Wildlife Services

Protecting People
Protecting Agriculture
Protecting Wildlife

FY 2015

Chemical and Metabolic Approaches for Minimizing Human-Wildlife Conflicts

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Groups Affected By These Problems:

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

Major Cooperators:

- APHIS Veterinary Services
- British Columbia Ministry of Forests and Range
- California Department of Food and Agriculture
- Case Western Reserve University
- Colorado State University
- Drexel University
- Island Conservation
- Karolinska Institutet (Sweden)
- Landcare Research (New Zealand)
- Monell Chemical Senses Center
- U.S. Department of Defense
- U.S. Department of the Interior Office of Insular Affairs
- U.S. Fish and Wildlife Service
- U.S. Geological Survey Patuxent Wildlife Research Center
- VetAgro Sup (France)

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 socially responsible methods, tools, and techniques.

NWRC scientists design methodologies to identify, analyze and develop new drugs, repellents, toxicants, and other chemically-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 pharmacology, environmental fate, chemical synthesis, toxicology, chemical ecology, computer modeling, and formulation chemistry.

Applying Science and Expertise to Wildlife Challenges

Residue Levels of Alpha-Chloralose in Duck Tissues. — WS experts often assist local, State, and Federal agencies and organizations with removing or relocating nuisance birds such as Canada geese. One tool is an immobilizing drug known as alpha-chloralose (AC), an investigational-use drug regulated by the FDA. Currently, the drug cannot be used 30 days before or during waterfowl hunting season because of food safety concerns due to limited information on how much of the drug remains in duck tissues following exposure, and how long it remains there. Birds immobilized with AC within 30 days of or during open hunting season must be either euthanized or held in captivity for 30 days before they are released. To provide the data necessary for determining a science-based restriction period on use that protects food safety, NWRC researchers conducted an AC absorption, distribution, metabolism, and excretion study. Researchers orally administered a 30-milligram/kilogram dose of AC to captive mallard ducks to analyze the level of AC in their edible tissues (breast muscle, liver, and skin) following euthanasia. This dose was akin to what birds receive when captured in the field. The results suggest that tissues from mallard ducks are safe for human consumption 48 hours after dosing, which is a significantly shorter period than the 30-day period FDA requires. This finding supports shortening the moratorium.

Effects of the Rodenticide Diphacinone on Eastern Screech Owls. — Anticoagulant rodenticides are used to control rodents in urban and suburban settings, in agricultural areas, and in island restoration projects. Even though rodenticides are widely used, concerns are growing about the risks they pose to people, companion and domestic animals, and nontarget wildlife. In the United States, new restrictions have been placed on using second-generation anticoagulant rodenticide baits in and around buildings. This regulatory action may lead to expanded use of some first-generation anticoagulant rodenticides (for instance, chlorophacinone, diphacinone, and warfarin) that are considered less hazardous than second-generation anticoagulant rodenticides. However, first-generation anticoagulants have been implicated in the accidental deaths of nontarget wildlife such as hawks, eagles, and owls. NWRC researchers examined clotting time and rodenticide residues in the tissues of captive Eastern screech owls that were fed prey treated with diphacinone. They also examined cell and tissue recovery and residue clearance in the owls following exposure. The findings showed that continuous dietary exposure to diphacinone at concentration levels that Eastern screech owls might encounter in the wild can cause intoxication, prolonged clotting time, and anemia in a matter of days. Clotting disorders arose when diphacinone concentrations in the liver exceeded approximately 0.1 microgram/gram in wet weight. However, due to diphacinone's short half-life, diphacinone concentration in tissues rapidly decreased once the exposure was terminated. These results provide more realistic and accurate estimates of the risks that anticoagulant rodenticides pose for target and nontarget species, and will help regulators determine the appropriate use of diphacinone.

Environmental Contaminants in Canada Goose Tissues. WS donates more than 60 tons of wild game - from deer, moose, feral swine, goats, geese, and ducks - to charitable organizations each year. These donated meats provide a vital source of food to many people. Although commercially produced meat routinely undergoes screening for contaminants, little is known about the level of environmental contaminants in wild game. Animals can be exposed to environmental contaminants through the air, soil, and water, as well as

through the food they eat. NWRC researchers and WS Operations experts worked collaboratively to collect goose breast meat from 194 captured Canada geese from 11 States and analyze it for residues of environmental contaminants including arsenic, cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, selenium, thallium, zinc, dichlorodiphenyldi-chloroethylene (DDE), and polychlorinated biphenyls (PCB). The results were compared to contaminant levels found in commercially raised poultry. Although there were exceptions, the majority of the wild goose meat samples contained contaminant concentrations below recommended thresholds of concern. The residue levels for most contaminants were similar to published residue concentrations in food for human consumption. Researchers did note that animals with high concentrations of one compound often had high concentrations of other compounds, suggesting certain animals may frequent a relatively limited number of sites containing contaminants. These findings provide information about contaminant concentrations in goose meat and potential exposures associated with meat consumption based on probabilistic models and enable others to make informed decisions about the risks associated with consumption of wild game.

Monitoring Wildlife Health using Fecal Odors. — Many diseases are known to produce changes in body odor. NWRC researches are attempting to capitalize on this phenomenon to develop novel methods for non-invasive monitoring of wildlife health. In one study, NWRC scientists studied changes of fecal odors in mallards infected with the avian influenza (AI) virus. Two compounds (acetoin and 1-octen-3-ol) have been identified as potential biomarkers for AI infection in wild bird populations. Researchers hypothesize that metabolites resulting from viral infection interact with bacteria in the gastrointestinal system of ducks to produce "odor signatures" indicating the presence of the AI virus. In a different study examining bovine tuberculosis (Tb) vaccination and infection in deer, NWRC scientists were able to distinguish between unvaccinated and experimentally infected (Tb-challenged) deer through chemical analysis of fecal volatiles. Furthermore, fecal volatiles were also used to discriminate between challenged and unchallenged samples when both groups had been vaccinated. The unique finding of this work is the ability to distinguish vaccinated from unvaccinated deer before and after Tb challenge on the basis of fecal volatiles.

Providing Analytical Support to Wildlife Services. — NWRC's Analytical Chemistry Laboratory provides support for all research projects being conducted at the Center's headquarters in Fort Collins, Colorado, the Center's field stations located throughout the United States, and WS operational programs. This chemistry assistance supports a variety of research topics including: infertility; wildlife diseases; wildlife hazards to aviation; mammal damage to crops and forest resources; and bird damage to rice, sunflowers, and aquaculture.

Selected Publications:

Ellis, C.K., R.S. Stahl, P. Nol, W.R. Waters, M.V. Palmer, J.C. Rhyan, K.C. VerCauteren, M. McCollum, M.D. Salman. 2014. A pilot study exploring the use of breath analysis to differentiate healthy cattle from cattle experimentally infected with Mycobacterium bovis. PloS One 9(2): e89280. doi:10.1371 / journal.pone.0089280.

Goldade, D.A., R.S. Stahl, and J.J. Johnston. 2014. Determination of residue levels of alpha-chloralose in duck tissues. Human-Wildlife Interactions 8(1):123-129.

Horak, K., R. Chipman, L. Murphy, and J. Johnston. 2014. Environmental contaminant concentrations in Canada Goose (Branta canadensis) muscle: Probabilistic risk assessment for human consumers. Journal of Food Protection 77(9):1634-1641. doi: 10.4315 / 0362-028X.JFP-13-364.

Kimball, B.A,, K. Yamazaki, D. Kohler, R.A. Bowen, J.P. Muth, M. Opiekun, and G.K. Beauchamp. 2013. Avian influenza infection alters fecal odor in mallards. PLoS ONE 8(10): e75411. doi:10.1371 / journal.pone.0075411.

Krauss, F., R. Stahl, and W. Pitt. 2014. Thermal fumigation provides a simple and effective solution for sanitizing cargo from invasive snakes. Journal of Pest Science. Online. doi: 10.1007 /s10340-014-0627-x.

Major Research Accomplishments:

- WS research involving the encapsulation of zinc phosphide rodenticide baits resulted in improved bait acceptance and a reduction in the amount of active ingredient needed to reach targeted efficacy levels.
- WS chemical analysis of alpha-chloralose absorption rates in duck tissues showed meat from waterfowl exposed to the anesthetizing agent is safe for human consumption 48 hours after the animals are exposed.
- WS scientists demonstrated that forced hot air (122-131 degrees Fahrenheit at 3.4m3/minute) was effective at causing invasive brown treesnakes to exit enclosed hiding spaces.
- WS experts analyzed tissues from wild Canada geese for the presence of 16 environmental contaminants including arsenic, lead, and mercury. The results were compared to contaminant levels found in commercially raised poultry. Although there were exceptions, the majority of the samples contained contaminant concentrations below recommended thresholds of concern.
- WS scientists developed an improved method for determining pentosidine concentrations in bird and reptile skin samples used to estimate age.
- WS chemists developed a method for the simultaneous analysis of 12 rodenticides (coumafuryl, warfarin, pindone, coumatetralyl, coumachlor, diphacinone, chlorophacinone, bromadiolone, difenacoum, brodifacoum, flocoumafen, and difethialone) in serum, plasma, and whole blood from birds and mammals.
- WS formulation scientists produced 100,000 acetaminophen tablets to support invasive brown treesnake eradication activities in Guam.