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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 have experience in a variety of scientific disciplines, including metabolism chemistry, environmental fate, chemical synthesis, toxicology, chemical ecology, molecular genetics, computer modeling and formulation chemistry.

**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).

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 and to identify individual pest animals.

3) Identifying existing products or naturally-occurring chemicals in plants that could be used to 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.

## Applying Science and Expertise to Wildlife Challenges

**Radio-Tracer Techniques—**Scientists are using NWRC's state-of-the-art radio-isotope 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.

**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.

**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, Center chemists are analyzing DRC-1339 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 using acetaminophen to control brown treesnakes on Guam, using anthraquinone to reduce bird damage to lettuce and rice, and using diphacinone to control pest rats on Hawaii. The residue data are used to develop computer models to estimate risk to target and non-target wildlife.

**Molecular Genetic (DNA) Based Wildlife Management Tools—**Molecular genetic techniques have been developed to identify the species, sex and individual genotype of pest wildlife. These techniques are being applied to census wildlife populations through the collection of hair and scat and to identify individual predators via the analysis of saliva recovered from predated carcasses. These techniques may facilitate the selective removal of pest wildlife and to provide managers with information about the effectiveness of a variety of wildlife management activities.

**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.

### 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 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

### Selected Publications:


- Kimball, B. A.; Johnston, J. J.; Arjo, W. M. 2004. Single point calibration with a non-linear detector: carbohydrate analysis of conifer needles by hydrophobic interaction chromatography evaporative light-scattering detection. Journal of Liquid Chromatogaphy & Related Technologies 27:1835-1848.
- Stahl, R. S.; Arjo, W. M.; Wagner, K. M; Furcolow, C. A.; Nolte, D. L.; Johnston, J. J. 2004. Development of a High Performance Liquid Chromatography/Mass Spectroscopy Method for the Determination of Strychnine Concentrations in Insects Used to Assess Potential Risks to Insectivores. Journal of Chromatography. B, Analytical Techniques in Biomedical and Life Sciences 811: 257-262.
- Johnston, J. J. 2003. Development of Chemistry Based Tools for Wildlife Damage Management. Pesticide Outlook 12: 250-254.
- Primus, T. M.; Kohler, D. J.; Furcolow, C. A.; Goodall, M. J.; Johnston, J. J.; Savarie, P. J. 2003. Determination of acetaminophen residues in whole body brown treesnakes. Journal of Liquid Chromatography & Related Technologies 27:897-909.
- Williams, C. L; Johnston, J. J. 2003. A coyote in sheep's clothing: sex identification of mixed species samples. Wildlife Society Bulletin 31: 926-932.