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“Rats and Weeds and Lizards—Oh My!” Eradication of *Rattus rattus* and Control of Invasive Exotic Plants on Buck Island, U.S. Virgin Islands

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Introduction

Once introduced to an island, non-native rodents can cause considerable damage to the native flora and fauna, including the endangerment of endemic species (Campbell 1989; Witmer et al. 1998). As a result, there have been numerous efforts in recent years to eradicate introduced rats (*Rattus* spp.) and house mice (*Mus musculus*) from islands around the world (e.g., Buckle and Fenn 1992; Howald et al. 1999; Billing and Harden 2000; Key and Hudson 2000). Problems caused by introduced roof rats (*Rattus rattus*) at Buck Island Reef National Monument, St. Croix, U.S. Virgin Islands, have been documented by the U.S. National Park Service (NPS) for many years (see Witmer et al. 1998). Of particular concern have been the impacts on endangered and threatened species, such as the hawksbill turtle (*Eretmochelys imbricata*), the ground-nesting least tern (*Sterna antillarum*), and the brown pelican (*Pelecanus occidentalis*). Efforts to protect and restore native vegetation, such as the lignum vitae (*Guaiacum officinale*), were hampered by rat foraging. Additionally, the NPS and the U.S. Fish and Wildlife Service (USFWS) have planned to reintroduce the endangered St. Croix ground lizard (*Ameiva polops*) to Buck Island as part of a recovery plan for that species (USFWS 1984). Rat predation poses a serious threat to lizards (Philobosin and Ruibel 1971; Meier et al. 1990) and *A. polops* reintroduction plans. The rats also posed a human health threat to visitors to Buck Island because since they harbor many diseases such as the tick-borne relapsing fever (caused by a *Borrelia spirochete* bacterium) that has been found to occur on Buck Island (Flanigan et al. 1991). Efforts to control the introduced rats on Buck Island have also increased public and territorial conservation agencies’ awareness to threats from exotic pest species.

Buck Island is primarily a tropical dry forest rising to 100 meters in elevation and is comprised of four distinct plant community types including scrub thicket, semi-deciduous dry woodland, mangroves, and a beach forest (Ray 2002). Historic documentation states the island was originally covered by the tropical hard wood species lignum vitae (*Guaiacum officinale*), which was harvested in the late 1700s. During the nineteenth and twentieth centuries, several non-native plants and trees used for domestic purposes were introduced, including African Guinea grass (*U. maximum*), tan-tan (*Leucaena leucocephala*), tamarind (*Tamarindus indica*), aloe (*Aloe vera*), and wild pineapple or penguin (*Bromelia penguin*); the island was grazed by goats and burned to improve forage; and severe changes in annual

rainfall coupled with exotic animal pest predation on fruits and seeds have all impacted native plant survival.

Nineteen out of the 228 plant species are not native to Buck Island Reef NM (Woodbury and Little 1976; Ray 2002). Six invasive non-native species (*Urochloa maxima*, *Leucaena leucocephala*, *Tecoma stans*, *Bromelia penguin*, *Boerhavia erecta*, and *Aloe vera*) on Buck Island were of immediate concern, and three additional invasive exotic plant species (*Melicoccus bijugatus*, *Thespesia populnea*, and *Morinda citrifolia*) on Buck Island are known to exhibit invasive characteristics in the region. One non-native plant species with historical consideration expanding its population on the island was *Tamarindus indica*.

Methods

A strategy to eliminate rats from Buck Island was formulated and proposed in early 1998 and a budget for the project was approved in August 1998. The NPS and the U.S. Department of Agriculture Animal and Plant Health Inspection Service Wildlife Services (WS) completed a study plan for the eradication of rats on Buck Island in April 1999. Under a 1999 interagency agreement, WS conducted an island-wide rat eradication project on Buck Island. In compliance with the National Environmental Policy Act, the NPS prepared an environmental assessment on the proposed rat eradication on Buck Island and a finding of no significant impact was issued on October 19, 1999.

Rat baiting using the anticoagulant rodenticide J. T. Eaton Bait Block (EPA reg. no. 56-42) containing 0.005% diphacinone was proposed. An island-wide 40 by 40 m grid pattern was mapped, and at each grid intersection point a bait station was established in the field. Baiting began on the island's shore in October 1999. Forty-four black plastic bait-stations—"Rodent Baiter" (Bell Laboratories, Inc., Madison, Wis.) measuring 23 by 18 by 10 cm (with a 6.5 by 6.5 cm opening in each end) were placed on the ground. Four bait blocks (peanut butter/molasses flavored) were placed in each station and maintained by checking the stations every day for two weeks and every three days thereafter. Hermit crabs (*Coenobita clypeata*) were observed feeding at the stations after the first three days of baiting and were possibly preventing rat access. All bait stations were subsequently moved to elevated locations by being stapled or cable-tied to tree trunks and tree limbs approximately two meters off the ground. No rats were captured in snap traps after two weeks of baiting, suggesting rat control along the shoreline areas.

Prior to establishing bait stations island-wide, a new station mount was created to deter crabs. The plastic bait stations were elevated to about 20 cm off the ground using a wire platform. The first island-wide baiting was conducted April 11–21, 2000, by distributing bait to all 428 stations. Bait was checked in every station every day for ten days. The first dead rat was observed on April 16, and by day seven the smell of decaying carcasses was apparent throughout the island. Snap traps were established at every other bait station (210 snap-traps) during non-baiting times and operated for three consecutive nights with only one rat captured.

The second island-wide baiting operation was conducted from May 2–14, 2000. Rat sign was observed early in the baiting operation, but by the second week, evidence of rats was

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gone. During this baiting session hermit crabs and birds took the majority of the bait. On May 11, a pearly-eyed thrasher (*Margarops fuscatus*) was observed taking bait out of a bait station. During this baiting session, least terns returned to the island and established a nesting colony on the open sand beach with over 40 adults, 17 nests and 28 eggs. No rat predation of tern adults, chicks, or eggs was observed.

The bait station mount was again modified to reduce access by hermit crabs and birds. The final configuration allowed rats to jump up to the bait station and access the bait while making it very difficult for birds landing on the bait station to get into the box. Tests with captive rats revealed that the rats could readily access the bait in the modified bait station containing bird and hermit crab excluder devices.

The final island-wide baiting was conducted from June 9–22, 2000, using these newly modified station mounts. Seventy-seven stations were fitted with bird excluder devices. The only bait that was consumed occurred when a bait station lid detached and the bait fell onto the ground—crabs were suspected of consuming that bait. On July 10–13, 2000, all bait was removed from the stations. On August 16–20, 2000, no rats were captured on the three original rat snap-trap lines and two new additional lines (north and east lines).

In 2003, the NPS Florida Partnership Exotic Plant Management Team (EPMT) was expanded to include the Caribbean park units, in line with the geographic boundaries of the NPS South Florida and Caribbean Inventory and Monitoring Network. The Caribbean extension of the team operates from the same organization and budget as the original Florida team, which was founded in 1999. An NPS staff liaison in Florida and one in the U.S. Virgin Islands coordinated with staff of area national parks and expert local citizenry to organize and prioritize invasive exotic plant removal projects in the parks. Contracted labor is utilized to conduct the work on the ground. The liaison supervises the contractor as a contracting officer representative in the field, providing technical expertise and tracking contractor performance.

In the spring of 2003, Buck Island Reef National Monument's Division of Resource Management attained funding to begin an invasive non-native plant control and management program on Buck Island. Coordination among monument staff and staff of the Florida/Caribbean EPMT (which brought additional funding to the project) led to the formulation of the project in August 2003. Utilizing the existing island-wide grid system (40 by 40 m) established by the park for the tree rat eradication project, and the existing trail system, the island was systematically treated. The ten target species were controlled by basal and foliar application of herbicide as described below. The method of treatment varied according to targeted species. Every effort was made to minimize non-target species damage during herbicide application and crew transit over the island. All herbicides and rates of usage had prior approval from the NPS Florida/Caribbean EPMT and Buck Island Reef National Monument Division of Resource Management.

- Grasses (*Urochloa maxima*) and Boerhavia (*Boerhavia erecta*): Foliarly spray to wet using compression or backpack sprayer with Glyphosate in water solution at a concentration of 4%.
- Woody vegetation (*Leucaena leucocephala*, *Tecoma stans*, *Melicococcus bijugatus*, *Thes-*

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pesia populnea, *Tamarindus indica* and *Morinda citrifolia*): Basally apply Triclopyr (in vegetable oil carrier) to entire stem(s) circumference above ground (between where the foliage starts and ground) at a concentration of 30% (using compression or backpack sprayer).

- Aloe and wild pineapple (*Aloe vera* and *Bromelia penguin*): Apply Triclopyr (in vegetable oil carrier) at a concentration of 30% to apical growth of each plant (using compression or backpack sprayer).

Results

The five rat snap-trap lines described above were operated again during December 15–18, 2000. No rats were captured, suggesting that the rat population on Buck Island had been eliminated. However, part of the project strategy was to continue monitoring the island for the presence of rats, by use of the standardized rat snap-trap lines, because a small group of rats on some part of the island may have been missed or because they could, again, be accidentally introduced. Annual post-project monitoring sessions using this method have yielded no rats captured to date. Island vegetation appears very robust with much new growth and a profusion of flowers and fruits. Fruits and seeds have even been observed, undisturbed, on the ground. There appeared to be more bird and lizard activity. Observations of this nature were very rare prior to rat eradication. NPS personnel reported more bird nesting activity by ground doves (*Columba palmerus*), white-crowned pigeons (*Columba leucocephala*), and Bahama ducks (*Anas bahamensis*) than in the past on Buck Island. No rat predation on sea turtle nests has been observed since 2000.

Since 2004, annual contractor visits to treat invasive exotic plant species on Buck Island have reduced the coverage of six of the targeted species (*Melicoccus bijugatus*, *Thespesia populnea*, *Morinda citrifolia*, *Aloe vera*, *Tamarindus indica* and *Bromelia penguin*) to fewer than 10 individual plants detected per species, per visit, island-wide. During the annual visits, any individuals of these species encountered are removed. The remaining four species (*Urochloa maxima*, *Boerhavia erecta*, *Leucaena leucocephala*, and *Tecoma stans*) were initially present in greater abundance, and have proven more persistent. However, the coverage of these species has been reduced island-wide by 95% through repeated treatments. African Guinea grass (*Urochloa maxima*) remains as the most persistent invasive species found in most island habitat types, occurring in 63 of the 176 total acres. Tan tan (*Leucaena leucocephala*), the second most persistent species, was found on 20 of the 176 acres. Removal costs to date have cumulatively totaled approximately US\$250 per acre, including labor, materials (including herbicide) and logistics (including crew travel).

Discussion

In response to floral and faunal ecological impacts, a sustained effort to eradicate the rats from Buck Island from 1998–2000 was undertaken. The island-wide grid of elevated bait stations using an anticoagulant rodenticide bait block was effective in eradicating the rats. The bait stations were modified several times to assure ready access by rats while minimizing access by non-target animals. Post-project snap-trapping has resulted in no rat captures, further suggesting that rats have been eradicated. Field personnel observed no non-target

losses as a result of the baiting program and a rapid recovery of many of the island's floral and faunal resources. The rat eradication project has also heightened local awareness of threats posed by exotic, introduced species in the Caribbean.

The mosaic of native flora on Buck Island continues to provide recruitment for areas where invasive exotic plants have been treated and removed. Persistence in the treatment program (in perpetuity) will continue to reduce coverage of targeted species while providing suitable sites for native plant recruitment. Herbicide treatment requirements decrease as targeted species decline in coverage, while treatment of and non-target damage to native plant species has been well below acceptable levels.

The combination of the eradication of *Rattus rattus* and the control of invasive exotic plant species on Buck Island demonstrates that an integrated pest management strategy is both fiscally and ecologically effective at restoring floral and faunal communities in a Caribbean island. Perpetual monitoring and maintenance will be required to ensure current positive results are not lost, and Buck Island remains a suitable location for the translocation of the federally endangered St. Croix ground lizard (*Ameiva polops*).

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