



Wildlife Services Tech Note

Snake Repellents

Wildlife Services (WS), a program within the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS), provides Federal leadership to help manage invasive brown treesnake (*Boiga irregularis*) populations on Guam and the Northern Marianas Islands. WS and its partners aim to reduce snake damage on the islands and minimize the accidental export of this invasive species to Hawaii or the continental United States. Brown treesnakes were accidentally introduced to Guam in the late 1940s or early 1950s hidden away in cargo shipments.

WS employees use a variety of management methods, such as trapping, acetaminophen toxicant baits, and the use of snake-sniffing detector dogs, to reduce snake numbers, particularly around military bases, airports, and shipping ports. Research also shows that cinnamon oil, clove oil, and eugenol are effective snake repellents. Snakes will retreat when sprayed directly with these oils and will exit cargo or other confined spaces when these oils are introduced to the area.

Certain substances used to mitigate pests are exempt from the requirement for federal registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended. Products containing cinnamon oil (CAS No. 8015-91-6), clove oil (CAS No. 8000-34-8), and eugenol (CAS No. 97-53-0) are exempt from FIFRA registration requirements when used as pesticide active ingredients at non-food use sites to repel brown treesnakes, provided they meet the conditions established by both the U.S. Environmental Protection Agency (www.epa.gov/minimum-risk-pesticides/conditions-minimum-risk-pesticides) and the Guam Environmental Protection Agency. These conditions include:

- Cinnamon oil, clove oil, and eugenol are used alone or in combination with other active ingredients exempted under FIFRA Section 25(b) and listed under 40 CFR 152.25(f)(1). The list of acceptable active ingredients may also be obtained at: www.epa.gov/minimum-risk-pesticides/active-ingredients-allowed-minimum-risk-pesticide-products.
- They can be mixed only with FIFRA Section 25(b) inert ingredients listed under 40 CFR 152.25(f)(2), commonly consumed food items in 40 CFR 180.950(a), animal feed items



Brown treesnakes are an invasive species on Guam. Photo by WS

in 40 CFR 180.950(b), edible fats and oils in 40 CFR 180.950(c), and/or substances listed under 40 CFR 180.950(e). The list of acceptable inert ingredients may also be obtained at: www.epa.gov/minimum-risk-pesticides/inert-ingredients-approved-use-minimum-risk-pesticide-products.

- All product containers are labeled, according to Guam's pesticide law and implementing regulations (www.guamcourts.org/compileroflaws/GAR/22GAR/22GAR003-15.pdf). The label must include the name and percentage by weight of each active ingredient, all the names of each inert ingredient, and the name and contact information of the producer (WS State Program contact).

This tech note describes how to use cinnamon oil, clove oil, and eugenol to repel brown treesnakes, per the requirements of FIFRA Section 25(b).

Endangered Species Considerations

Before using any of these substances as a snake repellent, consult with appropriate wildlife authorities to ensure its use is not hazardous to any threatened or endangered species. It may be necessary to obtain a permit from the U.S. Department of the Interior's Fish and Wildlife Service and/or the applicable State or local wildlife agency before repellents may be used. The applicator is responsible for obtaining all required permits and licenses.



Once a brown treesnake is detected in cargo, repellents may be used to flush it out. Photo by WS

Repellent Oils

Any commercially available cinnamon oil, clove oil or eugenol with 95 percent or greater purity are acceptable for use in brown treesnake repellent mixtures.

Aerosol Spray Mixture and Application

Cinnamon oil, clove oil, and eugenol aerosol sprays are effective for repelling snakes. Repellent spray mixtures should contain:

- One percent active ingredient (either cinnamon oil, clove oil, or eugenol)
- One percent sodium lauryl sulfate (CAS No. 151-21-3; a FIFRA Section 25(b) active ingredient)
- Ninety-eight percent water (a FIFRA Section 25(b) inert ingredient)

Spray the mixture directly on the snake, aiming for its head. Direct contact with the snake will trigger escape behavior. To be effective, the spray must come in direct contact with the snake. Applying the mixture to hard surfaces will not prevent snakes from entering areas.

Vapor Fumigant Application

Cinnamon oil, clove oil, and eugenol may also be used to fumigate enclosed spaces. To prepare, saturate a piece of absorbent material with one of the oils. Use only unadulterated oils. Pass hot air directly over the saturated absorptive material to volatilize the oils. **DO NOT USE OPEN FLAMES TO HEAT THE OILS.** The heated air should be no hotter than 200 degrees Fahrenheit, or no hotter than 10 degrees Fahrenheit below the flash point of the oil being used. The flash point for eugenol is 230 degrees Fahrenheit, and the flash points for cinnamon oil and Clove oil are 200 degrees Fahrenheit.

Direct the heated air into containers, cargo spaces, house crawl spaces, or other enclosed spaces where snakes may be located. Snakes will emerge and vacate the treated space. This application method is only effective for driving snakes out of enclosed spaces. These oils will not prevent snakes from entering enclosed spaces.

Storage and Disposal

Store oils in the original container. Recycle containers or dispose of them in an appropriate landfill.

Potential Hazards

Potential hazards to applicators are low unless the person is allergic to the oil being used. If eye irritation occurs, flush with water for 15 minutes. If the applicator has trouble breathing, move to fresh air and call a physician. Clove oil and eugenol are known fish anesthetics, and therefore should not be applied directly to water.

More Information

Call WS' National Wildlife Research Center at (970) 266-6000 or visit www.aphis.usda.gov/wildlifedamage/nwrc to learn more about these repellents.

You can find information on using this method for removing brown treesnakes from cargo in the following article:

Clark, L., C. Clark, and S. Siers. 2017. Brown Tree Snakes: Methods and Approaches for Control. Pages 107-134 in Pitt, W. C., J. Beasley, and G. W. Witmer, editors. Ecology and Management of Terrestrial Vertebrate Invasive Species in the United States. CRC Press, Boca Raton, Florida, USA. (nwrc.contentdm.oclc.org/digital/collection/NWRCPubs1/id/60458/rec/6)

For information about the availability of these products, contact your WS State Director at 1-866-4USDAWS (1-866-487-3297) or WS' Pocatello Supply Depot at (208) 236-6920. In Guam, call (671) 635-4400.