

THE ERADICATION OF INTRODUCED RATS AT BUCK ISLAND REEF NATIONAL MONUMENT, ST. CROIX, U.S. VIRGIN ISLANDS

FINAL REPORT

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ABSTRACT

The US National Park Service (NPS) and Department of Agriculture Wildlife Services (WS) conducted an island-wide tree rat (*Rattus rattus*) eradication and established a rodent monitoring program at Buck Island Reef National Monument. These introduced rats caused substantial damage to the island's flora and fauna, including threatened and endangered species. An anticoagulant (0.005 % diphacinone) rodenticide bait-block was distributed in elevated bait stations on an island-wide grid. The bait stations were modified several times to assure ready access by rats while minimizing access by non-target animals. Post-project trapping sessions resulted in no rat captures, suggesting rats have been eradicated from the island. The baiting program had minimal impact on non-target species and a recovery of island's flora and fauna has been documented. Post-eradication rodent monitoring has revealed the presence of a growing house mouse, *Mus musculus*, population on the island. Threats and potential management strategies are being assessed.

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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., Billing and Harden 2000, Buckle and Fenn 1992, Howald et al. 1999, 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*) (Fig. 1), the ground-nesting least tern (*Sterna antillarum*), and the brown pelican (*Pelecanus occidentalis*). Efforts to protect and to restore native vegetation such as the lignum vitae (*Guaiaacum officinale*) are also being hampered by rat foraging (Fig. 2). 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 (Meier et al. 1990, Philobosin and Ruibel 1971) and the reintroduction plans. The rats also pose a human health threat to visitors to Buck Island because rats can harbor many diseases such as the tick-borne relapsing fever (caused by a *Borrelia spirochete* bacteria) that has been found to occur on Buck Island (Flanigan et al. 1991). An effort to control the introduced rats on Buck

Island would also increase public and territorial conservation agencies' awareness to threats from exotic pest species.

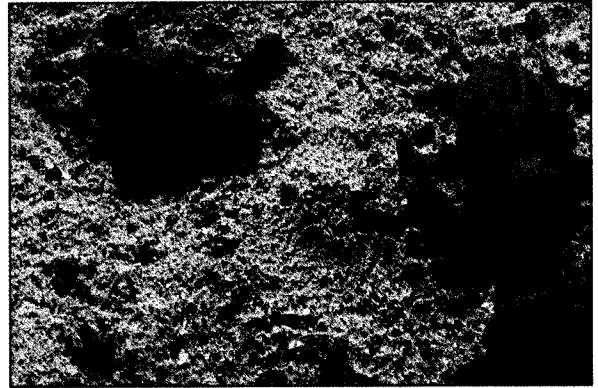
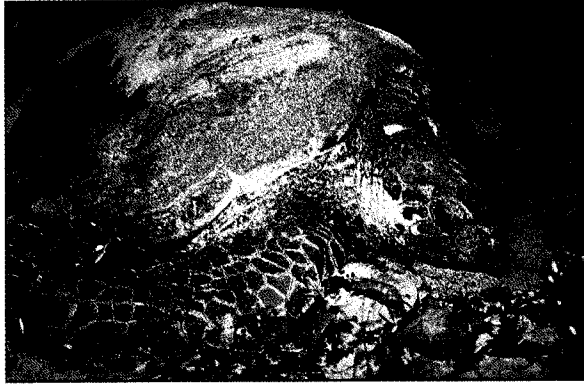


Figure 1. Endangered hawksbill sea turtles at Buck Island: an adult female and hatchlings.



Figure 2. Threatened and endangered species impacted by rats at Buck Island.

The NPS requested the U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) Wildlife Services' (WS) assistance to evaluate the potential for a rat eradication project on Buck Island in 1998. WS biologists visited the NPS in St. Croix and Buck Island in February 1998. The visit included meetings in St. Croix with personnel of several agencies and fieldwork on Buck Island. Using snap-traps attached to the trunks of trees and shrubs, 80 rats were captured (Table 1) from 3 trap lines (Dietrich's, Tower, and West lines) over a 3-night period (Fig. 3).

Table 1. Results of rat snap-trapping sessions during the Buck Island rat eradication project, 1998-2001.

Date	Location	No. of Snap Traps	No. of Nights	No. of Rats Caught	No. of Mice Caught
Feb-98	D, T, W lines*	45	3	80	0
Aug-99	D, T, W lines*	50	3	72	0
Oct-99	Beach and picnic areas	30	1	0	0
May-00	Island-wide	210	3	1	0
Aug-00	D, T, W, E, N lines*	93	3	0	0
Dec-00	D, T, W, E, N lines*	93	3	0	67
Apr-01	D, T, W, E, N lines*	93	3	0	104

*Code to snap trap lines: D = Dietrich's, T = Tower, W = West, E = East, N = North.

Consequently, a low-to-moderate density (by Caribbean standards), but healthy rat population was documented to exist on Buck Island and substantial damage to vegetation was noted (Witmer et al. 1998). A strategy to eliminate rats from Buck Island was formulated and proposed (Witmer et al. 1998). The NPS submitted a budget for the rat eradication project on April 23, 1998 that was approved in August 1998. NPS and WS completed a study plan for the eradication of rats on Buck Island in April 1999. An Interagency Agreement (No. 1443IA5000099005) between the NPS and WS was finalized in August 1999. Under this agreement, WS worked under NPS supervision to conduct an island-wide rat eradication project on Buck Island.

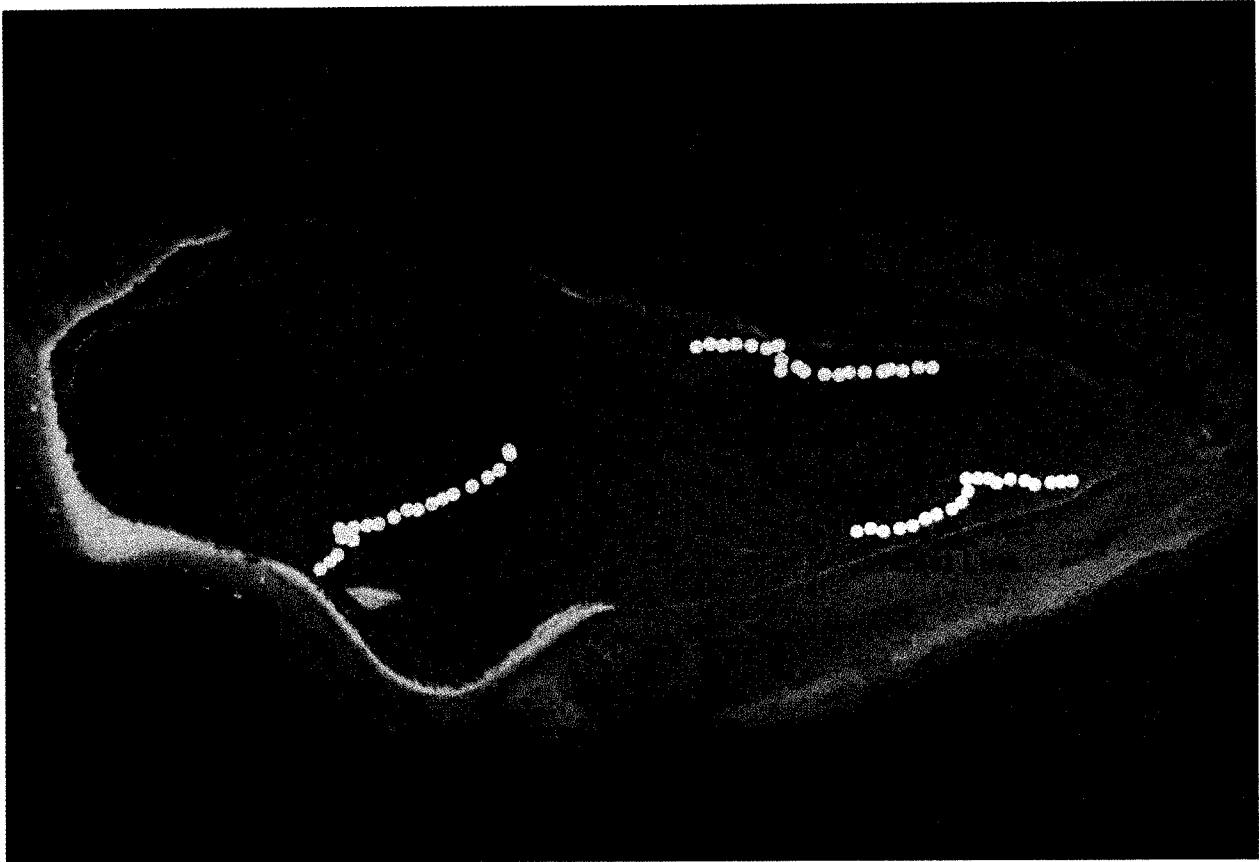


Figure 3. Buck Island aerial view with the snap trap locations. Dietrich, tower, and west trap-lines were used prior to baiting. North and east lines were added to facilitate rodent monitoring.

Prior to the start of this project the NPS instituted a "Pack-it-in, Pack-it-out" policy to reduce the rat problem on Buck Island. This action was taken to eliminate the trash generated by visitors in the picnic areas. These materials drew rats closer to the beach areas and provided a food source for rats. To inform the public about the new policy the NPS made public service announcements in local newspapers, radio programs, and television (Appendix I). Signs were posted in both picnic areas of Buck Island asking the public to take all their picnic trash off the island. The policy was implemented in August 1999, and WS field crew removed all trash receptacles from the island at this time.

This final report documents the details and results of the rat eradication project as conducted under the interagency agreement.

BACKGROUND PREPARATION

In compliance with the National Environmental Policy Act (NEPA), the NPS prepared an Environmental Assessment (EA) on the proposed rat eradication on Buck Island (Appendix II). It was distributed to the public for comment in August 1999. A public hearing was held in St. Croix on September 8, 1999. There was no attendance by the general public and no public comment was received. Comments from other groups or agencies (St. Croix Environmental Association, USFWS, U.S. Department of Agriculture Natural Resources Conservation Service, Virgin Islands DPNR Division of Fish and Wildlife) were in favor of the rat eradication project. The NPS issued a Finding-of-No-Significant-Impact (FONSI) on October 19, 1999 (Appendix III).

One of the first steps in the project was to obtain regulatory authority to use an anticoagulant rodenticide for the rat eradication, specifically for use on conservation lands. Background information along with discussions of the advantages and disadvantages of anticoagulants were presented in publications by Hadler et al. (1999), Timm (1994), and WHO (1995). It was necessary to apply for a registration with the U.S. Environmental Protection Agency (EPA) and the Government of the U.S. Virgin Islands, Department of Planning and Natural Resources (VIDPNR). The rodenticide bait selected was the J. T. Eaton Bait Block (EPA Reg. No. 56-42), a large, wax bait block containing 0.005% diphacinone that has been used in the U.S. for rodent control in and around buildings for many years. Registrations were sought for two formulations of bait

blocks (peanut butter/molasses flavored and fish flavored) to help assure that a flavor acceptable to the rats would be available. Some of the criteria and considerations in the selection and application of a rodenticide bait for rodent control in natural settings were summarized in Witmer et al. (1998). An application for registration was submitted to the VIDPNR in June 1999. Subsequently, two registrations were received: VI-970001 for the use of fish-flavored bait blocks and VI-970002 for peanut butter/molasses-flavored bait blocks (Appendix IV).

In preparation for the baiting program, a final check on the rat population was conducted in August 1999, using the same three snap-trap lines as used in the original survey (February 1998). Seventy-two rats were captured over the 3-night period (Table 1), whereas 80 had been captured in the first trapping session. These results indicated little to no change in the rat population from that documented in February 1998.

NPS worked with the WS team to develop a digital shoreline map of Buck Island. Using ArcView 3.2a (ESRI, Inc.), a 40 m by 40 m grid pattern was superimposed on this map. Each intersection point on the grid was labeled alphanumerically and became an individual bait station location (Fig. 4).

The bait stations were located using a handheld GPS unit. Initially a Trimble DGPS (Trimble Navigation, Inc., Sunnyvale, CA) was used. This was later replaced by a Garmin GPS 48 (GARMIN International, Inc., Olathe, KS) with a MBX-3 Beacon Receiver and MGL-3 GPS/DGPS Antenna (Communications Systems International, Inc., Calgary, Alberta), to lay out the grid. A database was created, using MS Access, to track rat bait consumption, habitat conditions, and vegetation surrounding each bait



Pending the registration for island-wide baiting, work was begun to mark and clear trails for the island-wide grid system for bait stations (Fig. 5). The use of gas-powered string trimmers fitted with special brush blades was necessary.



Figure 5. Locating and flagging bait stations with differential GPS and cutting trails.

Development of the trail system was an extremely laborious task and it was made even more difficult by the Island's steep slopes, the poisonous plant species, and the thorny thickets. Trail cutting was a four-person task: one person wearing the DGPS backpack unit, one person with machete and flagging tape, and two persons using brush cutters worked together to make narrow trails (maximum width was 1 meter) through the brush.

The task was begun in September 1999 and completed in February 2000, with intermittent breaks from the work because of problems with the GPS units and the occurrence of Hurricane Lenny in November 1999.

East-west parallel trails were cut across the island with each trail about 40 m from those adjacent to it. Bait stations were placed along each line at intervals of about 40 m. Trails were flagged with orange tape and bait station locations were identified by pink flagging tape. The bait station alphanumeric code was written on the flagging tape.

This activity resulted in the establishment of 428 bait stations. A portion of two grid lines (stations G19-G27 and F29-36) in the northeast part of the island occurred in a very steep area. Because it was considered unsafe for personnel to access those bait sites, bait blocks were thrown into those locations from corresponding stations above or below them (Fig. 4).

BAITING PROGRAM

Preliminary Baiting

Prior to cutting trails across the Island and beginning the island-wide baiting program, a preliminary baiting action was conducted along the shoreline turtle-nesting habitat. This action was taken 1) because the beach and picnic areas are critical nesting area for three species of sea turtle and the NPS sought relief from rat harassment of female turtles attempting to lay eggs and from the predation on eggs and hatchlings that follows, and 2) to assure that the bait blocks would be acceptable to, and effective on, the rats. Because the island-wide registration had been requested from the Virgin Island's Government, but not yet been obtained, only the beach and picnic areas were baited. These areas were within 40 meters of buildings or structures; such baiting was legal under an existing registration (EPA Reg. No. 56-42).

This first baiting was conducted in early October 1999 (Table 2). All bait station locations along the shoreline and one tier back from the shoreline were baited. Forty-four commercially available black plastic bait-stations ("Rodent Baiter" [Bell Laboratories, Inc., Madison, WI] measuring 23 by 18 by 10 cm with a 6.5 by 6.5 cm opening in each end) were initially 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. After the first three days of baiting, it was apparent that hermit crabs (*Coenobita clypeata*) were consuming the majority of the bait and possibly preventing rat access (Fig. 6). All bait stations were then moved to elevated locations. Bait boxes were stapled or cable-tied to tree trunks and tree limbs approximately 2 meters off the ground (Fig. 7). After two weeks of baiting, snap traps were set at every bait station location to determine the effectiveness of the baiting (October 14 - 15). No rats were captured suggesting that the bait was working to control rats along the shoreline areas. Hurricane Lenny, November 17, 1999, brought a halt to the baiting. When baiting was resumed, heavy concentrations of biting ants were a problem at many of the bait stations. There was concern that perhaps the ants were biting the rats when they attempted to access the bait. Bars of bait covered in ants were found in the bait stations and on the ground below the bait stations. This suggested that the rats had gotten to the bait, pulled it out of the boxes to get it away from the ants, and abandoned it because of the ants. Pending the decision on how to



Figure 6. Hermit crabs in bait station.

control the ants, all baiting was stopped. Ants were sent to experts at Auburn University and the University of Florida for identification; they were later identified as fire ants (*Solenopsis invicata*) and a treatment was recommended by the NPS Integrated Pest Management Program Coordinator in Atlanta and employed during the island-wide baiting that followed.

*Photo
changed
ZJS 4/9/03*

Table 2. Rodenticide bait block applications during the Buck Island rat eradication project, 1999-2000.

Date	Location	No. of Bait Stations	Bait Station Placement and Type	No. of Bait Blocks (flavor)
Oct. '99 (6 wks)	Beach & picnic areas	44	On ground three days, then stapled to trees	4 (peanut butter/molasses)
Apr. '00 (2 wks)	Island-wide	428	On wire platform, about 20 cm above ground	3 (peanut butter/molasses)
May '00 (2 wks)	Island-wide	428	On wire platform, about 20 cm above ground	2 (peanut butter/molasses)
June '00 (2 wks)	Island-wide	428*	Mounted on re-bar with PVC around it, about 26-30 cm above ground	2 (fish)
Sept.-Oct. '00 (2 wks)	Beach & picnic areas	52**	On wire platform for 2 days, then on re-bar as described in text	2 (peanut butter/molasses) plus 2 fish

* Includes 77 bait stations with bird excluders. ** Includes 26 with bird excluders.



Figure 7. Bait station E-2 on a tree and 0-2 on a wire platform.

Island-wide Baiting

Prior to establishing all of the bait stations, a new station mount was created to try and deter crabs. The plastic bait stations were elevated to about 20 cm off the ground, using a wire platform (Fig. 7). This system also added consistency because some station locations were not near a tree or shrub to which the plastic bait station could be attached. Additionally, two insecticides (Amdro Fire Ant Insecticide Granules and Raid Ant and Roach Insecticide Spray) were used to reduce the ant problem. They were only used at stations with heavy concentrations of ant; their use seemed to help deter the fire ant problem.

The first island-wide baiting was conducted April 11 - 21, 2000 (Table 2). A crew of seven persons distributed bait to all the Island's bait stations numbering over 400. Three peanut butter/molasses-flavored blocks were added to each station and replenished as needed to maintain 3 blocks per station. Bait was checked in every station every day for ten days. The following data were collected: bait consumption (which was equal to the amount of bait added), animal visitations, and treatment (insecticide, non-target interference). Vegetation data were also collected in the vicinity of each bait station. Initially, the crew saw signs that rats were consuming the bait: stations emptied of bait, rat feces in the boxes, and fur on the bait station openings. The first dead rat was observed on April 16 and by day seven, the smell of decaying carcasses was apparent throughout the island.

During the "off period" snap traps were established at every other bait station totaling about 210 snap-traps, island-wide (Table 1). One trap was always placed at

each end of the grid line. The traps were operated for three consecutive nights and only 1 rat was captured (Fig. 8).



Figure 8. Snap trap at station F-28 with a dead rat.

The second island-wide baiting operation was conducted from May 2 - 14, using 2 bait blocks, of the same flavor (peanut butter/molasses), per station (Table 2). A team of four persons conducted the baiting, dividing the island in half (north to south) with half the island's bait stations being checked each day. In the beginning of this baiting period, there were signs of rats, but by the second week, evidence of rats was 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. It is possible that birds may have been a bigger consumer of bait than was suspected. During this baiting session least terns returned to the island and established a nesting colony on the open sand beach. On May 25, over 40 adults and 17 nests with 28 eggs were counted. WS crew looked repeatedly for any sign of rats in or near the colony and none was found. However, visitors and dogs repeatedly disturbed the colony (even

though dogs are not allowed on the island) and the nesting site was abandoned by the end of June. The colony failed not because of rats, which had been a significant problem in the past, but because of a lack of NPS control of visitors and their pets in the nesting area. This situation will be remedied with the return of ranger patrols in fiscal year '03.

Prior to undertaking the final island-wide baiting, the bait station mount was again modified to reduce access by hermit crabs and other terrestrial non-targets, specifically the pearly-eyed thrasher (Fig. 9, Table 3). Each bait station was affixed about 25 cm above the ground to one end of a vertical steel stake ("re-bar"; 60 cm long and 1 cm diameter) that was driven into the ground 10 cm leaving 0.5 m above the ground. Each box was attached to the rebar in a vertical orientation by cable ties held in place by steel washers, which prevented the plastic box from tearing in the wind. A section of PVC pipe (25 cm long and 6 cm diameter) was first placed over the steel stake. The PVC pipe, which has a smooth surface, prevented the hermit crabs from climbing up the rebar and into the bait station. On stations where birds were observed to be a problem, an additional section of PVC pipe was inserted into the bait box to reduce access to the bait by birds (primarily the pearly-eyed thrasher). A length of PVC pipe (30 cm long with 6 cm diameter) with a 9 by 6 cm diamond cut from the middle of its side was inserted horizontally through the bait station access holes, leaving 4 cm protruding from each end (Fig. 9). This device 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 with the bird and hermit crab excluder devices.

Table 3. Bait station placements and modifications during the Buck Island rat eradication project, 1999-2000.

Order of Use	Box Orientation	Description of Bait Station Used
1 (first)	Horizontal	Plastic bait box (commercially available; 23x18x10 cm with 6.5x6.5 cm opening on each end) placed on ground surface
2	Vertical	Plastic bait box (described above) stapled to tree
3	Horizontal	Plastic bait box (described above) on wire platform about 20 cm off ground
4	Vertical	Plastic bait box (described above) attached to re-bar (steel stake, 76 cm long, 1 cm diameter), vertically driven into ground with a 25 cm long PVC pipe, 6 cm diameter, placed around the re-bar) with cable ties, the box 26-30 cm above the ground
5 (last)	Vertical	As described above (4), but with "bird excluder" (25 cm long PVC pipe, 6 cm diameter, with a 5x5 cm diamond-shaped section cut out of the center) inserted through the openings in the bait box

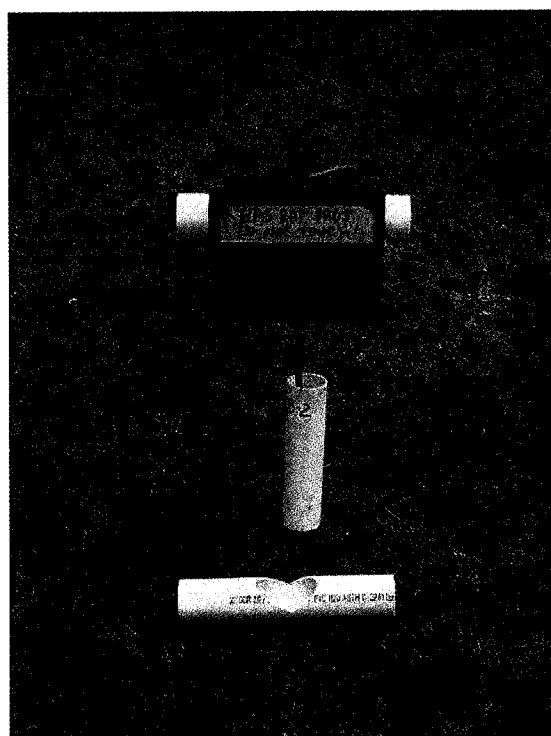
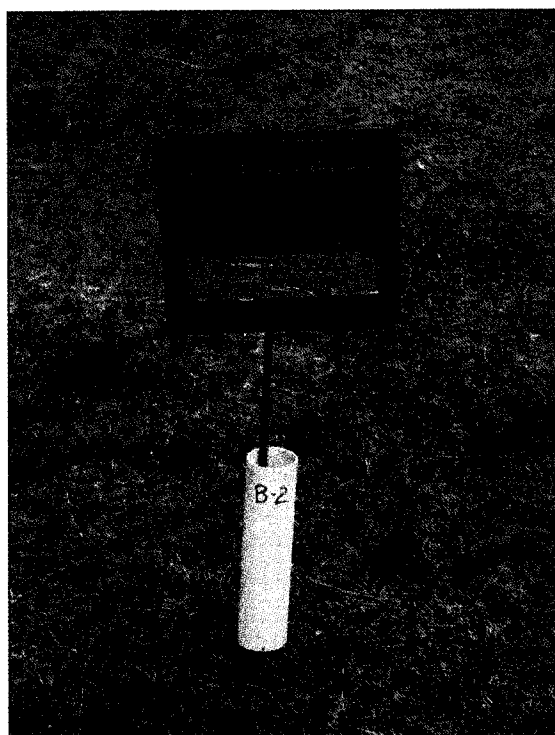


Figure 9. Bait station modifications to exclude hermit crabs and birds.

The final island-wide baiting was conducted from June 9 - 22, 2000, using these newly modified station mounts. A team of three persons conducted the baiting by dividing the Island into three roughly equal areas with the bait stations of one area checked each day. Seventy-seven stations were fitted with bird excluder devices. The fish-flavored bait was introduced, using two bait blocks per station (Table 2). The bait "switch" was done so that any remaining rats that were not attracted to the original flavor (peanut butter/molasses) might be attracted to, and succumb to, the alternately flavored bait block. The only bait that was consumed occurred when a bait station lid detached and the bait fell onto the ground. It was believed that crabs then consumed the bait. On July 10 - 13, 2000, all bait was removed and bait remaining in each station was noted. On August 16 - 20, 2000, the 3 original rat snap-trap lines were run along with the addition of two new lines (North and East lines; Fig. 3). No rats were captured (Table 1). During both the May and June island-wide baitings, the WS crew observed white-crowned pigeons (*Columba leucophala*) and ground doves (*Columbaigalina passerina*) nesting throughout the island. The brown pelican (*Pelecanus occidentalis*) rookery was active with adult birds establishing nests. These wildlife observations were very encouraging.

During September 2000, NPS personnel were monitoring 1,500 meters of turtle-nesting shoreline at night. One technician momentarily observed a "rat" near the salt pond along the south-central shore of the island. As a result, the original bait stations (described under "Preliminary Baiting" above) around the beach and picnic areas were re-established along with an additional 8 bait stations around the salt-pond to ensure adequate coverage where the "rat" was observed. These bait stations were maintained

with 4 bait blocks each (2 of each flavor) until the end of October (Table 2). Initially, both platform and re-bar style station mounts were used, but the platform stations were changed to re-bar stations only after a few days because of the high number of crabs observed in the platform stations. Twenty-six of the stations also included bird excluder devices. All bait was removed from the island on November 15, 2000.

During the island-wide baiting operations, WS personnel spent considerable time walking the grid lines that extended over the entire island. Despite being instructed to look for them, no non-target carcasses (e.g. birds or crabs) were observed by personnel during the many months of work on the island.

The total weight of rodenticide bait purchased for the project was 754 kg with 208 kg remaining at the end of project. Consequently, about 546 kg of bait was applied on Buck Island to complete the rat eradication. This amount of rodenticide bait would contain about 0.027 kg (= 27 g) of active ingredient (diphacinone).

POST-BAITING OBSERVATIONS

The 5 rat snap-trap lines described above were operated again during December 15 -18, 2000 (Table 1). 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. The first post-project monitoring session was scheduled for April 2001.

During the December trapping session, NPS and WS personnel looked for fresh sign of rat gnawing on vegetation and also for signs of active burrows. No fresh gnawing was observed and no rat droppings were found on plants or at burrow or other openings into the soil. Indeed, the vegetation appeared very robust with much new growth and a profusion of flowers and fruits. Fruits and seeds were even observed, untouched, on the ground. There appeared to be more bird and lizard activity. Observations of this nature were very rare during past trips to the island. NPS personnel reported seeing more bird nesting activity than in the past. For example, nesting by ground doves (*Columbaigalina passerina*), white-crowned pigeons (*Columba leucophala*), and Bahama ducks (*Anas bahamensis*) were commonly observed. It is especially noteworthy that the sea turtle monitoring team reported no rat predation on sea turtle nests in the 2000 - 2001 nesting season, which ended in March 2001. It will require a period of monitoring to document whether the least tern population is benefiting from the rat eradication. Also during the December trip, very little trash was observed along the beach, trails, or at the picnic areas. It appears that the "Pack-it-in, Pack-it-out" strategy is being successful and the NPS is continuing the policy.

Interestingly, during the rat trapping session of December 2000, in which no rats were captured, 67 house mice were captured in the rat snap-traps (Table 1, Fig. 10). Mice were captured on all 5 snap-trap lines (range = 7 - 31 mice per line), suggesting an island-wide distribution. It is intriguing that during the entire previous rat trapping, no mice were captured and that mice had never been reported as occurring on the island. (In 1994, there was one unsubstantiated sighting of a "hopping mouse" on the over-island trail. At the time this was presumed to be a juvenile rat). Presumably, this

introduced rodent species has been present all along, but its population and activity was perhaps greatly suppressed by the rats. House mice are common on many of the islands and cays of the Caribbean (e.g., Dammann and Nellis 1992). They can cause considerable damage to vegetation and predation on eggs and very small animals, although probably not as severe as that caused by rats (Key et al. 1996, Miller and Miller 1995). The NPS may need to consider a project to further assess and monitor the house mouse population should future management action be required.

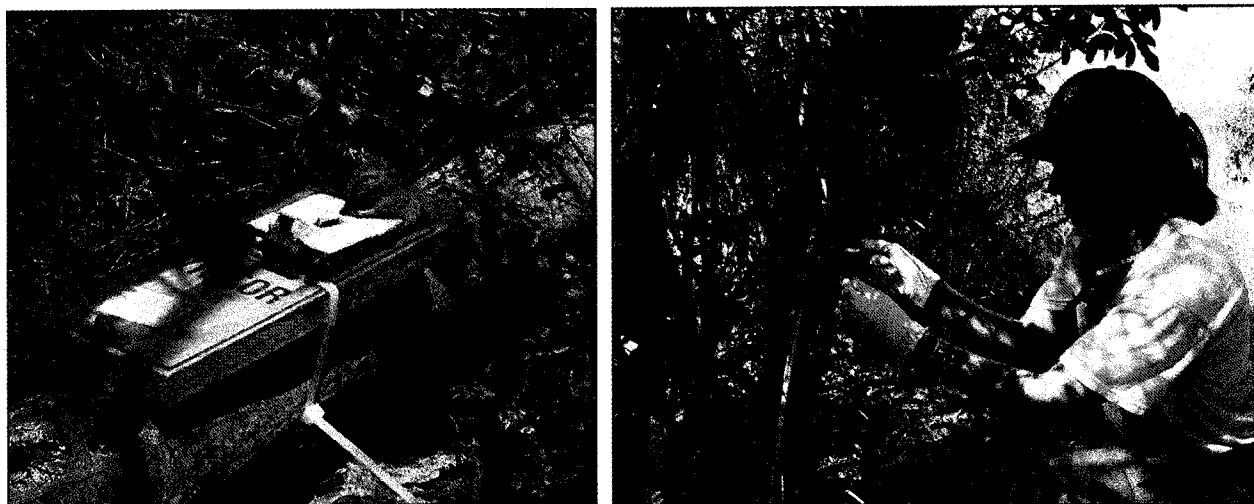


Figure 10. Mice (*Mus sp.*) caught in the rat snap-traps at Buck Island.

MONITORING PROTOCOL

In the original project proposal, it was strongly recommended that a rodent monitoring protocol be designed and implemented by the NPS for the indefinite future (Fig. 10). A monitoring protocol would serve several important functions. It would assure the NPS that the rats had, indeed, been eradicated from Buck Island. It would provide a long-term, consistent, systematic source of information on the rat and mouse

populations on Buck Island. The protocol could extend beyond rodent monitoring and include an assessment of the vegetation, noting especially any rodent damage. The monitoring protocol would provide the baseline information needed should any modification of the rodent management program be necessary. Finally, it would give the NPS time to respond to a new reintroduction of rats to the Island before the rat population becomes widespread and abundant, and substantial natural resource damage begins to occur.

For consistency, it is recommended that the 5 snap-trap lines (Fig. 3), used in the eradication project, be used by the NPS for the basis of the rodent monitoring protocol. The traps can be set, baited, and operated for 3 consecutive nights as had been done on several occasions before. The trap locations have been recorded by GPS and provided to the NPS for use in future monitoring. The traps could be removed at the end of each monitoring session so that they are not damaged or obtrusive to the public. It is recommended that, initially, the monitoring be conducted 3 - 4 times per year. After a year or so, this rate could be dropped to 2 times per year. The NPS should also establish one or more vegetation monitoring transects. Selected species of plants subject to rodent damage in the past along the transects should be permanently marked so that their condition and any damage can be recorded periodically. Elements of the vegetation monitoring should include an assessment of plant recruitment and changes in native/non-native plant community composition and abundance.

The first rodent monitoring session was conducted April 18 - 21, 2001. The park added additional funds to the WS agreement with the NPS so that WS could conduct the monitoring session. The 5 snap-trap lines were operated for 3 nights and no rats

were captured (Table 1). It is important to note, however, that 104 house mice were captured. This is about 50 % more than the 67 captured in December 2000, using the same trapping effort. During the trap session some gnawing of woody vegetation was observed along the East trap line, presumably by mice. In addition to food, the mice may have been seeking moisture from the plants, as the weather had been very dry for an extended period. Also, the grassy habitat where the gnawing occurred provides excellent habitat for mice and this area is where the highest rate of mouse capture occurred.

WS scientists also conducted a brief bait efficacy trial with some captive mice from Buck Island during the April 2001 rodent monitoring period. The objective of the trial was to determine if the house mice may have survived the rat baiting operations because of a resistance to the anticoagulant (diphacinone) toxicant used in the project. This outcome was recently documented as an unexpected result of a rat eradication project, using the anticoagulant warfarin, on an offshore-island of Australia (Billing 2000, Billing and Harden 2000). In the WS trial, 7 of 9 (78 %) treatment mice succumbed to the rodenticide bait, whereas 9 of 9 (100 %) control mice (fed a commercial rodent chow) survived the 7-day no-choice trial. This suggests that resistance to the bait used on Buck Island was not responsible for the survival and irruption of mice on Buck Island. Other possibilities include that the elevated bait stations were inaccessible to the mice or that rat activity and the small home ranges of the mice (relative to rats) precluded access by mice to the 40 x 40 m island-wide bait station grid set for rats.

During the April 2001, rodent trap monitoring session, field personnel noted a large expansion of the brown pelican (*Pelecanus occidentalis*) colony on the north side

of the island (Fig. 11). Many more adults, juveniles, and active nests were observed over the December 2000 visit to the area. Over the last ten years, seasonal nesting averaged 20 - 30 nests, whereas in April 2001 over 100 nests were counted with an average of 2 - 3 chicks per nest. It is unknown, however, whether or not this is related to the rodent control efforts and the subsequent recovery of vegetation.

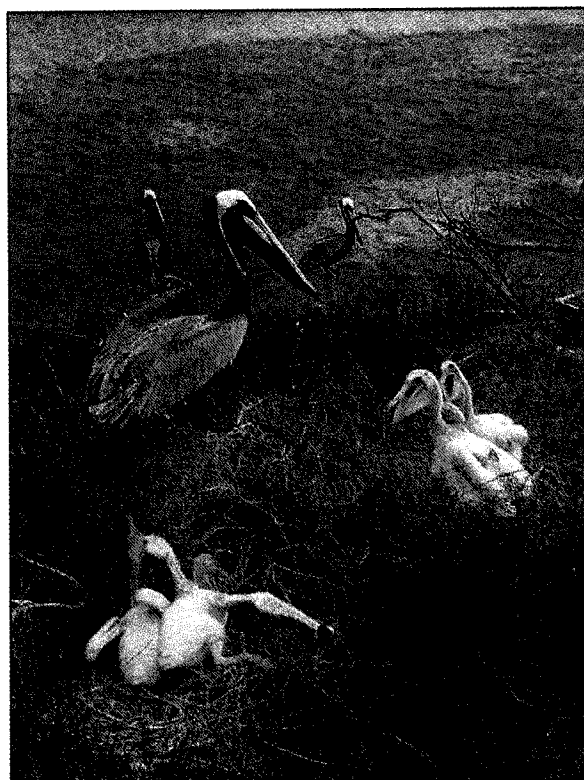
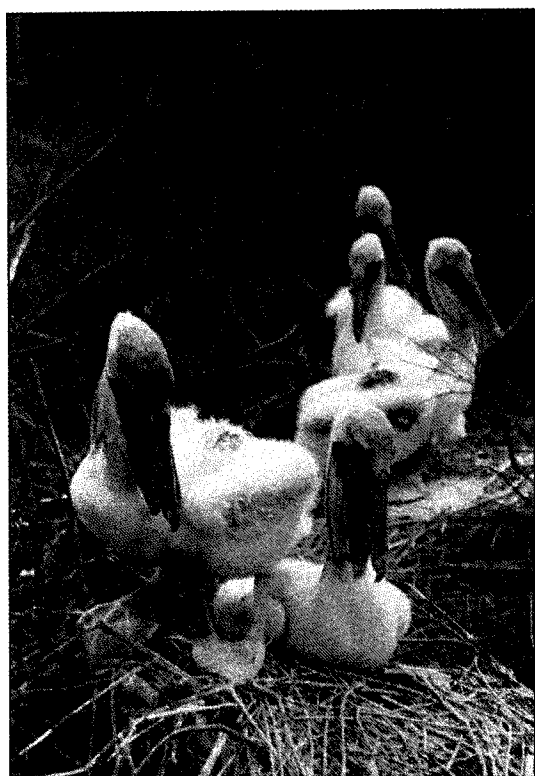


Figure 11. Juvenile and adult brown pelicans (*Pelecanus occidentalis*) in the north side rookery at Buck Island.

CONCLUSIONS

The National Park Service, with Wildlife Service cooperators, made a planned and sustained effort to eradicate the introduced roof rats from Buck Island Reef National Monument from 1998 - 2000. The rats were causing substantial damage to a variety of Buck Island's floral and faunal resources. WS established an island-wide grid of elevated bait stations and used an anticoagulant (0.005 % diphacinone) rodenticide bait block to eradicate the rats. The bait stations were modified several times to assure ready access by rats while minimizing access by non-target animals. Several post-project snap-trapping sessions resulted in no rat captures, suggesting that, indeed, the rats had been eradicated from the Island. Field personnel observed no non-target losses as a result of the baiting program. They noted what appeared to be a rapid recovery of many of the Island's natural resources, both floral and faunal. Hence, it appears that all the objectives of this project have been achieved: the rats have been eradicated; the recovery of rare, endangered or threatened plant and animal species is occurring; the island can now be used as a re-introduction site for the St. Croix ground lizard; and the disease threat posed by rats and their ecto-parasites has been greatly reduced (although perhaps not eliminated because house mice may carry some of these same ecto-parasites).

It is also suspected that the press releases, processes, and outcomes of this project have heightened the public and agency awareness of threats posed by exotic, introduced species. A post-eradication rodent monitoring protocol has been implemented. Post-project monitoring sessions revealed the presence of a house mouse population (another introduced species) on the island. The threats posed by, and

potential management strategies for this introduced pest species should be assessed by the NPS.

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