Wildlife Services

Protecting People
Protecting Agriculture
Protecting Wildlife

National Wildlife Research Center

FY 2008

Reducing Wildlife Damage with Chemistry, Biochemistry and Computer Modeling Research

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Major Cooperators

- Colorado State University
- University of Florida
- University of California
- U.S. Food and Drug Administration
- U.S. Environmental Protection Agency
- U.S. Department of Defense
- U.S. Fish and Wildlife Service
- California Department of Food and Agriculture
- Hawaii Department of Natural Resources
- LiphaTech, Inc.
- Kolfolk, Inc.
- Berryman Institute, Utah State University
- Wildlife Conservation Society
- ENSR Environmental Consultants
- Department of the Environment, Food and Rural Affairs, UK
- CIIT Institute for Health Research
- USDA/APHIS International Services
- Nevada Division of Wildlife
- Oregon Department of Fish and Wildlife
- University of Arizona
- Idaho State University
- Texas Tech University
- Wisconsin Department of Natural Resources
- The Nature Conservancy
- Island Conservation

Groups Affected By These Problems

- U.S. citizens
- Agricultural producers
- Consumers of Agricultural products
- Industry groups
- State wildlife and natural resource managers

NWRC Scientists Use Chemistry to Resolve Wildlife Damage

Wildlife Services' (WS) National Wildlife Research Center (NWRC) is the only Federal research facility devoted exclusively to resolving conflicts between people and wildlife through the development of effective, selective, and acceptable methods, tools, and techniques.

To help meet the increasing need for new, Federally-approved chemical tools for use in wildlife damage management, NWRC scientists design and test methodologies to identify, analyze and develop new drugs, repellents, toxicants, DNA markers, and other chemistry-based wildlife damage management tools. These methodologies are used to support U.S. Environmental Protection Agency (EPA) and U.S. Food and Drug Administration (FDA) registration requirements. NWRC scientists are experienced in a variety of scientific disciplines, including metabolism chemistry, environmental fate, chemical synthesis, toxicology, chemical ecology, molecular genetics, computer modeling, and formulation chemistry.

Studies include, but are not limited to the following:

1. Developing alternative chemical tools (toxicants, repellents, contraceptives, and attractants) to reduce bird damage to rice and sunflower crops, to control Canada geese in urban and suburban settings, and to facilitate selective removal of predatory canids.
2. Developing and implementing DNA methodology to census wildlife species and to identify individual pest animals.
3. Identifying existing products or naturally-occurring chemicals in plants and animals that could be used as agents to protect against wildlife damage.
4. Developing formulations for increasing the effectiveness of wildlife damage management chemicals already in use.
5. Developing computer models to evaluate the efficacy and safety of pesticides to target and non-target wildlife.

Applying Science & Expertise to Wildlife Challenges

Radio-Tracer Techniques—Scientists are using NWRC's state-of-the-art radioisotope laboratory to develop techniques for better understanding the metabolism, residues, degradation pathways, and mode of action for various chemicals (fertility agents, immobilizing agents, toxicants) of interest to APHIS. Current radio-tracer studies with alpha-chloralose (an immobilizing agent) may be used to support changes in use restrictions which would increase the value of this tool to the WS program and stakeholders.

Identification of Compounds—In an effort to develop effective repellents for pest birds and mammals, NWRC scientists are conducting experiments with inexpensive proteins and other natural products. These studies indicate that animal-derived protein sources, such as gelatin and casein, may serve as non-lethal repellents for a variety of herbivores, such as deer and rabbits.

Analytical Methods for Risk Assessment—NWRC chemists are developing new or improved methods for determining the risk to non-target animals posed by chemicals developed to reduce wildlife damage. Data on chemical residues found in treated wildlife are critical for assuring that the proposed uses of these tools are accompanied by minimal risk to nontarget animals, humans, and the environment. For example, NWRC chemists are analyzing DRC-1339 (an avicide) residues in nontarget and target birds collected from DRC-1339-baited sunflower and rice fields. Findings show that birds feeding on DRC-1339-baited fields pose little risk to scavenging or predatory wildlife. Similar analytical approaches are being used to assess the safety of acetaminophen to control brown treesnakes on Guam, using anthraquinone to reduce bird damage to lettuce and rice, and

using diphacinone and brodifacoum to control pest rodents on Hawaii, Alaska, and islands located in the Pacific and Caribbean. The residue data are used to develop computer models to estimate risk to target and nontarget wildlife. The computer models are also being used to identify pesticide formulation and application strategies.

Genetic (DNA) Based Wildlife Management Tools—Genetic techniques have been developed to aid in the identification of species, sex, and individual genotype of various wildlife species. These techniques are being applied to census wildlife populations through the collection of hair, scat, saliva, and tissue. NWRC scientists have used genetic techniques to track Mexican wolves, identify wolf-dog hybrids in Wisconsin and Wyoming, identify and census coyotes, assess taxonomy of species of concern and endangered species, identify source populations of invasive beavers, and understand bat and raccoon population movements in areas of high rabies incidence. These techniques provide managers with information about the effectiveness of a variety of wildlife management activities related to predator control and wildlife disease issues.

Chemistry Support for NWRC Scientists—NWRC's Analytical Chemistry Laboratory provides support for all research projects being conducted at the Center's headquarters in Fort Collins, CO, and the Center's field stations located throughout the United States. This chemistry assistance supports a number of research topics, including avian infertility; bovine tuberculosis; rabies; wildlife hazards to aviation; wildlife damage to forest resources; bird damage to rice, sunflowers, and aquaculture; and waterfowl disease.

Selected Publications:

Cariappa, C.A., W. Ballard, S. Breck, A.J. Piaggio, M Neubaum. 2008. Estimating Population Size of Mexican Wolves Noninvasively. Ecological Restoration 26:14-16.

Field, K.L., Kimball, B.A., Mennella, J.A., Beauchamp, G.K., and Bachmanov, A.A. 2008. Hydrolyzed Casein Reduces the Palatability of Food for Mice. Physiol. Behav. 93:189-199.

Figueroa, J.A., Kimball, B.A., and Perry, K.R. 2008. Lagomorph and Rodent Responses to Two Protein Hydrolysates. Crop Protect. 27:851-854.

Kimball, B.A. and Perry, K.R. 2008. Manipulating Beaver (Castor canadensis) Feeding Responses to Invasive Tamarisk (Tamarix spp.). J. Chem. Ecol. 34:1050-1056.

Kimball, B.A., Russell, J.H., DeGraan, J.P., and Perry, K.R. 2008. Screening Hydrolyzed Casein as a Deer Repellent for Reforestation Applications. West. J. Appl. For. 23:172-176.

Pelz-Serrano K., A. Munguia-Vega, A.J. Piaggio, M.A. Neubaum, P. Munclinger, C. van Riper III, Culver M (in press) Development of nine microsatellite loci for the American Beaver, Castor canadensis (Rodentia: Castoridae). Molecular Ecology Resources.

Piaggio, A.J., K.W Navo, C. Stihler. 2008. Intraspecific comparison of population structure, genetic diversity, and dispersal among three subspecies of Townsend's big-eared bats, Corynorhinus townsendii townsendii, C. t. pallescens, and the endangered C. t. virginianus. Conservation Genetics. Online early: http://dx.doi.org/10.1007/s10592-008-9542-0

Piaggio, A.J., J.J. Johnston, S.L. Perkins. 2008. Development of polymorphic microsatellite loci for the common vampire bat, Desmodus rotundus (Chiroptera: Phylostomidae). Molecular Ecology Resources 8:440-442.

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VanDalen, K.K., M.L. Killian, T.D. Anderson, J.C. Pedersen, A.B. Franklin, A.J. Piaggio. 2008. Development of Influenza A H16 Specific Primers Following Increased Detection in the United States. Archives of Virology 153:1981-1983.

Werner, S.J., Kimball, B.A., and Provenza, F.D. 2008. Color, Flavor, and Conditioned Avoidance among Red-Winged Blackbirds. Physiol. Behav. 93:110-117.

Werner, S. J., J. L. Cummings, S. K. Tupper, D. A. Goldade, and D. Beighley. 2008. Blackbird repellency of selected registered pesticides. Journal of Wildlife Management 72:1007-1011.

Horiuchi, J., Badri, D., Kimball, B.A., Negre, F., Dudareva, N, Paschke, M., and Vivanco, J. 2007. The Floral Volatile, Methyl Benzoate, from Snapdragon (Antirrhinum majus) Triggers Phytotoxic Effects in Arabidopsis thaliana. Planta 226:1-10.

Hurley, J. C., P. A. Pipas, S. K. Tupper, J. L. Cummings, and R. S. Stahl. 2007. Field method for analyzing birds for avicide 3-chloro-p-toluidine hydrochloride. Proceedings of the Wildlife Damage Management Conference 12:94-102.

Johnston, J. J. 2007. Assessing rodenticide hazards: improving the art and science of risk assessment. Proceedings of the Wildlife Damage Management Conference 12:170-174.

Kimball, B.A. and Billings, V. 2007. Do Herbivores Associate Flavours with Specific Consequences in Flavour Aversion Learning? Appl. Anim. Behav. Sci. 107:252-261.

Linz, G. M., H. J. Homan, L. B. Penry, T. M. Primus, and M. J. Goodall. 2007. Evaluation of caffeine and garlic oil as bird repellents. National Sunflower Association Sunflower Research Forum.

Primus, T.M., Jojola S.M., Robinson, S.J., and Johnston, J.J. 2007. Determination of Sulfadimethoxine Residues in Skunk Serum by HPLC J. Liquid Chrom. Rel. Tech., 30, 2095-2102.

Werner, S.J., J.L. Cummings, S.K. Tupper, J.C. Hurley, R.S. Stahl, T. M. Primus. 2007. Caffeine formulation for avian repellency. J. Wildl. Manag. 71:1676-1681.

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Major Research Accomplishments:

- WS research has shown hydrolyzed casein to have great potential as a repellent for mountain beaver to reduce damage to conifer seedlings.
- WS has used genetic markers to identify canids involved in predation cases. The same markers have been used to identify wolf-dog hybrids.
- WS developed a database of genetic markers for domestic dogs, coyotes, and wolves from various parts of the country to aid state departments of natural resources in livestock predation investigations.
- WS developed analytical chemistry methods and analyzed numerous samples to support the development of avian repellents (anthraquinone, caffeine) and fertility control agents (nicarbazin, diazacholesterol).
- WS developed a bioenergetics computer model that estimates exposure and mortality to select bird species baited with DRC-1339. This model has been adopted by WS Operations to estimate baiting efficacy.
- WS developed methods to track wildlife depredation of farm raised fish and select high value gamefish to estimate the impact of bird depredation on stocks.

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