

Wildlife Services

Protecting People
Protecting Agriculture
Protecting Wildlife

National Wildlife Research Center

FY 2017

Managing Invasive Species Impacts to Agriculture, Natural Resources, and Human Health & Safety



Contact Information:

Dr. Shane Siers
Supervisory Research Wildlife Biologist
Hawaii Field Station
P.O. Box 10880
Hilo, HI 96721

Phone: (808) 961-4482
FAX (808) 961-4776
E-mail: shane.r.siers@aphis.usda.gov
Website: www.aphis.usda.gov/wildlifedamage/nwrc/

Groups Affected:

- Commercial transportation industry
- Farmers/Homeowners
- Horticulture industry
- Military operations managers
- Natural resource managers
- Seed crop industry
- Tropical fruit and nut producers
- Wildlife and refuge managers

Major Cooperators:

- Guam
- Hawaii Agriculture Research Center
- Hawaii Department of Agriculture
- Hawaii Department of Land and Natural Resources
- Hawaii Macadamia Nut Growers Association
- Hawaiian Commercial and Sugar
- Hilo International Airport
- Kamehameha Schools (Bishop Estate)
- MacFarms of Hawaii
- Mauna Loa Mac Nut
- Monsanto Corporation
- Nature Conservancy
- Pioneer Hi-Bred Seed
- Syngenta Corporation
- Tropical Fruit Growers of Hawaii
- University of Hawaii
- U.S. Department of Defense
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- U.S. Geological Survey

National Wildlife Research Center Scientists Develop Methods to Reduce Damage Caused by Invasive Species

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's field station in Hilo, Hawaii, is ideally located to allow research biologists to develop methods needed to control invasive species damage to agricultural crops and native ecosystems on islands.

Oceanic islands like the Hawaiian archipelago are more susceptible to the impacts of invasive species than mainland areas because remote islands evolved in ecological isolation and have few predators or competitors, have a lot of air and sea traffic, and typically provide a favorable habitat and climate for many introduced species. Furthermore, native species on the islands have evolved in the absence of many introduced threats and usually respond poorly to invasive animals or disease.

Invasive species are one of the greatest threats to Hawaii's agricultural economy, natural environment, and the health and lifestyle of Hawaii's people. Invasive vertebrate species cause millions of dollars in damage, compete with native species, destroy native forests, spread disease, and threaten the health and safety of residents. NWRC scientists in Hawaii are investigating a variety of methods to reduce damage caused by invasive species, such as rodents, coqui frogs, brown treesnakes, invasive birds, mongooses, and feral ungulates in Hawaii and other islands throughout the Pacific Rim.

Applying Science and Expertise to Wildlife Challenges

Automated Aerial Bait Delivery System for Brown Treesnakes. — NWRC researchers partnered with a private engineering firm to design an automated aerial bait delivery system for controlling invasive brown treesnakes on Guam. The system can rapidly and accurately deliver baits from an aircraft over large forested areas on the island. The technology uses acetaminophen-treated dead mouse baits (a registered toxicant for brown treesnakes). The baits are attached to biodegradable streamer-like cartridges. Launched from a helicopter, the baits are designed to snag in trees where the snakes feed. In 2016, NWRC and its partners at the U.S. Department of the Interior and U.S. Department of Defense tested the new system, deploying baits from a helicopter on a 270-acre site within Andersen Air Force Base. Researchers are monitoring snake activity in the area through 2017 to help guide future control efforts. Initial results show a reduction in snake activity. If successful on Guam, the device could be adapted for other invasive species management efforts.

Evaluating Toxicants for Use with Invasive Mongooses. — NWRC researchers evaluated the efficacy and palatability of 10 commercial rodenticide baits, technical diphacinone powder and two alternative acute toxicants for control of small Indian mongooses. Mongooses are an invasive species on Hawaii and Puerto Rico causing damage to agricultural and natural resources. Mongooses in Puerto Rico also pose a human health hazard as they can carry and transmit rabies. In general, the commercially produced rodenticide baits were not preferred by mongooses and had lower mortality rates. More palatable baits had higher consumption and achieved higher mortality rates. Bait achieving 100 percent mortality included Tomcat® bait blocks containing 0.1% bromethalin; 0.005% technical diaphacinone in minced chicken; and 0.10 to 0.15% para-aminopropiophenone (PAPP) in minced chicken. These findings will aid in the development of an effective bait for invasive mongooses that is palatable, long-lasting under harsh environmental conditions, and relatively safe for non-target species.

Understanding and Managing Invasive Rose-ringed Parakeets. — The rose-ringed parakeet has been introduced to over 35 countries and five continents, including the Hawaiian island of Kauai. In its native range of Africa and India, this bird is considered an agricultural pest. It has proven to be a successful invader and poses a significant threat to Hawaii's agricultural economy and ecology because of its gregarious nature, generalist diet, high reproductive rate, and ability to live in disturbed



United States Department of Agriculture
Animal and Plant Health Inspection Service

and human-populated areas. NWRC researchers documented the movement and foraging patterns of rose-ringed parakeets, and provided estimates of population size and roost site locations. A diet analysis showed that rose-ringed parakeets on Kauai feed on important corn seed crops, as well as soft fruits. Results also indicate the birds may be dispersing seeds of yellow guava, an invasive plant. Continued research will determine the extent of the rose-ringed parakeet invasion of Kauai, test potential control tools, and develop management strategies for protecting human interests and Kauai's unique natural resources from further damage by this invasive bird.

Rodent Eradications on Tropical Islands. — Responsible and legal uses of rodenticides provide immeasurable benefits to human health, food security, and protection of natural resources. NWRC researchers test lethal and non-lethal methods to control rodent damage, develop bait application strategies that minimize environmental contamination, and assess the ecological impacts of rodenticide use through the monitoring of chemical residues in soil, water, and non-target organisms. For example, recent cage trials with invasive Polynesian rats and house mice resulted in a 100 percent mortality rate using a new diphacinone rodenticide formulation. This new formulation could be an alternative to more toxic compounds for use in island eradication. In a similar effort involving field trials with placebo rodenticide baits, researchers demonstrated a method for controlling rats in tidal areas on Wake Atoll while minimizing marine contamination. NWRC researchers have also collaborated with other agencies to conduct environmental monitoring assessments for rodenticide residues on Wake Atoll, Palmyra Atoll and the Waianae Mountains of Oahu, and also in Hawaiian birds resulting from general agricultural and commensal uses. Rodent eradication on tropical islands have resulted in the conservation of numerous native plant and animal species.

Zoonotic Parasites in Invasive Black Rats. — Black rats are among the most harmful invasive species worldwide, damaging crops, native ecosystems, stored food, dwellings, and other structures. They can also carry and spread diseases and parasites to other mammals, including people. In a recent black rat population density study on the island of Diego Garcia in the British Indian Ocean Territory, NWRC researchers discovered that 75 percent of rats had been infected with *Capillaria hepatica*, a parasitic nematode that can cause capillariasis and hepatitis in humans. Another major human health concern in Hawaii and other tropical and subtropical locations is the rat lungworm, *Angiostrongylus cantonensis*. This parasitic nematode causes human meningitis and other serious health consequences when larval stages are ingested in undercooked foods. NWRC scientists partnered with the University of Hawaii to develop a test for rat lungworm infection in the blood of wild Hawaiian rats. Continued efforts involve harvesting adult worms from wild-caught rats for the purpose of isolating proteins to develop an antibody diagnostic test for human exposure.

Selected Publications:

Jarvi, S.L. S.I., W.C. Pitt, M. Farias, L. Shiels, M. Severino, K. Howe, S. Jacquier, A.B. Shiels, K. Amano, B. Luiz, D. Maher, M. Allison, Z. Holtquist, and N. Scheibelhut. 2015. Detection of *Angiostrongylus cantonensis* in the blood and peripheral tissue of wild Hawaiian rats (*Rattus rattus*) by a quantitative PCR (qPCR) assay. PLoS ONE 10: 1-12. doi: 10.1371/journal.pone.0123064

Keitt, B., S. Boudjelas, K. Broome, S. Cranwell, R. Griffiths, J. Millett, A. Samaniego, W.C. Pitt. 2015. Best Practice Guidelines

for Rat Eradication on Tropical Islands. Biological Conservation 185:17-26. doi: 10.1016/j.biocon.2014.10.014

Kimball, B.A., S.A. Stelting, T.W. McAuliffe, R.S. Stahl, R.A. Garcia, and W.C. Pitt. 2015. Development of artificial bait for brown treesnake suppression. Biological Invasions 18:359-369. doi: 10.1007/s10530-015-1031-z

Kraus, F., R. Stahl, and W. C. Pitt. 2015. Thermal fumigation provides a simple and effective solution for sanitizing cargo from invasive snakes. Journal of Pest Science 88(3):331-341. doi: 10.1007/s10340-014-0627-x

Pitt, W.C., R.T. Sugihara, and A.R. Berentsen. 2015. Effect of travel distance, home range, and bait on the management of small Indian mongooses, *Herpestes auro-punctatus*. Biological Invasions 17:1743-1759.

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

Pott, M., A.S. Wegmann, R. Griffiths, A. Samaniego-Herrera, R.J. Cuthbert, M. de L. Brooke, W.C. Pitt, A.R. Berentsen, N.D. Holmes, G.R. Howald, K.Ramos-Rendon, J.C. Russell. 2015. Improving the odds: Assessing bait availability before rodent eradication to aid in selecting bait application rates. Biological Conservation. 185:27-35. doi: 10.1016/j.biocon.2014.09.049

Major Research Accomplishments:

- WS researchers partnered with a private engineering firm to design an automated aerial bait delivery system for controlling invasive brown treesnakes on Guam. Initial tests of the device show a reduction in snake activity in areas where the baits were distributed.
- WS researchers screened a comprehensive panel of candidate commercial and custom rodenticide formulations for effectiveness as mongoose toxicants, identifying promising avenues for further bait development.
- A diet analysis conducted by WS researchers demonstrated that rose-ringed parakeets on Kauai feed on important corn seed crops, as well as soft fruits. Results also indicate the birds may be dispersing seeds of yellow guava, an invasive plant.
- WS researchers developed a bait application strategy for tidal areas on tropical islands that ensures rats foraging in these areas are exposed to toxic baits while preventing significant contamination of the marine environment.
- WS scientists partnered with the University of Hawaii to develop a test for rat lungworm infection in the blood of wild Hawaiian rats. Rat lungworm (*Angiostrongylus cantonensis*) causes human meningitis and other serious health consequences when larval stages are ingested in undercooked foods.