

## Improving Rodenticides and Other Rodent Damage Control Methods



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### Groups Affected:

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

### Major Cooperators:

- California Department of Food and Agriculture
- Connovation, Ltd., New Zealand
- Invasive Animal CRC, Australia
- Netafim, Ltd., Fresno CA
- SenesTech, LLC., Flagstaff AZ
- University of California, Davis CA
- U.S. Fish and Wildlife Service
- U.S. Department of Defense

### 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 (NWRRC) 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 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, and property, including cables and irrigation pipes. They also eat and contaminate stored food, transmit diseases, and contribute to the decline of native plants and animals on islands. Many tools are used to reduce rodent populations and mitigate damage. NWRRC 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

**Reducing Active Ingredients in Rodenticides.** — Historically, vole damage to artichokes has been managed using first generation anticoagulant rodenticides. These rodenticides were effective for many years until voles began to develop a resistance to them. Today, efforts to find new tools has led NWRRC researchers and colleagues at the University of California to test the effectiveness of rodenticides using cholecalciferol (vitamin D3) and diphacinone (a first generation anticoagulant). By combining these compounds, researchers hope to develop a more effective and safer management tool. Under normal conditions, vitamin D helps the body maintain appropriate levels of calcium. However, toxic doses of cholecalciferol cause high levels of calcium in the blood which affects organ functions. NWRRC researchers found that the addition of a small dose of cholecalciferol to diphacinone bait is effective against voles resistant to anticoagulants. Researchers note the combination also reduces risks to other wildlife due to lower concentrations of both compounds and shorter time to death. This rodenticide and one containing cholecalciferol and brodifacoum were also effective with pocket gophers and ground squirrels.

**Secondary Hazards Associated with Prairie Dog Rodenticide Bait.** — Secondary toxicity in predatory and scavenging mammals and birds that eat animals containing residues of anticoagulant rodenticides is a conservation, agricultural and environmental contamination concern among land managers. Rozol® Prairie Dog Bait (chlorophacinone 0.005%) is a pesticide registered to control black-tailed prairie dogs in 10 states. NWRRC researchers fed Rozol Prairie Dog Bait to captive black-tailed prairie dogs for 2 days and analyzed their livers and whole bodies (without livers) for chlorophacinone residues. Results showed the greatest levels of residues in livers and whole bodies after 3 days. Residues in both tissues declined rapidly over time, with estimated half-lives of approximately 6 days post-exposure. However, a risk assessment of secondary toxicity to non-target mammals indicated high risks for mammal species up to 27 days post-exposure. There were negligible risks for birds. The results suggest that the greatest risk of secondary toxicity occurs less than or equal to 14 days post-application of Rozol Prairie Dog Bait. This corresponds to the time when chlorophacinone residues are high, and prairie dogs exhibit signs of intoxication — likely making them more susceptible to predation and scavenging. These results confirm that Rozol Prairie Dog Bait should not be used in areas where endangered black-footed ferrets or other sensitive species occur.

**Best Management Practices for Rat Eradication on Tropical Islands.** — Methods to eradicate rats from islands are well established, and there have been over 580 successful eradications to date. Unfortunately, rat eradications on tropical islands have a lower success rate than those in temperate areas. In an effort to identify why and find solutions, the University of Auckland in New Zealand held a workshop with 34 experts in rat eradication, tropical rodent and island ecology, and toxicology. Two of the NWRRC's scientists attended and helped in writing the workshop's proceedings. The workshop, which gathered leading experts from around the world, resulted in a list of best management practices

for eradication efforts using aerial broadcast of brodifacoum bait. Recommendations included developing a non-target species inventory, conducting a peer-reviewed environmental assessment, applying additional bait to the forest canopy to reach rats while preventing ground-based land crabs from eating them, obtaining climate and seasonal data to help plan and time bait drops, and conducting a bait availability trial to inform application rates. Although current success rates for aerial broadcast rat eradication efforts in tropical environments are high (89 percent), experts hope these recommendations will further increase rates to those obtained in temperate locations (97 percent).

#### **Selected Publications:**

Baldwin, R.A., R. Meinerz, and G.W. Witmer. 2016. Cholecalciferol plus diphacinone baits for vole control: a novel approach to a historic problem. *Journal of Pest Science* 89:129-135. doi: 10.1007/s10340-015-0653-3

Pitt, W.C., A.R. Berentsen, A.B. Shiels, S.F. Volker, J.D. Eisemann, A. Wegmann, and G. Howald. 2015. Non-target species mortality and the measurement of brodifacoum rodenticide residues after a rat (*Rattus rattus*) eradication on Palmyra Atoll, tropical Pacific. *Biological Conservation* 185:36-46. doi: 10.1016/j.biocon.2015.01.008

Shiels, A.B. and D.R. Drake. 2015. Barriers to seed and seedling survival of once-common Hawaiian palms: The role of invasive rats and ungulates. *AoB Plants* 7(1):plv057. doi: 10.1093/aobpla/plv057

Witmer, G. W. and R.S. Moulton. 2016. Design of a self-resetting, low-maintenance, long-term bait station for rodent control. *Proceedings of the 16th Wildlife Damage Management Conference* 21-25.

Witmer, G.W., N.P. Snow, and R.S. Moulton. 2016. Retention time of chlorophacinone in black-tailed prairie dogs informs secondary hazards from a prairie dog rodenticide bait. *Pest Management Science* 72(4):725-730. doi: 10.1002/ps.4045

#### **Major Research Accomplishments:**

- WS researchers found that the addition of a small dose of cholecalciferol to diphacinone bait is effective against voles resistant to anticoagulant rodenticides.
- WS researchers found that secondary hazards to non-target mammals who feed or scavenge upon prairie dogs treated with Rozol® Prairie Dog bait are highest immediately following to 14 days post-application.
- As part of an international workshop, WS researchers developed a list of best management practices for eradicating rodents from islands using brodifacoum rodenticide bait.