

Biology in Focus

Better Lives Through Better Science

USGS Helps Protect Island Life and Biodiversity

Snake Invaders Threaten Island Ecosystems

Imagine an island teeming with the chirps and calls of tropical birds, some occurring nowhere else in the world. Now imagine a stowaway reptile inadvertently being introduced to this predator-free island, through post-World War II shipping traffic. The island is Guam; the stowaway, the brown tree snake. Today, the brown tree snake's invasion and subsequent flourish on Guam has silenced — and virtually eliminated — all of the island's birds and has caused many other biological, economic and human health problems for residents. The island's lizards and bats have also suffered from the snake's presence.



USGS scientist Tom Fritts displays a handful of brown tree snakes.

well-being of people, birds and other animals. Finding ways to limit their movement to vulnerable islands and other countries is especially imperative. But management of the brown tree snake problem has been hampered by insufficient biological information and the many complexities associated with curbing their spread, and the snakes remain unusually abundant.

In response, the U.S. Geological Survey has assumed a central role in studying the biology of the brown tree snake, the problems it can cause and alternatives for control. USGS researchers are also examining how ecological health is jeopardized on Guam

and other islands when a nonnative species is introduced.

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Snakes Harm Guam's Ecosystems

Even though Guam had survived destructive battles in World War II and countless typhoons, it was not prepared to combat the devastating effects of more than one million brown tree snakes — up to 13,000 in one square mile. The snakes have virtually wiped out all of the island's forest birds, including some species found nowhere else in the world. Today, only three of Guam's 13 native species of forest birds remain.

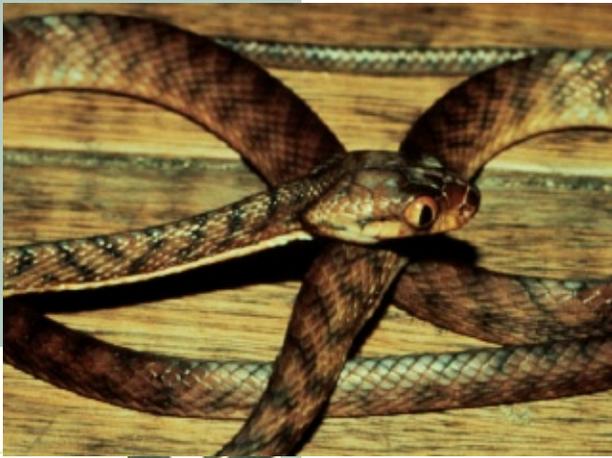
The brown tree snake invasion demonstrates how a nonnative species, left unchecked, can devastate the biological world when it invades new habitats.



Bet You Didn't Know:

- **Before the brown tree snake's arrival, Guam was effectively snakeless, with only the harmless, wormlike blind snake in residence.**
- **Adult brown tree snakes on Guam grow to about eight feet long and weigh about five pounds.**
- **More snakes can be caught per hour on Guam than in the rainforests of the Amazon Basin in Ecuador, where up to 51 snake species can occur at a single site.**

Of the island's 12 native lizards, six species survive and only three are common on the island. Likewise, two of Guam's three bat species have disappeared. As seed dispersers, pollinators and insect predators, all of these animals played a vital role in Guam's ecosystems.



USGS research has helped illuminate the intricacies of Guam's ecosystems and the importance of the various animal species in the ecological functions on the island; understanding these details of ecology is an important step in enlisting the cooperation and action of the general public, the Guam government and appropriate local, state and federal officials. Survey biologists have helped to clarify the cause and extent of the ecological damages to Guam — and to provide

hope for Guam's native species. After identifying abnormally high snake populations and demonstrating that snakes were preying on birds, lizards and mammals, USGS scientists conducted controlled experiments proving that these animals can increase in numbers when snakes are removed from the habitats in which they are presently so numerous.

In addition to causing biological damage, the brown tree snake has cost taxpayers millions of dollars. The snake's propensity for crawling on high voltage cables results in frequent power outages and damaged electrical equipment. Since 1978, brown tree snakes have caused more than 1,600 blackouts, intermittently disrupting nearly every facet of civilian and military life. Food spoilage, computer failures, traffic jams and loss of work productivity are common aggravations. To assist Guam Power Authority officials, USGS biologists helped identify the routes of access the snakes follow; this information has been used to develop ways to exclude snakes from sites where they cause the most damage.



USGS scientists use innovative traps to capture brown tree snakes.

By working through its science centers, the USGS Biological Resources Division supports the sound management of our nation's biological resources.

Also distressing to island residents are the snakes' frequent invasions into poultry houses and cages, where they prey on chickens, eggs, pigeons, pet birds and small mammals. Hungry snakes occasionally kill newborn pigs and dogs, even though these animals are usually too large for the snakes to swallow. Brown tree snakes also slither into homes, warehouses and office buildings in search of daytime shelter. Snakes have been found in light fixtures, cabinets, stairwells and beds. More commonly, though, they are found in bathrooms, which they enter through rooftop vents connected to sewer lines. The USGS has provided guidance to Guam's residents on ways to snake-proof farm buildings, cages and human residences.

Although the snake is only mildly venomous and its bite is not fatal to adult humans, it can cause serious health problems for infants and small children. USGS studies of the circumstances, signs and symptoms associated with snakebites have been important in educating emergency medical room personnel and physicians in the best ways to treat and respond to snakebites.



Deadly Stowaways Invade New Places

Because of their ability to fit into small spaces, their nocturnal habits and sheer numbers, brown tree snakes often become accidental stowaways on ships and planes leaving Guam. The likelihood of dispersal to other islands and countries is increased by Guam's high volume of civilian and military transportation. Since the snakes can live up to a year without food, they can survive long voyages.

Unless contained, brown tree snakes could become established in other places where they would likely wreak the same kind of havoc caused on Guam. USGS scientists have documented the reality of the dispersal risk from Guam. In past years, the snakes have been unwittingly transported to Spain, Texas, Hawaii and other Pacific Islands. Although one stowaway doesn't necessarily result in colonization, if a female snake has recently mated or encounters other male stowaways, she can produce many offspring over several years. Methods for detecting and removing brown tree snakes before they become established are being shared with islands most at risk, through workshops and educational materials.

USGS Research Provides New Insights

“Invasive species pose some of the most difficult biological problems we face,” notes Tom Fritts, a scientist at the USGS Midcontinent Ecological Science Center. “The case of the brown tree snake demonstrates how problems caused by invasive species can mushroom out of control.” To help address such problems, the USGS has spent the last several years studying the snakes and developing solutions for curbing their spread.

USGS scientists are developing baseline data on islands most at risk (such as the Hawaiian Islands and the Northern Mariana Islands) and are documenting responses of snakes to changing ecological conditions. By determining snake densities, population trends, behaviors and habitat uses, USGS scientists can more effectively anticipate long-term ecological consequences. Land managers, in turn, can use these findings to make prudent conservation decisions based on sound science.

To assist with snake control, USGS scientists have designed and developed prototypes of innovative traps and barriers. They are also developing specialized traps for use in warehouses, shipping containers and electrical facilities. In the future, USGS scientists plan to develop artificial attractants to lure snakes over long distances. And, finally, scientists are studying how to capture snakes in areas where they are extremely rare — such as in Saipan, where stowaways have only recently arrived.

To keep snakes from entering certain areas in the first place, USGS scientists are demonstrating the effectiveness of various barriers. One such barrier incorporates electrified fences; another involves attaching a smooth, low-friction panel to the bottom of an existing chain link fence. Both methods reduce the snakes’ climbing abilities and limit intrusions. Traps developed by USGS biologists are currently being used on Guam and on several islands in the Pacific region as the first line of defense against continued spread of the snake.

Barriers have been tested during military exercises, when equipment is moved between islands. Physical obstructions developed by the USGS will soon be in place on Guam to reduce snake access to cargo destined for other islands — and on other islands to prevent snakes from dispersing into natural habitats from seaport and airport facilities receiving cargo from Guam. Special concrete barriers are being used to eliminate snakes from endangered species habitats, electrical substations and other critical sites.



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**Tom Fritts, scientist,
USGS Midcontinent
Ecological Science
Center**

Research Can Help Anticipate Future Problems

Fritts observes that “the turmoil caused by the brown tree snake shows why we need to understand and pay attention to all parts of our ecosystems. This situation demonstrates how a nonnative species, left unchecked, can devastate biological systems when it invades new habitats.”

Research on the brown tree snake has been used to highlight the importance of curbing invasive species all over the world. USGS brown tree snake work has been featured in major news and television outlets — including the New York Times, the Wall Street Journal, National Geographic Explorer, ABC’s “Day One” and “David Attenborough’s Life of Birds.” The story has appeared in children’s outlets such as Ranger Rick and Weekly Reader. Quammen’s *Song of the Dodo* and Jaffe’s *And No Birds Sing* as well as technical books on conservation biology also use Guam’s plight to illustrate the devastation caused by invasive species.

USGS scientists reach out to others involved in invasive species studies. Their efforts have guided the programs of other agencies on local, regional and national levels — such as the Department of Defense, Department of Agriculture, the government of Guam, the Commonwealth of the Northern Marianas, the Federated States of Micronesia, Palau, the state of Hawaii and others. Survey researchers participate on interagency committees, including the National Research Council committee focusing on the conservation of the Mariana crow, the Brown Tree Snake Control Committee founded under the Nonindigenous Aquatic Nuisance Species Legislation of 1990 and recovery teams for various endangered species on Guam and elsewhere in Micronesia. USGS biologists have been requested to assist island governments in addressing other introduced species problems (wolf snakes on Mauritius, and frogs and mammals on Galapagos, for example). They are frequently called upon to brief legislators, agency heads and top managers on the complexities of invasive species issues and potential ways to reduce or avoid the problems introduced species cause.

“As the world shrinks through transportation and trade, accidental introductions of nonnative species will only increase,” Fritts notes. In response, USGS scientists will continue to study the brown tree snake and other invasive species. By sharing their findings, they will help land managers and government agencies anticipate future problems, protect biodiversity and, ultimately, enhance our quality of life.



The nocturnal brown tree snake can easily escape notice.

To learn more about the brown tree snake and the nation’s biological resources, visit the following Internet home pages:

<<http://www.pwrc.usgs.gov/btree.htm>>

<<http://biology.usgs.gov>>

<<http://biology.usgs.gov/outreach/biohome.htm>>

Or contact:

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All photos provided by Tom Fritts, USGS



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