on average at each site. Yellow perch were a predominant prey item in number and biomass at both locations. Walleye made up a small proportion of the diet at both locations. However, estimated cormorant consumption of walleye at Brevoort Lake accounted for a large percentage of the age-one walleye (between one and two years old). Both walleye and yellow perch abundance increased significantly at Drummond Island following cormorant harassment. Walleye abundance increased to record levels in 2008, following three years of cormorant management at Brevoort Lake. These results support the hypothesis that cormorant predation on spawning aggregations of sportfish was a significant mortality factor, and that cormorant management could reduce sportfish mortality and increase abundance at both locations. Continuation of cormorant harassment programs and fishery assessments will determine whether improvement of targeted sport fisheries is sustainable.

Reducing deer-vehicle collisions.

BLACKWELL, B. F., AND T. W. SEAMANS. 2009. Enhancing the perceived threat of vehicle approach to deer. Journal of Wildlife Management 73:128-135.

Each year, 1.5 million deer-vehicle collisions (DVCs) occur in the United States resulting in more than $1.1 billion in damages and injuries, as well as loss of human and animal life. In this study, NWRC researchers investigated different vehicle-mounted lighting systems for warning deer of approaching vehicles. Most cars are equipped with TH lamps, which might not provide the best compliment to deer visual capabilities at night. NWRC scientists measured flight-initiation distance of white-tailed deer to an approaching vehicle relative to lighting scenarios involving standard TH lamps alone and in combination with a HID lamp set to constant illumination or pulsed. Results showed that a combination of standard tungsten-halogen (TH) lamps and constant illumination of a high-intensity discharge (HID) lamp increased the distance in which white-tailed deer reacted to an approaching vehicle, on average by as much as 20 meters. Though the experiment resulted in a more rapid response by deer to approaching vehicles, further studies are needed to account for variations in deer behavior and habitat types. Many factors contribute to the number of DVCs in an area, including deer population, demographics, traffic volume and speed, activity patterns, seasonality, and habitat features. Although the majority of these factors are unchangeable, the ability to develop vehicle lighting systems that enhance deer avoidance may be one factor that could be improved.

Using thermography to detect disease.

DUNBAR, M. R., S. R. JOHNSON, J. C. RHYAN, AND M. MCCOLLUM. 2009. Use of infrared thermography to detect thermographic changes in mule deer (*Odocoileus hemionus*) experimentally infected with foot-and-mouth disease. Journal of Zoo and Wildlife Medicine 40:296-301.

Infrared thermography (IRT) measures the heat emitted from a surface, displays that information as a pictorial representation called a thermogram, and is capable of being a remote, noninvasive technology that provides information on the health of an animal. Foot-and-mouth disease (FMD) is a severe, highly communicable viral disease of cloven-hoofed animals, including cattle, pigs, sheep, goats and deer. Early detection of the disease may reduce economic loss and loss of susceptible wildlife. The objective of this study was to evaluate the use of IRT to detect possible heat changes associated with sites of FMD infection in experimentally infected mule deer (Odocoileus hemionus). Results indicated infected mule deer had a significant foot-temperature rise over the course of the infection. The increase in foot temperatures of these animals is probably associated with inflammation related to the development and occurrence of lesions. Also, the animals' body temperatures elevated significantly from the pre-infection temperature starting the day before any lesions were observed. These observed changes indicate that IRT may be a rapid, remote, and noninvasive method to screen for suspect animals during an FMD outbreak.

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