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Eradicating Rats on Lehua Island, Hawaii, with the Help of GIS and GPS

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Eradicating Rats on Lehua Island, Hawaii, with the Help of GIS and GPS

By Justin W. Fischer and Peter Dunlevy, U.S. Department of Agriculture

Highlights

- Wildlife Services used GIS and GPS to document and track bait distribution during each bait drop.
- GIS and GPS were critical in making this eradication project effective and environmentally safe.
- Use of the technologies ensured the coverage necessary for the project's goals.


Lehua Island (photo credit: Steve Ebbert, U.S. FWS).

Lehua Island is an uninhabited, 290-acre crescent-shaped volcanic cone located approximately 150 miles north-northwest of Honolulu, Hawaii, or approximately 20 miles west of the island of Kauai. Lehua is a state-designated seabird sanctuary managed by the Hawaii Department of Land and Natural Resources (HIDLNR) and federally owned by the U.S. Coast Guard. Renowned for its diversity of nesting seabirds, it is home to at least 17 recorded species of seabirds, including, but not limited to, colonies of Laysan and black-footed albatross, red-footed and brown boobies, black noddies, and Newell's shearwaters. Lehua is also home to several species of native coastal plants and insects.

However, invasive rats are also flourishing on the island. Early biological surveys (1931) of Lehua discovered the presence of Polynesian rats. Polynesian rats are slightly smaller than their more common cousin, the Norway rat, but are still effective predators of native island flora and fauna. Rats eat a wide variety of foods, including fleshy fruits, seeds, flowers, and other plant parts and many species of insect; they also prey on birds and their eggs. Invasive rats have eliminated seabird species and suppressed or eliminated native plant and insect populations from islands around the world.

In addition to rats, nonnative European rabbits were documented on Lehua in 1931. These rabbits have also altered the island ecosystem by competing with seabirds for use of burrows and decimating native plant communities. The combination of nonnative rats and rabbits depredating plant and animal communities for decades has dramatically reduced or eliminated many native species found on Lehua.

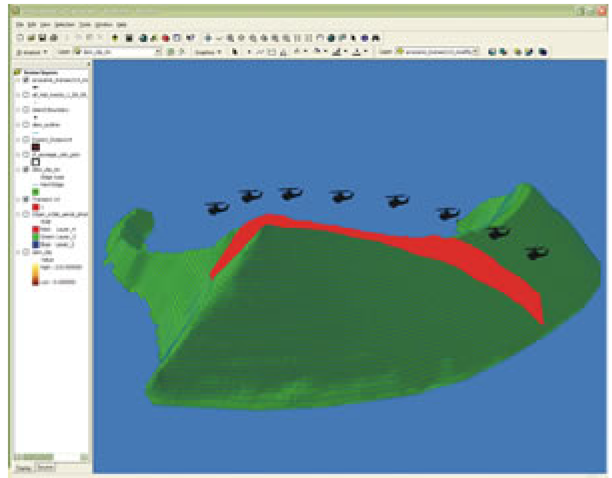
Biological surveys were again conducted on Lehua in the late 1990s, and the impact of rats and rabbits on the island ecosystem were well documented. After consultation between HIDLNR and Fish and Wildlife Service (FWS) biologists, it was decided that eradicating the rats and rabbits would be the prudent management action. The Lehua Island Ecosystem Restoration Project was founded for this purpose. This project also focused on restoring native plant communities and allowing recolonization of the island by seabirds. The original Environmental Assessment (EA) and Final Supplemental EA were approved in September 2005 and October 2008, respectively.

This shows environmental monitoring plot GPS data collection.

The EA proposed broadcasting bait pellets containing diphacinone over Lehua using a helicopter. Diphacinone is an anticoagulant rodenticide that causes internal hemorrhaging, resulting in death, and has been used throughout the world. This method of aerially broadcasting rodenticide to remove rats was recently conducted on Mokapu Island, just off the north shore of Molokai, Hawaii, in February 2008. The EA also stated that the eradication would occur during winter months (December through February). Based on recent trapping on the island, this is when the rat population is at its lowest. This is also when migratory bird species are lowest in numbers, thereby reducing any chance of hatchlings accidentally eating bait pellets and the helicopter colliding with flying seabirds.

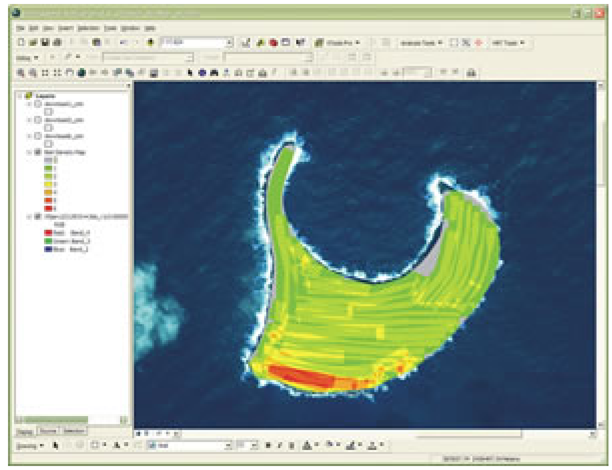
On January 6, 2009, the FWS, HIDLNR, and United States Department of Agriculture-Animal and Plant Health Inspection Service (USDA-APHIS)-Wildlife Services conducted the initial bait drop involving the broadcast of 3,900 pounds of rodenticide on Lehua Island. To ensure the bait was spread uniformly over the entire island, they used a Trimble AgGPS Trimflight 3 System to accurately map the island boundary and record every flight path for each application.

All data was stored in Esri shapefile format on a removable compact flash (CF) card. The AgGPS Trimflight 3 System in-cockpit display and lightbar provided the pilot with instantaneous guidance along flight lines. The team downloaded GPS data from the CF card during bait reloading and helicopter refueling. Once downloaded, GIS and GPS data was imported into ArcGIS to track and document bait distribution. The team used ArcGIS ArcInfo ModelBuilder and scripting to quickly and efficiently transform downloaded AgGPS Trimflight 3 System data to highlight areas on the island where the helicopter may have failed to broadcast bait and where swaths had overlapped. In a nutshell, this entailed splitting the multipolygon transect layer into individual polygons, converting all polygons to raster files, then overlaying the raster files to create a bait distribution density map. The goal of the bait drop was to broadcast bait uniformly over the entire island. ArcInfo was also used to calculate the three-dimensional surface area of the island. The topography of Lehua is very steep, so the 3D surface area is much more than the 2D planimetric area of the island. Determining correct surface area of the island was very important, because all rats must be exposed to lethal dosages of bait to achieve eradication, and the Environmental Protection Agency label determines the maximum amount (kg) of bait that can be broadcast per unit area (ha).


This is a 3D view of helicopter broadcasting bait. The transects (see red area) were 80-meters wide.

A second bait broadcast occurred on January 13, 2009, to ensure an adequate exposure period. Anticoagulants are far more effective when ingested in small doses over multiple days. This also circumvents the rodents' ability to detect toxins in their food because symptoms are delayed for days after a lethal dose is consumed. Environmental monitoring of the fate of bait pellets occurred after each bait drop. The team mapped terrestrial and marine plots with a Trimble GPS unit prior to the first bait broadcast. Bait pellets were counted within plots to confirm spread rates on the ground and measure bait disappearance by rats after each drop. Intertidal invertebrate, fish, soil, and seawater samples were also collected 24 hours later and again seven days after each bait broadcast to determine if diphacinone residue was present in any nontarget organisms or the environment.

The presence of rats will be determined over the next two breeding seasons (2009 and 2010) to assess whether the eradication effort was a success. The team will use night vision, snap traps, and tracking tunnels to determine whether rats were eradicated. The use of GIS and GPS technology was critical during each bait broadcast for documenting bait distribution and identifying areas of the island that had been missed.



This is a bait distribution density map for the first broadcast.

"Wildlife Services in Hawaii has conducted rat eradications on remote islands since 1991," explains Mike Pitzler, Hawaii, Guam, and Pacific Islands Wildlife Services state director, "but Lehua is the first project in the world to use these safer methods developed here in Hawaii over the last 15 years."

In 2005 and 2006, all rabbits were removed from the island through intensive hunting efforts. With the rabbits already gone and the rats hopefully eradicated, plant communities and seabirds are expected to recover quickly on their own. Following verification of rat elimination on the island, restoration of several native plant and invertebrate species will begin. Eradication of rats and rabbits from Lehua Island should increase the populations of threatened and endangered seabirds using the island and also give all native species a better chance of survival.

About the Authors

Justin W. Fischer is a GIS specialist/wildlife biologist with USDA-APHIS-Wildlife Services-National Wildlife Research Center's Chronic Wasting Disease Project and Invasive Species and Technology Development Research Program. His current position involves devising means to reduce chronic wasting disease transmission, spatial analysis using GIS and remote-sensing techniques, and database design and maintenance. Peter Dunlevy is a project manager/supervisory wildlife biologist with USDA-APHIS-Wildlife Services in Hawaii, Guam, and the Pacific islands. He is currently involved in development, planning, and implementation of invasive species eradications for native species and ecosystem restoration.

More Information

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