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Dry Tortugas National Park Black Rat Eradication and Post Eradication Monitoring

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ABSTRACT: The eradication of black rats from Dry Tortugas National Park (DRTO; 42 ha land mass) was completed in January 2022 through collaboration between USDA APHIS Wildlife Services and the National Park Service. Black rats had been documented throughout DRTO since the park was established in 1935. Rat predation of ground nesting birds at DRTO has included brown noddies and sooty terns. Additionally, black rats have damaged equipment and infrastructure throughout the park, and caused human health and safety issues in staff residences. For this eradication, WS chose to use a diphacinone-based rodenticide: Diphacinone-50 Conservation. Diphacinone was chosen instead of brodifacoum because it poses lower risks to non-target species (e.g., 100× less toxic to birds) and has less environmental accumulation over time. Diphacinone-50 Conservation was deployed throughout the park in bait stations placed on a 30m × 30m grid. Bait stations were baited and monitored daily for 14 days. Additionally, three hand broadcast applications were utilized during the eradication in areas of the park closed to visitors. Daily monitoring of the bait stations showed a high initial uptake of the toxicant. Also, monitoring using thermal imaging optics was used throughout the eradication to surveil bait uptake and rat activity. No rats were detected during the last four days of the eradication. Post-eradication monitoring was conducted quarterly for the first year following the eradication, and twice during the second year. Post eradication monitoring consisted of 120 snap traps and chew sachets placed throughout the park for four nights. In addition, track surveys were completed along the dune lines and thermal monitoring was conducted after dark during each monitoring period. The eradication was deemed a success in January 2024. National Park Service currently maintains a strict biosecurity plan for DRTO. This plan includes permanent bait stations and cameras placed in areas of likely reintroductions, monitoring of docking vessels, and checking cargo before distribution. Two weeks post eradication, NPS personnel observed a rat jump off a vessel onto DRTO. This rat was later found dead after consuming toxicant from the permanent bait stations. No rats have been detected at DRTO since.

KEY WORDS: bait station, diphacinone, ground-based eradication, hand-broadcast, inhabited island, *Rattus rattus*, rodenticide

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INTRODUCTION

Black rats (*Rattus rattus*) are one of the world's most detrimental invasive species and have led to the extinction of multiple island species of flora and fauna (Howald et al. 2007, Witmer et al. 1998, Shiels et al. 2014). Spread around the globe by seafaring explorers, black rats compete with native species and are known carriers of multiple zoonotic diseases including typhus, toxoplasmosis, Weil's disease, and trichinosis. When introduced to islands, black rats can impact populations of ground nesting seabirds and shorebirds that previously had no predators. Black rats have been documented in the Dry Tortugas National Park (DRTO) since the park was established in 1935.

Dry Tortugas National Park is located in the Gulf of Mexico approximately 68 miles west of Key West, Florida, U.S.A. The Park consists of seven islands, totaling around 104 acres (42 ha) and is host to Fort Jefferson, the largest brick masonry structure in the U.S.A. Of the seven islands, four of these were inhabited by black rats (Garden Key, Bush Key, Long Key, and Loggerhead Key). Due to recent sand movement Garden and Bush Key are currently connected, and Long Key is separated by a narrow channel (<50m) that can be waded at low tide. Loggerhead Key is located three miles West of Garden Key.

Garden Key, home of Fort Jefferson, is the most popular island in the park, receiving an estimated 80,000 visitors annually, or approximately 200 visitors each day.

Public access to DRTO is facilitated through a commercial ferry service, chartered seaplanes, and private boats. Visitors are allowed access to Garden Key and Loggerhead Key daily, and seasonal access to Bush Key is permitted outside of seabird nesting season. Garden Key also facilitates visitor access with a primitive campground for overnighting visitors.

Since the establishment of Dry Tortugas National Park, black rats have caused human health and safety issues. Ongoing issues with black rats include their nesting inside staff residences, contaminating staff and visitors' food, damaging infrastructure such as dive compressors and generators, and impacting visitor experiences to the park. Black rats have also been documented depredating threatened and endangered species including sooty terns and brown noddies, and also impacting native vegetation. At the request of the National Park Service (NPS), the Florida Office of the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) designed and conducted an eradication project for black rats (*Rattus rattus*) at Dry Tortugas National Park.

METHODS

Site Details

DRTO is managed by the U.S. National Park Service (NPS). The four islands targeted for the eradication are

low-lying (<3 m above sea level) and include: Garden Key, Bush Key, Long Key, and Loggerhead Key. The black rat is the only rodent species at DRTO and it is established on each of these four keys. Vegetation throughout DRTO is mostly low-lying shrubs and bushes, consisting of buttonwood (*Conocarpus erectus*), saltwort (*Batis maritima*), seal lavender (*Limonium* spp.), and sea grape (*Coccoloba uvifera*). Exotic species, including date palm (*Phoenix dactylifera*) and East Indian almond (*Terminalia catappa*) can be found throughout the park as well. These species have provided a major food source for black rats and large caches of almonds have been found in Fort Jefferson. Throughout Garden Key are large piles of bricks, building ruins, and debris left over from the construction of Fort Jefferson. These piles have become overgrown with thick vegetation, making ideal habitat for black rats.

Garden Key is home to the main operations of the park, including park headquarters, staff housing, trash and recycling, maintenance shops, visitor center, and dive shop. The generators, reverse-osmosis facilities, and wastewater treatment site are located on Garden Key as well. Park Service maintains a barge service to Garden Key bi-weekly for resupply and trash removal.

Loggerhead Key consists mainly of natural vegetation and sees far fewer visitors than the other islands. A non-operational lighthouse is located on Loggerhead Key, as well as two residences which are used seasonally for staff housing. NPS personnel are stationed on Loggerhead key during the summer months to monitor sea turtle and shorebird nesting.

Background Preparation

In October of 2021 WS entered into a cooperative service agreement with the NPS. Several site visits involving WS, USDA National Wildlife Research Center (NWRC), and NPS staff were taken prior to the eradication effort in order to assess and develop a strategic eradication plan. During these site visits, 20 rats were collected from DRTO and saved for later genetic and toxicological analysis at NWRC.

In December 2021 WS field staff visited Loggerhead Key to cut transects for later deployment of bait stations. This network of transects allowed access to the entire island and placement of bait stations on a 30m × 30m grid. Utilizing a strict network of bait stations on the 30m × 30m grid ensured every rat on the islands had access to the rodenticide. Similar methods had previously been utilized by WS in various successful black rat eradication projects, including Egmont Key, FL, which was completed in 2008 (Witmer et al. 2009).

In January 2022, a 30m × 30m grid of bait stations was placed over the four islands. We utilized Bell Protecta Tamper-Proof Bait Stations, which provided secure weather resistant housing for the toxicant. These were elevated at 12 inches on PVC pipe to reduce the chances of hermit crabs consuming the toxicant. Although the toxicant does not negatively affect hermit crabs, they can readily consume the bait and therefore make it unavailable to rats. The secure bait stations were also important to help prevent visitors or pets from accessing the rodenticide. At the time of eradication, visitors were allowed to access Garden Key and Loggerhead Key.

The complexity of Fort Jefferson presented a unique challenge for the eradication effort due to the many floors, rooms, staff housing, powder magazines, and cisterns. Bait stations were placed in every room of the fort and an additional 18 stations were placed on the top of the fort. In addition, a bait station was placed in the residence of and outside every housing unit at the Park. A total of 611 bait stations were deployed throughout the DRTO.

Rodenticide Application

WS evaluated the potential rodenticides to be used for the black rat eradication. The two potential rodenticides evaluated were diphacinone and brodifacoum. The need for, and use of, rodenticides for conservation purposes was reviewed by Florida WS, along with their advantages, disadvantages, methods of use, and potential mitigation measures. We opted for a diphacinone rodenticide (with 0.005% active ingredient) due to its lower toxicity and reduced likelihood of toxic residue accumulation compared to brodifacoum (Witmer et al. 2007b). Moreover, birds exhibit lower susceptibility to diphacinone poisoning than to brodifacoum, as brodifacoum is on average 100× more toxic to birds than diphacinone (California Department of Pesticide Regulation 2018). Dry Tortugas National Park is home to 80,000 nesting sooty terns and 4,500 nesting brown noddies annually, so the need for a rodenticide that would limit the amount of non-target take was prioritized. Diphacinone baits also have been successfully used to eradicate black rats from several islands in the US Virgin Islands as well as Egmont Key, Florida (Witmer et al. 2009). Given the similarity of the ecosystem and environment between Egmont Key and DRTO, uptake and response from rats was expected to be similar.

We utilized Diphacinone-50 Conservation (active ingredient diphacinone 0.005%) for the eradication effort. Registration for Diphacinone-50 Conservation was submitted in September 2021 and granted in November 2021 by the Florida Department of Agriculture.

Rodenticide bait pellets were deployed in bait stations beginning on January 11, 2022 on Loggerhead Key, and January 12, 2022 on Garden, Bush, and Long Key. 8-10 ounces of bait were placed in each bait station. Bait stations were checked daily and bait was refilled in each station as needed to maintain approximately 8-10 ounces of bait. Field staff removed and disposed of any dead rats found during the eradication. The public use areas were patrolled hourly during the eradication period to remove any dead rats as quickly as possible. Bait stations were maintained for 14 days, ending January 24, 2022 on Loggerhead Key and January 25, 2022 on Garden, Bush, and Long Key.

In addition to bait stations, areas of the park that were closed to public access were hand broadcasted with rodenticide pellets at the recommend label rate of 10 lbs per acre. These areas were hand broadcast three times during the control period. Also, there were certain areas that posed a particular problem and needed special attention. Thick vegetation, old brick piles, and structure ruins limited access and could potentially hold rats. Field staff broadcast these areas with rodenticide pellets three times in order to ensure all rats had access to the rodenticide.

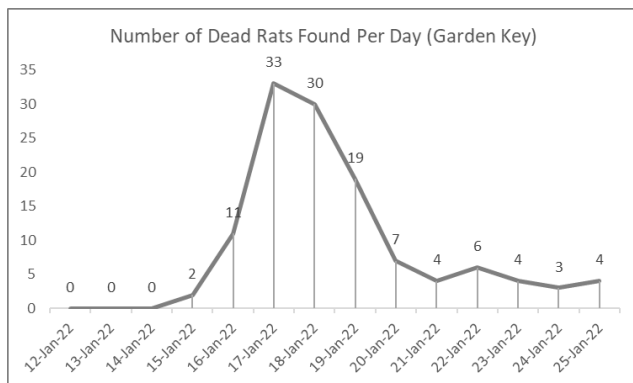


Figure 1. The number of dead rats recovered on the ground during the 14-day baiting operation to eradicate black rats at Dry Tortugas National Park, Florida.

RESULTS

Monitoring for rat activity was conducted at night with the use of thermal imaging optics (FLIR). The FLIR units provided field staff with the ability to watch rats undisturbed at night feeding on the rodenticide and to ensure that all rats were accessing the rodenticide. If a rat was active in an area that lacked bait, a bait station was relocated to that location. The FLIR units were also helpful to ensure that there was no rat activity throughout the park prior to ending baiting operations. No rats were seen with the FLIR units in the last three nights (or 4 days) of baiting.

All dead rats found by WS or NPS staff were removed and recorded. Typically, the rodenticide takes 4-10 days to be lethal on black rats (Witmer 2009). As expected, there was a sharp increase in the number of dead rats found on the sixth day of the rodenticide application (Figure 1). A total of 121 rats were found on Garden/Bush Key, two rats were found on Long Key, and 44 rats were found on Loggerhead Key. It should be noted that all the rats found after January 22, 2022 were starting to decompose and had been dead for several days.

DISCUSSION

Monitoring after rodent eradication is important to ensure the eradication has been successful and to allow a rapid response if any living rats are detected. Due to the number of visitors arriving by boat and seaplane to DRTO daily, the potential for rat reintroduction exists, which is another reason for persistent monitoring. Prior to leaving DRTO, WS and NPS staff setup 10 camera traps and 22 permanent bait stations as a first line of defense and detection. Cameras and bait stations were placed near the docks, boathouse, seaplane beach, and areas of likely reintroduction. NPS staff agreed to check the cameras and bait stations biweekly for any signs of rodent activity. Additionally, a FLIR unit was left with NPS staff to continue night monitoring.

WS conducted quarterly monitorings, each of five days, throughout DRTO for the first year following the eradication, and every six months thereafter. These five-day monitoring periods consisted of surveying 12 100-m-long transects dispersed throughout the island (three on Bush Key, four on Garden Key, four on Loggerhead Key, and

one on Long Key), with each transect consisting of five snap traps and five bait sachets, alternating, each 10m. Traps and bait sachets were elevated to avoid non-target captures and detections.

Visual inspections of the beach and sandy areas were conducted each morning for rat tracks during the monitoring periods. During the monitoring periods the entire fort, staff housing, campground, and maintenance facilities were inspected for any signs of fresh rat activity. Night monitoring with FLIR was conducted each night during the monitoring periods. FLIR optics were used to watch for rats around Fort Jefferson and throughout Garden Key.

Two weeks post eradication, several NPS staff witnessed a rat jump off an unloading barge onto the main dock on Garden Key. Within a week the permanent bait stations in the area showed signs of bait consumption. Two weeks after the event a rat carcass was found in the area. There have been no rat detections since. With 2 years without rats being detected, DRTO's rat eradication in 2022 was declared a success in January 2024. Moving forward, the NPS will sustain strict biosecurity measures to help reduce the chances that rats will again establish on DRTO.

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