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# Reducing Wildlife Damage With Chemistry, Biochemistry and Computer Modeling Research

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## National Wildlife Research Center 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.

Due to the increasing need for new, Federally-approved chemical tools that can be used by wildlife damage management professionals, NWRC scientists have begun a project devoted to developing 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:

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 DNA fingerprinting to census wildlife densities of problem species, to identify pest animals, and to monitor movement of pest wildlife.

3) Identifying existing products or naturally-occurring chemicals in plants 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.

The ultimate goal of these studies is to provide the data needed by EPA and FDA to successfully register chemicals for use as wildlife damage management tools.

**Major Research Accomplishments:**

- WS developed a Wildlife Molecular Genetics laboratory which develops methodology to identify pest wildlife and census pest wildlife populations. These methods are applicable to the selective removal of predatory canids and nuisance bears.
- WS developed a probabilistic computer model to estimate exposure and mortality associated with pesticide applications. This model is being used to estimate target and non-target mortality associated with application of the avicide DRC-1339 and the rodenticide diphacinone.
- WS research has shown that rodenticide bait acceptance and efficacy can be increased with the addition of malted flour to the bait matrix.
- WS laboratory and field research has shown that chlorophacinone and diphacinone can be safely used to control rangeland rodents.
- WS developed analytical chemistry methods to support the development of avian repellents (anthraquinone, caffeine) and fertility control agents (nicarbazin, diazacholesterol).

## Applying Science and 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 deer, 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 nontarget 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 to control introduced rats on Hawaii. The residue data are used to develop computer models to estimate risk to target and non-target wildlife. The computer models are also being used to identify pesticide formulation and application strategies.

**Groups Affected by These Problems:**

- U.S. Citizens
- Agricultural producers
- Consumers of Agricultural products
- Industry groups
- Wildlife and natural resource managers

**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
- California • Department of Food and Nutrition
- Hawaii Department of Natural Resources
- Lipha Tech, 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

**Molecular Genetic (DNA) Based Wildlife Management Tools—**Molecular genetic techniques have been developed to identify the species, sex and genetic relationships of wildlife. These techniques are being applied to census wildlife populations through the collection of hair and scat and to identify the species and/ or pack of predators via the analysis of saliva recovered from predated carcasses. These techniques may facilitate the selective removal of pest wildlife and 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:


Kimball B. A. and D. L. Nolte. 2006. Development of a new deer repellent for the protection of forest resources. Western Journal of Applied Forestry 21:108-111.

Johnston, J. J, T. M. Primus, D. J. Kohler, M. J. Holmes, and A. Hart. 2005. Probabilistic model for estimating field mortality of target and non-target bird populations when simultaneously exposed to avicide bait. Pest Management Sci. 61:649-659.

Johnston, J. J. 2005. Evaluation of cocoa and coffee derived methylxanthines as a toxicant for control of predatory coyotes. J. Agric. Food Chem. 53:4069-4075.

Johnston, J. J., W. C. Pitt, R. T. Sugihara, J. D. Eisemann, T. M. Primus, J. Crocker, M. J. Holmes, and A. Hart. 2005. Probabilistic risk assessment for snails, slugs and endangered honeycreepers in diphacinone baited areas on Hawaii, USA. Journal of Environmental Toxicology and Chemistry 24:1557-1567.

Johnston, J. J., T. M. Primus, T. Buettgenbach, C. A. Furcolow, M. J. Goodall, D. Slate, R. B. Chipman, J. L. Snow, and T. J. DeLiberto. 2005. The Evaluation and significance of tetracycline stability in rabies vaccine baits. Journal of Wildlife Diseases 41:549-558.

Johnston, J. J, D. L. Nolte, K. R. Perry, J. C. Hurley and B. A. Kimball. 2005. Assessing the potential of malted grains to increase bait acceptance by rodents. Crop Protection 24:381-385.

Kimball, B. A., D. L. Nolte, and K. B. Perry. 2005. Hydrolyzed casein reduces browsing of trees and shrubs by white-tailed deer. HortScience 40:1810-1814.

Primus, T. M., B. A. Kimball, J. C. Hurley, J. J. Johnston, S. Blom and P. J. Savarie. 2005. Stability of Tranquilizer Drug Propionylpromazine Hydrochloride in Formulated Products. Pest Management Science 61:605-611.

Fagerstone, K. A., J. J. Johnston, and P. J. Savarie. 2004. Predacides for Canid Management. Sheep and Goat Research Journal 19:76-79.

Goldade, D. A., J. D. Tessari, and J. J. Johnston. 2004. Absorption, distribution and excretion of 14C-3-chloro-4-methylaniline hydrochloride in two species of birds following a single oral dose. J. Ag. Food Chem. 52:8074-8080.

Stahl, R. S., J. H. Homan, G. M. Linz, and J. J. Johnston. 2004. Using fatty acid profiles to assess dietary intake of sunflower in red-winged blackbirds. Proceedings of the Vertebrate Pest Conference 21:87-91.

Williams, C. L., Homan, H. J., J. J. Johnston and G. M. Linz. 2004. Microsatellite variation in Red-winged Blackbirds (Agelaius phoeniceus). Biochemical Genetics 42:35-41.