

Wildlife Services

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Leader in Nonlethal Solutions to Wildlife Damage



Contact Information:

Larry Clark
Director
NWRC Headquarters
4101 LaPorte Avenue
Fort Collins, CO 80521-2154
Phone: (970) 266-6036
FAX: (970) 266-6040
larry.clark@aphis.usda.gov
www.aphis.usda.gov/wildlife_damage/
nwrc/

USDA Scientists Apply Expertise to Wildlife Conflicts

The National Wildlife Research Center (NWRC, Center) 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 human-wildlife conflicts related to agriculture, human health and safety (including wildlife diseases and aviation), invasive species, and threatened and endangered species. In 2010, the majority of NWRC's research funding was devoted to the development or improvement of nonlethal wildlife damage management tools and methods. Many of the nonlethal methods used today by Federal, State, and private sector wildlife professionals stem from research conducted at or through the Center.

Protecting Agricultural Crops, Aquaculture, and Natural Resources

NWRC is committed to finding nonlethal solutions to reduce wildlife damage to agricultural crops, aquaculture, and natural resources. NWRC scientists have shown that "decoy" plantings of sunflower can significantly reduce bird damage to nearby commercial sunflower fields. In recent studies, scientists observed higher blackbird damage in decoy fields than nearby commercial sunflower fields with blackbirds removing an average of 388 pounds/acre and 44 pounds/acre of sunflower seed, respectively. In addition to reducing bird damage to the commercial fields, decoy fields also are benefiting many other bird and wildlife species. In a collaborative study with North Dakota State University, NWRC scientists examined migratory bird use of croplands in North Dakota and found species diversity and densities to be highest in decoy sunflower fields compared to commercial sunflower or other non-sunflower row-crops such as corn, soybeans and wheat. In fact, scientists determined that decoy fields with tall (≥ 4.3 ft/1.3 m), densely planted rows (≥ 1.5 crop plants/linear foot) with some non-crop plants—such as forbs from flowering mustard, cabbage and goosefoot families—resulted in the highest bird densities. Results showed greater bird densities in sunflower and especially in decoy fields than previously reported during fall in fallow, sunflower and wheat fields; in cornfields during the breeding season; in Great Plains forest fragments in spring; and in Conservation Reserve Program grassland and row-crop fields in winter. The cost-benefits associated with decoy fields are still being evaluated. Scientists are hopeful that the proper placement and management of these fields will provide sunflower producers with an economically viable nonlethal blackbird damage management option that also improves wildlife habitat for other migratory birds.

NWRC scientists continue to develop the use of 9,10-anthraquinone (AQ) for repelling birds from newly planted seeds and ripening crops. In laboratory studies, AQ effectively prevented Canada geese, red-winged blackbirds, and ring-necked pheasants from eating treated seed by as much as 80 percent. Information from this and other studies will be used in the registration of AQ-based repellents with the U.S. Environmental Protection Agency.

Birds can also cause a great deal of damage at fish farms and other aquaculture facilities. Currently, NWRC is studying the migratory movements and feeding behavior of double-crested cormorants and other fish-eating birds. NWRC scientists and collaborators have identified a biomarker in the bird's skin that is a predictor of age in double-crested cormorants. This information may lead to a rapid and cost effective technique for identifying age of cormorants and many other species of birds. This technique will help provide a better understanding of the population characteristics of cormorants that are impacting commercial and natural resources in the United States. Bird age estimates are useful for predicting population growth rates and responses to various management activities.

Foraging wildlife can damage forest resources in many ways, such as reducing productivity or disrupting re-vegetation efforts. NWRC researchers discovered that certain food-grade materials, such as milk casein and gelatin, have great potential as repellants to reduce rodent and rabbit consumption of seedlings, ornamental plants and food crops. NWRC



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researchers also are working to determine how certain wildlife species respond to chemical components in the plants they eat. Ongoing collaborative efforts are determining which traits can be selected to produce less palatable trees. For instance, studies suggest that, when given a choice, deer prefer to eat conifer seedlings with low terpene levels. Tree breeding programs can be used to produce seedlings with elevated terpenes. Understanding these and other mechanisms that control dietary behaviors aid in the development of management strategies for decreasing damage and help create models for predicting where damage is most likely to occur.

Protecting Human Health, Safety and Property

NWRC works to protect human health and property by developing wildlife damage management tools that help reduce wildlife hazards. Wildlife that occurs on and near airport runways is an ongoing concern for many airport managers. Recently, the Federal Aviation Administration (FAA) provided NWRC researchers with funding to evaluate the effectiveness of avian radars at airports. The effort brings together experts in wildlife biology, ornithology, radar engineering, and system integration from government, industry, and academia to evaluate the MERLIN Avian Radar System by DeTect, Inc., one of several radar systems used to detect birds at and near airports. The assessment effort is part of the FAA's overall investigation into the effectiveness of commercially available avian radar detection systems at U.S. civil airports when used in conjunction with other known wildlife management and control techniques. Though it is well established that radar can detect wild birds, there is little published information concerning the accuracy and detection capabilities related to range, altitude, target size, and effects of weather for avian radar systems. NWRC researchers are leading the effort involving experts from the National Center for Atmospheric Research and several universities. Efforts involve: 1) a technical evaluation of the candidate radar system, including sensor components and associated data delivery systems, 2) field evaluations of system accuracy using remote controlled aircraft and wild birds, 3) an assessment of the integration of radar technology with other, more traditional aspects of wildlife hazard management at airports, and 4) a behavioral study on the potential effects of radar energy on bird behavior. Information gathered from these studies might contribute to the development of future wildlife hazard mitigation guidelines as part of an integrated wildlife hazard management approach at civilian and military airports across the country.

The ways in which birds respond to approaching objects is critical when it comes to their ability to detect predators, forage, flock, and avoid collisions with static or moving objects. Understanding variations in animal visual capabilities and other sensory systems may shed light on how animals detect and avoid threats from approaching aircraft, other vehicles, wind turbines and communication towers. NWRC scientists, along with university and private partners, are working to enhance animal detection and avoidance behaviors related to vehicle approach using vehicle-based lighting treatments. Studies show that vehicle lighting varied by pulse frequency can be used to enhance birds' abilities to detect and avoid approaching ground-based vehicles and aircrafts. Researchers also found that the response of a species to an approaching vehicle depends not only on its visual capacity but also on its innate response to predators. For example, brown-headed cowbirds—with a reduced ability to visually track an object—were especially alert to an approaching vehicle under specific vehicle-lighting treatments, which, according to researchers, might also cause them to flush earlier to reduce the risk of predation. In contrast, mourning doves—with wider fields of vision and an ability to detect more-distant objects—maintained position, possibly relying on cover for safety. This new information presents an opportunity

for WS and its partners to work with industry to design aircraft lighting systems that detect ambient light conditions, then tailor the lighting output to one more readily discerned by birds under those conditions. More research is forthcoming, but scientists have presented their most recent findings before representatives of a major aircraft manufacturer and already seen their initial findings employed by a commercial airline in a field trial.

Similar studies with vehicle-mounted lighting systems for warning deer found 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, by, on average, as much as 20 meters. These findings could potentially aid in the development of new vehicle lighting systems that enhance deer detection of approaching vehicles and, thus, lower the number of deer-vehicle collisions (DVCs) occurring in the United States and abroad. Each year, DVCs are responsible for more than \$1.1 billion in damages, injuries and loss of animals in the United States. 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.

As goose and pigeon populations in urban areas expand, these birds are often considered a nuisance and potential health problem (fouling land and water, colliding with and damaging aircraft, etc.). NWRC scientists partnered with Innolytics, LLC, a California-based company, to develop an oral contraceptive bait called OvoControl for geese and pigeons. Final regulatory approval and registration of the bait was granted in 2005 for Canada geese (registration # 80224-5) and 2007 for pigeons (registration # 80224-1) by the U.S. Environmental Protection Agency. NWRC was awarded the 2009 Governor's Research Impact Awards in Colorado for their part in the development of OvoControl. Current research is evaluating other potential contraceptives including the chemical 20,25-diazacholesterol dihydrochloride (diazacon) to reduce reproductive output in birds through reduction of blood cholesterol and cholesterol-dependent reproductive hormones. NWRC and researchers at the United Kingdom's Food and Environment Research Agency tested diazacon on captive invasive rose-ringed parakeets and observed a 54 percent reduction in egg fertility rates for the first clutch and 66 percent for the second clutch, compared to control birds. Based on these results, researchers conclude that diazacon has potential for fertility control in rose-ringed parakeets if a suitable formulation and delivery system is developed for free-living populations.

Current NWRC research also protects human health by developing methods to reduce or eliminate disease transmission among wildlife, domestic animals, and humans. In 2009, NWRC researchers successfully registered with the U.S. Environmental Protection Agency the first single-shot, multi-year immunocontraceptive vaccine for use in female white-tailed deer. Called GonaCon™ Immunocontraceptive Vaccine (GonaCon), this new tool may not only be useful as part of urban white-tailed deer management plans where traditional options are limited, but it also shows promise in other areas, such as contraception in companion animals and disease prevention. For instance, NWRC and its collaborators are investigating the development of a combined GonaCon-rabies vaccine for use in feral dogs and raccoons. The vaccine

is being used for research purposes in the United States, Mexico, Europe, New Zealand and Australia. Future NWRC research with GonaCon will likely involve studies to support expanded registration to other species, develop oral delivery systems, and prevent transmission of wildlife diseases. NWRC received the 2010 Colorado Governor's Award for High-Impact Research for its development of GonaCon.

NWRC has been active in the development and testing of wildlife rabies vaccines. Though rabies is well controlled in domestic animals, its spread among wildlife populations is still cause for concern. Since 1995, WS has been involved in a national rabies prevention and oral rabies vaccination effort. Raboral V-RG®, the oral rabies vaccine used in the United States to immunize free-ranging wildlife requires low temperatures for stability. The longer the vaccine remains viable, the better the odds are for a target animal to encounter the vaccine and become immunized. NWRC scientists have been working on a method called vitrification that may help increase rabies vaccination rates for wild, free-ranging wildlife. Vitrification is the process of preparing materials in a matrix of compounds, usually sugars or polymers, in a manner that, upon drying, results in the formation of a glass rather than a crystallized product. Vitrification of Raboral V-RG® provides protection from a loss of viability at elevated temperatures. This protection extends through temperatures likely to be encountered in outdoor and non-refrigerated storage conditions. NWRC scientists observed that substantial amounts of viable vaccine virus remained in the samples even with 24 hour exposure to temperatures of 50° C or higher. For the three weeks studied at 37° C, the vaccine virus was protected and, essentially, no loss was observed. This is in stark contrast to the standard liquid suspension presently being used where viability decreased measurably over time and no detectable viable vaccine virus remained prior to the three-week time point. These results suggest that the vaccine virus would remain stable for even longer periods of time in a vitrified format.

Protecting Threatened and Endangered Wildlife

NWRC conducts research to help managers protect threatened and endangered wildlife species. These activities focus on protecting listed species from predation and competition with other wildlife, enhancing recovery programs, and increasing the public's ability to live with introduced and expanding populations of listed species. Predators can have a severe impact on rare and endangered species through predation and competition. NWRC and the Florida Department of Environmental Protection examined the biological and bioeconomic results of predator management relative to sea turtles and shorebirds on two adjacent barrier islands (Cayo Costa and North Captiva) along Florida's west coast. Both islands suffered severe nesting losses due to predation and disturbance by raccoons, while Cayo Costa also was impacted by a large population of feral swine. Prior to predator management by WS operations, no least tern production occurred on either island, and sea turtle nest predation was as high as 74 percent. Following predator management on the islands, Cayo Costa and North Captiva produced 20 and 55 least terns and had 16- and 0-percent sea turtle nest predation, respectively. The entire cost for predator management by experts over the course of the study was \$39,636, and the returns in additional production of least tern young and hatchling sea turtles were valued at over \$1.1 million.

The puaiohi or small Kauai thrush is an endangered bird endemic to the island of Kauai, Hawaii. The sole population of about 500 birds is currently restricted to remote, high elevation areas of the Alakai Plateau. Puaiohi nest primarily on steep

stream-side cliffs, and their distribution and abundance are limited partly by the availability of suitable nest sites. Invasive black rats often eat nesting adults, nestlings, and eggs, and ground-based rodent control has not been effective at reducing nest predation. Researchers at the NWRC Hilo, Hawaii field station investigated whether artificial nest structures might be a viable alternative to rodent control by testing and redesigning nest boxes to find one that was resistant to rats. Field tests of a new rat-resistant nest box are currently underway to determine whether the boxes will be successfully used by wild birds.

Mountain beaver (*Aplodontia rufa rufa*) are endemic to the Pacific Coast of North America and can be found in California, Nevada, Oregon, Washington, and British Columbia, Canada. There are seven subspecies of mountain beaver. The U.S. Fish and Wildlife Service classified one of these subspecies, *A. r. nigra*, as endangered and several other mountain beaver subspecies as populations of concern under the Endangered Species Act. However, in some portions of its range, mountain beaver cause significant damage to forestry interests and are managed as a pest species. NWRC scientists are studying the genetics of mountain beaver to determine whether populations in certain areas are "closed" systems or if individuals move across landscapes to new areas to breed. Understanding the genetic continuity and relatedness of a species across habitats can help determine whether a local population is rare, and should be protected, or whether it is part of a larger genetically similar group. In the later case, more management actions may be available. Such studies are critical for understanding the status of mountain beaver populations and informing wildlife damage management practices.

Protecting Against Invasive Species

NWRC develops innovative strategies to minimize the impacts and spread of invasive wildlife species in the continental United States, its territories and nearby countries or islands. For example, the monk parakeet, an invasive species from South America, has become established in Florida and several other states. Monk parakeets often build their large, bulky nests of twigs and other materials on electric utility structures, frequently resulting in power failures as nest materials and birds come into contact with conductors. NWRC investigated the potential use of diazacon, an oral contraceptive, as a nonlethal method for reducing monk parakeet populations. Results from field studies involving wild monk parakeets showed a 68 percent reduction in the number of young produced by birds feeding on diazacon-treated seeds.

NWRC researchers are also testing fencing designs to limit access of feral swine to agricultural crops. There are more than 4 million feral swine in the United States. Their estimated damage, which totals \$800 million annually, does not include costs associated with the spread of disease or the loss of native habitats and species. NWRC researchers have evaluated several fence designs to help prevent feral swine access to domestic swine and agricultural crops. In field trials, NWRC scientists observed a 64 percent decrease in crop damage by feral swine and other wildlife in areas protected by electric fences. In addition to fencing, NWRC researchers are also evaluating feral swine-specific feeders for delivering vaccines or toxicants.

Protecting Livestock

Protecting livestock from predators and disease is an important part of WS' mission. For example, recent restrictions on the use of traps have led NWRC to test a wider array of nonlethal tools and methods that minimize predation on livestock. NWRC scientists and partners continually work to develop new aversive conditioning devices to keep predators away from livestock.

Currently, one study is examining the use of electrified fladry that combines an animal's fear of a novel stimulus with conditioning from an unpleasant electric shock. Fladry is simply a line of flags hung along the perimeter of a pasture. It has a long history of use in Europe to deter wolves. Because wolves are often wary of new or novel items in their environment, they are cautious of crossing the fladry. Studies have shown fladry and electrified fladry effectively exclude wolves from a food resource for short periods of time (1 to 14 days), which may be useful during calving seasons.

Bovine tuberculosis (bTB) is a contagious bacterial disease primarily affecting the respiratory tract of both animals and humans. In the U.S. today, the threat of humans contracting bTB from animals is extremely remote.

At risk, however, are deer, other wildlife species and livestock. Recently, an extensive surveillance program conducted by the Michigan Department of Natural Resources identified raccoons as a host for *Mycobacterium bovis*, the causative agent of bTB. NWRC scientists examined the potential for disease transmission between raccoons and livestock and discovered raccoons used anthropogenic features, such as loafing sheds, barns, and feed storage facilities when they are adjacent to forested habitat. Additionally, while simultaneous use of resources by raccoons and cattle was documented, it was determined that pathogen transmission was most likely to occur through indirect means, such as consumption of infected feed or water. Based on these findings, scientists recommend reducing the likelihood of disease transmission between cattle and raccoons by placing feeding and watering facilities away from forested patches.

Chronic wasting disease (CWD) is a fatal neurological disease that infects elk, white-tailed deer, mule deer, and moose. Realized and perceived CWD threats have significant implications for Federal and State wildlife management agencies, domestic cervid farmers, hunters, and businesses and economies reliant on deer and elk. Prions, the infectious agent of chronic wasting disease, bind to a wide range of soils and minerals, potentially forming environmental reservoirs for infection. NWRC scientists assisted colleagues from the University of Nebraska-Lincoln and Creighton University to test the ability of the commercially available enzyme, Prionzyme™, to degrade CWD prions in soil. Investigators concluded the enzyme, produced by soil bacterium, successfully degraded CWD prions bound to contaminated soil. Although it may be impossible to totally eliminate prions in the environment, a topical enzyme treatment could help limit indirect disease transmission to cervids in some areas, such as captive cervid farms.

NWRC scientists are dedicated to resolving conflicts that occur between people and wildlife. Through their efforts, NWRC scientists provide WS field biologists and those who struggle with wildlife damage an array of tools and methods that they can adapt and employ to resolve wildlife conflicts. NWRC scientists protect the welfare of all animals and look for solutions that are biologically sound, environmentally safe, and socially acceptable. This critical research ensures that the broadest array of wildlife damage management tools will continue to be available for use by WS biologists as well as State wildlife agency professionals, landowners, and others.

Selected Publications

ATWOOD, T. C., T. J. DELIBERTO, H. J. SMITH, J. S. STEVENSON, AND K. C. VERCAUTEREN. 2009. Spatial ecology of raccoons related to cattle and bovine tuberculosis in northeastern Michigan. *Journal of Wildlife Management* 73:647-654.

BENDER, S. C., D. L. BERGMAN, K. M. WENNING, L. A. MILLER, D. SLATE, F. R. JACKSON, AND C. E. RUPPRECHT. 2009. No adverse effects of simultaneous vaccination with the immunocontraceptive GonaCon™ and a commercial rabies vaccine on rabies virus neutralizing antibody production in dogs. *Vaccine* 27:7210-7213.

BLACKWELL, B. F., E. FERNANDEZ-JURICIC, T. W. SEAMANS, AND T. DOLAN. 2009. Avian visual system configuration and behavioural response to object approach. *Animal Behaviour* 77:673-684.

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

COOEY, C. K., J. A. FALLON, M. L. AVERY, J. T. ANDERSON, E. A. FALKENSTEIN, AND H. KLANDORF. 2010. Refinement of biomarker pentosidine methodology for use on aging birds. *Human-Wildlife Interactions* 4:304-314.

ENGEMAN, R. M., B. U. CONSTANTIN, K. S. GRUVER, AND C. ROSSI. 2009. Managing predators to protect endangered species and promote their successful reproduction. Pages 171-187 in A. Columbus and L. Kuznetsov, editors. *Endangered Species: New Research*. Nova Science Publishers, Hauppauge, New York.

HAGY, H. M., G. M. LINZ, AND W. J. BLEIER. 2010. Wildlife conservation sunflower plots and croplands as fall habitat for migratory birds. *American Midland Naturalist* 164:119-135.

KIMBALL, B. A., AND J. D. TAYLOR II. 2010. Mammalian herbivore repellents: tools for altering plant palatability. *Outlooks on Pest Management* 21:181-187.

LAMBERT, M. S., G. MASSEI, C. A. YODER, AND D. P. COWAN. 2010. An evaluation of diazacon as a potential contraceptive in non-native rose-ringed parakeets. *Journal of Wildlife Management* 74:573-581.

PIAGGIO, A. J., M. A. NEUBAUM, H. YUEH, C. E. RITLAND, J. J. JOHNSTON, AND S. L. PERKINS. 2009. Development of 10 polymorphic microsatellite loci isolated from the mountain beaver, *Aplodontia rufa rufa* (Rafinesque). *Molecular Ecology Resources* 9:323-325.

PILON, J. L., P. B. NASH, T. ARVER, D. HOGLUND, AND K. C. VERCAUTEREN. 2009. Feasibility of infectious prion digestion using mild conditions and commercial subtilisin. *Journal of Virological Methods* 161:168-172.

REIDY, M. M., T. A. CAMPBELL, AND D. G. HEWITT. 2008. Evaluation of electric fencing to inhibit feral pig movements. *Journal of Wildlife Management* 72:1012-1018.

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.