

Wildlife Services

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National Wildlife Research Center

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Controlling Rodent Populations and Damage with an Emphasis on Invasive House Mice and Native Voles



Contact Information:

Dr. Gary Witmer
Supervisory Research Wildlife Biologist
NWRC Headquarters
4101 LaPorte Avenue
Fort Collins, CO 80521
Phone: (970) 266-6335
FAX: (970) 266-6157
gary.w.witmer@aphis.usda.gov
www.aphis.usda.gov/wildlife_damage/
nwrc/

Major Cooperators

- California Department of Food and Agriculture
- Colorado State University
- Global Materials Technology
- Island Conservation, Inc.
- University of California-Davis
- U.S. Department of Defense
- U.S. Fish and Wildlife Service
- U.S. National Park Service

Groups Affected By These Problems

- Conservationists
- Farmers
- Livestock producers
- Military bases
- Natural resource managers
- Urban citizens

National Wildlife Research Center Scientists Assess and Develop Methods to Manage Native Rodents and Eradicate Introduced, Invasive Rodents

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

Rodents occur worldwide and have adapted to most types of ecosystems. Rodents provide many important ecosystem functions and although most rodent species do not cause serious damage problems, a small number of species do. Rodents damage ripening crops, forestry and nursery trees, rangelands, ornamental plants, and property, including cables and irrigation pipes. They also consume and contaminate stored food, transmit diseases, and contribute to the decline of native flora and fauna on islands. Many tools are used to reduce rodent populations and mitigate damage. NWRC researchers develop and evaluate rodenticides, barriers, and other tools to eliminate or reduce the damage caused by native and invasive rodents.

Applying Science and Expertise to Wildlife Challenges

Ground Squirrel Barriers for Underground Missile Sites—Richardson's ground squirrels pass through or under chain link security fences, triggering sensors and undermining facility infrastructure at Intercontinental Ballistic Missile (ICBM) sites in the western U.S. Among potential solutions to ground squirrel intrusions at these remote sites are permanent barriers, extending both above and below ground. NWRC biologists tested several barrier systems in the rodent buildings at NWRC's outdoor animal research facility in Colorado, using wild-caught Richardson's ground squirrels from deactivated ICBM sites at Malmstrom Air Force Base, Montana. Several barrier systems were identified that have a high potential to prevent movement by Richardson's ground squirrels through or under standard, chain link-fenced areas. Effective above-ground barriers included clear, polycarbonate plastic, and a 2x4-inch woven wire fence with 2 strands of electrified tape near the soil surface. Effective below-ground barriers included a pea gravel-filled trench, and a small-mesh expanded metal sheets. The barriers prevented both above- and below-ground intrusions by ground squirrels. These barrier systems will be field tested at ICBM sites to verify their effectiveness.

Assessing Seedling Damage by Mice—Research has shown that house mice and deer mice may cause substantial damage to tree seedlings. In studies at NWRC, deer mice and house mice were placed in metal stock tanks with planted ponderosa pine and narrow-leaf cottonwood seedlings. Both rodent species damaged leaves and stems of cottonwood seedlings, with house mice damage resulting in the mortality of more than half of the cottonwood seedlings. Only slight damage was done by either species to the pine seedlings, and neither species damaged the roots of seedlings, despite extensive burrowing by house mice. Researchers conclude that management actions to reduce mouse damage at regeneration sites or in plant nurseries may be warranted.

Efficacy of a Cholecalciferol Plus Diphacinone Bait for California Voles—NWRC researchers determined the efficacy of a new cholecalciferol plus diphacinone bait for use with California voles in California agricultural fields where they have developed resistance to chlorophacinone bait. In no-choice tests with captive voles, results showed that the pelleted bait was highly effective (100-percent mortality). Subsequent two-choice tests also showed a high efficacy (80-percent mortality). Field efficacy trials are planned.



United States Department of Agriculture
Animal and Plant Health Inspection Service

Assessment of Anticoagulant Rodenticide Hazards to Non-Target Animals—Anticoagulant rodenticides are important and widely used tools for managing rats, ground squirrels, voles, and other rodents that damage agriculture, impact native flora and fauna, transmit diseases, or otherwise conflict with human interests. However, concerns about nontarget hazards to wildlife and other adverse environmental effects could limit the use of these rodenticides in the United States. There has been a growing concern that the use of anticoagulant rodenticides to control prairie dog populations may pose a significant hazard to animals that feed on dead or dying prairie dogs. NWRC biologists assessed chlorophacinone residues in captive prairie dogs under controlled conditions. Chlorophacinone levels quickly peaked in prairie dogs after being fed Rozol® prairie dog bait. The highest levels were recorded from animals euthanized on the third day after being offered the bait. Levels quickly declined thereafter and were significantly lower by the seventh day. The results also demonstrated that prairie dogs allowed unlimited access to the bait did not consume more bait nor did they have higher residue levels than those offered only 53g of bait. Results suggest that the highest risk of secondary exposure to chlorophacinone residues by non-target animals consuming prairie dogs exposed to the bait would occur within a few days after bait application and would drop quickly thereafter.

Preliminary Evaluation of Sodium Nitrite as a Rodenticide—NWRC researchers evaluated sodium nitrite (a compound commonly used as a color fixative and preservative in meats and fish) as a potential rodenticide. The preliminary trials involved black-tailed prairie dogs and Norway rats and used food and liquid bait containing encapsulated sodium nitrite. The lethal dose (LD-50) for both species was less than 200 mg/kg, which indicates that sodium nitrite has the potential to be an effective rodenticide for these species.

Development of a Food Bait Block for Use With Black-Tailed Prairie Dogs—Fertility control may be a useful tool for managing prairie dog populations in urban and suburban environments where rodenticide use is limited or socially unacceptable. However, an effective, oral delivery system is needed. NWRC biologists tested a food bait block delivery system that allows prairie dogs' access to bait over several days. Prairie dogs readily consumed the bait blocks which were stacked on vertical metal poles during the day. However, rabbits and mice also consumed the food bait blocks, mainly at night. Researchers are working to modify the delivery device to eliminate bait access at night.

Selected Publications:

SAVIDGE, J., G. WITMER, S. JOJOLA, J. PIERCE, and P. BURKE. 2012. Genetic evaluation of an attempted *Rattus rattus* eradication on Congo Cay, U.S. Virgin Islands, identifies importance of eradication units. *Biol. Invasions* 14:2343-2354.

SNOW, N., and G. WITMER. 2011. A field evaluation of a trap for invasive American Bullfrogs. *Pacific Conservation Biology* 17:285-291.

WITMER, G. W. and P. HALL. 2011. Attempting to eradicate invasive Gambian giant pouched rats (*Cricetomys gambianus*) in the United States: lessons learned. Pp. 131-134 in: *Proceedings of the Symposium on Island Invasives: Eradication and Management*. New Zealand.

WITMER, G. W., J. PIERCE, and W. C. PITT. 2011. Eradication of invasive rodents on islands of the United States. Pp. 135-138 in: *Proceedings of the Symposium on Island Invasives: Eradication and Management*. New Zealand.

WITMER, G., N. SNOW, R. MOULTON, and J. SWARTZ. 2012. An assessment of seedling damage by wild house mice and wild deer mice. *Can. J. Forest Research* 42:1168-1172.

WITMER, G., T. SHEFFELS, and S. KENDROT. 2012. The introduction, impacts, and management of a large, invasive, aquatic rodent in the United States. Pp. 49-89 in: D. Abreau and S. deBorbon (eds.). *Marshes: Ecology, Management, and Conservation*. Nova Science Publishers, Inc., NY.

WITMER, G., and W. PITT. 2012. Invasive rodents in the United States: ecology, impacts, and management. Pp. 47-75 in: J. Blanco and A. Fernandes (eds.). *Invasive Species: Threats, Ecological Impact and Control Methods*. Nova Science Publishers, Inc., NY.

WITMER, G. W., and P. FULLER. 2011. Vertebrate species introductions in the United States and its territories. *Current Zoology* 57:559-567.

Major Research Accomplishments:

- WS identified effective barrier systems to prevent ground squirrel access and subsequent damage to underground missile sites.
- WS determined house mouse damage to cottonwood seedlings can be severe and lead to seedling mortality.
- WS evaluated the efficacy of a new cholecalciferol plus diphacinone bait for use with California voles in California agricultural fields where voles have developed rodenticide resistance.
- WS assessed non-target hazards associated with chlorophacinone residues in dead or dying prairie dogs.
- WS determined sodium nitrite has the potential to be an effective rodenticide.