Wildlife Services

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National Wildlife Research Center

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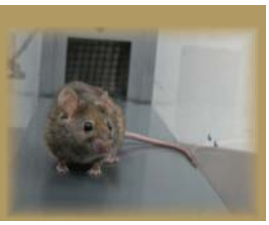
Controlling Rodent Populations and Damage with an Emphasis on Invasive House Mice and Native Voles



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Major Cooperators
- U.S. Fish and Wildlife Service
- U.S. National Park Service
- U.S. Department of Defense
- Florida Wildlife Commission
- California Department of Food and Agriculture
- Island Conservation, Inc.

Groups Affected By These Problems
- Urban citizens
- Farmers
- Livestock producers
- Natural resource managers
- Conservationists
- Military bases

National Wildlife Research Center Scientists Assess and Develop Methods to Manage Native Rodents or 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. 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, property, 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

Identifying Effective Attractants and Rodenticide Baits for Gambian Rats— Native to Africa, Gambian giant pouched rats are currently in Grassy Key, Florida and threaten to invade mainland Florida. Because of their large size, they pose a serious threat to native species and agricultural crops. Gambian giant pouched rats were implicated in a monkeypox outbreak in humans in the Midwestern U.S. in 2003, and are potential vectors of other diseases. To assist with WS initiated eradication and detection efforts in the Florida Keys, NWRC biologists tested 15 attractants for use in traps for capturing or detecting Gambian rats. The biologists found that similar scents (i.e., feces and urine) from other Gambian rats were the best attractant, but peanut butter, anise, ginger, and fatty acid scents could also be useful. In another study, NWRC evaluated several rodenticide baits with captive Gambian rats from Florida in multiple choice food trials: two formulations of diphacinone baits, and one formulation each of brodifacoum, chlorophacinone, zinc phosphide, and bromethalin bait. Only the brodifacoum and zinc phosphide baits were highly effective. In future Gambian rat control efforts, NWRC recommends the use of acute rodenticide zinc phosphide, or the second-generation anticoagulant, brodifacoum.

Behavior of Invasive Rats in an Unfamiliar Environment— Invasive rats pose a threat to native flora and fauna, especially on islands where native species have evolved in the absence of terrestrial predators. Effective detection and eradication is essential to preserve the integrity of island ecosystems. A better understanding of the behavior of rats when they first arrive in a new setting could lead to the development of more effective methods for detecting and eradicating rats from insular ecosystems.

NWRC biologists studied the behavior of three commensal rat species in a novel environment with various familiar and unfamiliar stimuli. While there were some differences in responses by species and sex, most rats sought out and spent considerable time in the den box, suggesting an immediate need for security when in an unfamiliar setting. Rats also sought out the feces of other rats, suggesting the need for social contact or reproduction. The management implications of the study results are two-fold. First, the detection of newly arriving rats on islands may be aided by the strategic placement of den boxes that are highly acceptable to rats. Wildlife managers could inspect the den boxes periodically for evidence of rats. Secondly, placing rat feces in the den boxes might enhance attraction of invading rats to the den boxes and slow their dispersion.

Eradication of Roof Rats on Egmont Key, FL— Roof rats were accidently introduced to Egmont Key, a U.S. Fish and Wildlife Service National Wildlife Refuge near Tampa Bay, Florida, during a shoreline stabilization program in 2000. The rats pose a threat to all ground-nesting native species and could also damage historic structures in the area. NWRC biologists conducted a study to determine if two proposed rodenticide formulations (Ramik® Green pellets and Ramik Mini-Bars, both 0.005 percent diphacinone) would be palatable to, and effectively kill, roof rats from Egmont Key. Although both rodenticides resulted in high mortality, the scientists recommended the use of Ramik Mini-Bars on Egmont Key because their large size reduces potential hazards to the island's gopher tortoises compared to the smaller Ramik Green pellets. Based on these recommendations, in 2009, WS operations biologists designed and conducted a successful eradication program for these rats using an island-wide grid of bait stations and Ramik Mini-Bars. WS is also involved in several other island invasive rodent eradications.

Rodenticide Resistance in Meadow Voles— Meadow voles cause significant damage to agricultural crops. The anticoagulant rodenticide chlorophacinone has been used in artichoke fields in northern California for nearly 2 decades to control vole populations and reduce damage. Although initially efficacious, anecdotal evidence indicates that voles have developed resistance to chlorophacinone and are increasingly difficult to manage. NWRC researchers isolated liver microsomes from voles captured from areas with populations identified by farmers to be resistant to chlorophacinone and from areas that had never been baited with chlorophacinone to investigate possible metabolic differences between the two populations. The study found that microsome preparations from resistant populations of voles metabolized significantly more chlorophacinone than did non-resistant voles resulting in increased resistance to the rodenticide. NWRC researchers currently are investigating ways to improve the efficacy of the rodenticide in these resistant populations.

Determining Non-Target Risks of Rodenticides— Diphacinone is a first generation anticoagulant rodenticide used to manage pests such as rats, mice, and other rodents. Non-target species are potentially exposed to anticoagulant rodenticides through a variety of pathways, including through consumption of animals that ingested anticoagulant bait. Thus, determining tissue concentrations of diphacinone in target animals is an integral component of assessing secondary risks. NWRC researchers determined the concentrations of diphacinone in the liver, kidneys, lungs, muscle, whole blood, and whole body remainder of treated Wistar rats to develop physiologically based pharmacokinetic models (PBPK) to estimate diphacinone tissue concentrations and improve risk assessment strategies.

Selected Publications:

WITMER, G. W., N. P. SNOW, AND P. W. BURKE. 2010. Evaluating commercially available rodenticide baits for invasive Gambian giant pouched rats (*Cricetomys gambianus*). Crop Protection 29:1011-1014.

WITMER, G. W., N. P. SNOW, AND P. W. BURKE. 2010. Potential attractants for detecting and removing invading Gambian giant pouched rats (*Cricetomys gambianus*). Pest Management Science 66:412-416.

WITMER, G. W., and G. R. Singleton. 2010. Sustained agriculture: the need to manage rodent damage. Pp. 1-52 in: F. Wagar, ed. Agricultural Production. Nova Science Publishers, Inc., New York, NY.

WITMER, G. W., J. D. EISEMAN, T. M. PRIMUS, J. R. O'HARE, K. R. PERRY, R. M. ELSEY, AND P. L. TROSCLAIR III. 2010. Assessing potential risk to alligators, *Alligator mississippiensis*, from nutria control with zinc phosphide rodenticide baits. Bulletin of Environmental Contamination and Toxicology 84:698-702.

WITMER, G., A. E. FINE, J. GIONFRIDDO, M. PIPAS, K. SHIVELY, K. PICCOLO, AND P. BURKE. 2010. Epizootiologic survey of *Mycobacterium bovis* in wildlife and farm environments in northern Michigan. Journal of Wildlife Diseases 46:368-378.

JOJOLA, S. M., G. W. WITMER, AND P. W. BURKE. 2009. Evaluation of attractants to improve trapping success of nutria on Louisiana coastal marsh. Journal of Wildlife Management 73:1414-1419.

WITMER, G. W., AND P. W. BURKE. 2009. Influence of vitamin K-rich plant foods on anticoagulant baiting efficacy in wild house mice, Norway rats and wild black rats. Pacific Conservation Biology 15:87-91.

WITMER, G. W., G. M. KEIRN, N. HAWLEY, C. MARTIN, AND J. K. REASER. 2009. Human dimensions of invasive vertebrate species management. Proceedings of the Wildlife Damage Management Conference 13:100-105.

WITMER, G. W., N. P. SNOW, L. HUMBERG, AND T. SALMON. 2009. Vole problems, management options, and research needs in the United States. Proceedings of the Wildlife Damage Management Conference 13:235-249.

Major Research Accomplishments:

- WS identified effective attractants and rodenticides for Gambian giant pouched rat management.
- WS helped to successfully eradicated roof rats from Egmont Key, Florida.
- WS determined tissue concentrations of the rodenticide diphacinone in target species and used the data to improve risk assessment strategies for non-target species.

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