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Abstract Many invasive rodents have become established in the United States and its territories. The species include several species of *Rattus*, house mice (*Mus musculus*), Gambian giant pouched rats (*Cricetomys gambianus*), ground squirrels (*Spermophilus parryii*), nutria (*Myocastor coypus*) and marmots (*Marmota caligata*). These rodents have caused serious impacts to native flora and fauna, agriculture, and other resources. Since the early 1990s, agencies have been eradicating rodents from various islands, primarily for conservation purposes. Of about 40 eradication attempts, 22 (55%) appear to have succeeded. For several islands, however, it is too early to determine if the attempted eradication has been successful or not. In the case of failed eradications, rapid re-invasion by rodents from nearby islands may be the reason. Numerous additional eradications are planned. We review the eradications, both successful and unsuccessful, that have occurred in the United States. Most eradications involved the use of the anticoagulant rodenticides diphacinone and brodifacoum. Rodenticides have been applied by hand-broadcast, bait station deployment, and aerial broadcast. We briefly review the strategies and methods used in eradication projects and the efforts to mitigate potential non-target and environmental impacts.

Keywords: *Rattus*, rodent, rodenticide

INTRODUCTION

Introduced rodents pose a serious threat to the native flora and fauna of islands (Moors and Atkinson 1984; Veitch and Clout 2002; Engeman *et al*. 2006). Rodents can be prolific on islands where they have few or no predators. Their omnivorous foraging has led to the endangerment or extinction of numerous island species (Moors and Atkinson 1984; Witmer *et al*. 1998; Veitch and Clout 2002; Engeman *et al*. 2006,). Most seabirds that nest on islands have not evolved to deal with mammalian predators and are very vulnerable to introduced rodents and other species introductions. There has been a concerted worldwide effort to eradicate introduced rodents from islands with numerous successes (Howald *et al*. 2007). These efforts have relied heavily on the use of rodenticides (Howald *et al*. 2007; Witmer *et al*. 2007c). In this paper, we review the strategies and methods used and success with rodent eradications from islands in the USA. We also provide the first comprehensive list of attempted eradications.

INVASIVE RODENT INTRODUCTIONS AND DAMAGE

Many species of terrestrial vertebrates have been introduced into the United States and its territories (Witmer *et al*. 2007b; Witmer and Fuller 2011). The most common introductions are the commensal rodents, which have been widely introduced around the world (Long 2003). They include: Norway (*Rattus norvegicus*), ship (*R. rattus*), and Pacific (*R. exulans*) rats and two subspecies of house mouse (*Mus m. musculus, M. m. domesticus*). Other non-native rodents that have been introduced include nutria (*Myocastor coypus*, Carter and Leonard 2002) and Gambian giant pouched rats (*Cricetomys gambianus*; Engeman *et al*. 2006). Species native to the mainland and introduced to some islands include Arctic ground squirrels (*Spermophilus parryii*, Ebbert and Byrd 2002) and hoary marmots (*Marmota caligata*, United States Department of Interior 2010). It is possible that there have been undocumented introductions of other native rodents (deer mice, *Peromyscus* spp., and voles, *Microtus* spp.) to some islands for research purposes. Long (2003) reviewed the many rodent introductions around the world.

Rodents were introduced to islands for a variety of reasons and by various pathways. Most arrived accidentally as a result of shipping, shipwrecks and inadvertently landed with stores by landing parties. Some, possibly including hoary marmots, were introduced as a source of subsistence food for people. Other species, such as Arctic ground squirrels, were introduced as a food source of foxes that were introduced to islands for fur harvest. Nutria were introduced to numerous states and islands for the fur industry. Gambian giant pouched rats were introduced indirectly as escapes from the pet industry (Long 2003; Engeman *et al.* 2006).

Several types of damage have been caused by rodent introductions to the United States (Hyngstrom *et al*. 1994). A major impact is harm to native flora and fauna, including species endangerment and extinction with implications for ecosystem structure and function. In some cases, such as in the Hawaiian Islands, there has been substantial damage to agriculture, including crops in the field and stored foods. Rodents are also responsible for disease hazards such as plague and monkeypox (Meerburg *et al*. 2009).

PLANNING CHALLENGES

Planning and conducting a successful invasive rodent eradication from islands poses many challenges and should not be undertaken without a thorough commitment and adequate resources. The basic tenets of a successful eradication are: all individuals must be put at risk; animals must be removed faster than they can reproduce; and the risk of immigration must be zero (Parkes and Murphy 2003).

An eradication attempt that is 99% successful can ultimately result in 100% failure. Because of the large commitment of resources and public funds in eradication efforts, the potential for failure should be minimised. At times, as was the case with the giant Gambian pouched rat population in the Florida Keys, there was inadequate knowledge about the ecology of the invasive species in its newly invaded "habitat" (Witmer and Hall 2011). Obstacles to success can include inadequate funding and public support. Many people are sensitive to – or even strongly opposed to – the use of chemicals and lethal methods on public lands. People and non-target animals may disturb or damage traps or bait stations. Refused access to properties can be an impediment to eradication. People may provide food and water outdoors for pets or for feral cat colonies that then becomes available to the invasive

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rodents. Monitoring rodent populations when they are at low density is problematic. This presents the difficulty of detecting a newly-arrived invasive rodents or completing the final (and necessary) "mop-up" operation to get the last few rodents in an eradication effort. These issues make the achievement of a successful invasive rodent eradication a real challenge, especially in inhabited areas.

Agency reports and some personnel communications suggest that early eradication attempts in the USA involved relatively little planning or situation evaluation. In recent years, there has been more extensive planning, more pre-eradication monitoring of invasive rodent populations and potential non-target animals (especially threatened or endangered species), and increased efficacy testing of methods and rodenticides. Additionally, environmental assessments are now completed to assure that the proposed action is justified, in compliance with state and federal laws and regulations, and that the hazards to the environment and non-target animals will be minimal or adequately mitigated. Public involvement and support are usually incorporated as well. The steps involved in planning and implementing a robust eradication strategy with a high probability of success involves:

Preliminary monitoring and research
Feasibility of eradication
Regulatory compliance
Public information and communications media
Public support
Technical assistance and operations
Planning
Logistics
Procurement of equipment and other services
Monitoring and research
Staff recruitment and training
Implementation
Contingency planning
Follow up monitoring
Implementation of a bio-security plan

RODENT ERADICATIONS

We learned of 40 rodent eradication attempts in the United States and its territories (Table 1), some of which were on clusters of islands (e.g., Midway Atoll, Anacapa Islands, Bay of Islands). Most historic attempts were not well documented, so some may have been overlooked. The list is considerably longer than one presented by Howald *et al*. (2007), mostly because of an increase in the rate of attempts in recent years (e.g., 12 since 2004).

Of the 40 attempted eradications, 22 (55%) were successful (Table 1). For some failed attempts, it is difficult to know if the eradication failed or there was a relatively rapid reinvasion. This can be the case when target islands are near others that still have rat populations capable of natural dispersal. This was recently documented by Russell *et al*. (2005) in which case a radio-collared Norway rat swan 400 m from one island to another. This ability of rats may have affected eradication success in the Bay of Islands (Dunlevy and Scharf 2007). Molecular genetics have become a powerful indicator of whether the reappearance of rodents has been in response to a failed eradication or a subsequent re-invasion. For example, analyses of rat DNA on Congo Island suggests that rats found on the islands shortly after an eradication attempt were probably survivors, not invaders (Antoinette Piaggio pers. comm.). The 2-year rule of thumb is frequently applied after eradications: if no rodents are detected for the following 2 years with relatively intensive monitoring, the eradication can be considered successful (Howald *et al*. 2007; Witmer *et al*. 2007c).

Just over half (about 55%) of the islands were less than 20 ha. Some larger islands have been cleared of rats in recent years (e.g., Rat Island; 2900 ha). Aerial broadcast baiting has allowed the larger islands to be attempted more efficiently. Now that many of the methods and logistics of conducting island rodent eradications in the United States have been worked out and numerous successes achieved, we can probably expect more successful eradications. Planning for other island rodent eradications is already under way.

Approaches to Rodent Eradications

About 27 island eradications (67.5%) of rodents in the United States used the first generation anticoagulant diphacinone (0.005% active ingredient). In contrast, worldwide island rodent eradications most commonly used the second generation anticoagulant brodifacoum (Howald *et al*. 2007). Only nine eradications on islands (22.5 %) in the United States used brodifacoum (0.0025% active ingredient). In at least two cases, both diphacinone and brodifacoum were used and in a few cases bromethalin or bromadialone were used, but only in conjunction with brodifacoum. Currently, the USDA Animal and Plant Health Inspection Service (APHIS) has two rodenticides registered with the United State Environmental Protection Agency (EPA) for island conservation purposes: one formulation of diphacinone pellets and two formulations of brodifacoum pellets (Witmer *et al*. 2007c).

Most eradications (about 75%) used bait stations, often in conjunction with some hand broadcasting of baits. Hand broadcasting was usually in cliff areas and/or dense vegetation thickets. In recent years, there has been a trend towards aerial broadcast of rodenticide pellets from helicopters, using calibrated buckets and GPS guidance systems to help assure complete island coverage (Howald *et al*. 2005). The APHIS rodenticide registrations for conservation uses have allowed this to become more commonplace.

Reducing Non-Target Species Hazards

Rodenticide use poses risks of primary hazards through direct consumption and secondary hazards through the consumption of poisoned animals. Substantial efforts are made to minimise the loss of non-target animals which are often the resources that eradications of rodents aim to protect. On many islands, the risks to non-target mammals from rodenticide use are non-existent or very low because there are few, if any, species of native terrestrial mammals. The main safeguard for the safe use of rodenticides in conservation efforts is carefully following the EPA-approved label instructions for the product. Other basic considerations include the rodenticide product used; when, where, how and how much of it is applied; cleaning up spills promptly; and not using rodenticides in areas where there are highly valued or protected wildlife, as determined by pre-operation monitoring.

Other mitigation measures used in island eradication efforts are often selected on a case-by-case basis. The timing of bait application (especially with broadcast baiting) may be done after migratory birds have left the island to reduce their chance of direct or indirect exposure (Howald *et al*. 2005). Bait pellets can be large enough to help assure that they will not be consumed by small granivorous birds and pellets coloured dark green or blue can reduce their visibility to birds and lizards. Specially-designed bait stations can be used to restrict access by non-target species (e.g., Witmer *et al*. 2007a).

Table 1. Invasive rodent eradications in the United States with question marks denoting projects that need additional monitoring to confirm a successful eradication.
Species: e = *Rattus exulans*, r = *R. rattus*, n = *R. norvegicus*, m = *Mus musculus*, C. = *Cricetomys gambianus*, y = *Myocastor coypu.*
Toxins: brod = brodifacoum, brom = bromethalin, broa = bromadialone diph = diphacinone, zinc = zinc phosphide.
Methods: b = bait stations, h = hand broadcast, t = traps, a = aerial broadcast, sn = snares, sh = shooting.
Status: Y = successful, F = failed, R = reinvasion

Region Island	Area (ha)	Spp	Year Erad.	Toxin	Method	Status	Reference
Pacific Ocean							
Rose Atoll, American Samoa	6	e	1990-92	brod, brom	b, t	Y	Murphy and Ohashi 1993
Palmyra I., Line Islands	230	r	2001	brod	b	F	Howald e*t al*. 2004
Cocos I., Guam	33.6	e, m	2009	brod, diph	b, t, h	Y?	Lujan pers. comm.
Midway Atoll Spit & Eastern, HI	134	r	1994-95	brod, brom	t, b	Y	Murphy, unpubl.
Kure Atoll, HI	105	e	1993	brod, brom	t, b	Y	Murphy, unpubl.
Mokoli'i I., HI	1.5	r	2002	diph	t, b	Y	Smith e*t al*. 2006
Mokapu I., HI	4	e	2008	diph	a	Y	Dunlevy pers. comm.
Lehua I., HI	125	e	2009	diph	a	F	Dunlevy pers. comm.
Anacapa Is. (3), CA	296	r	2001-02	brod	a, h	Y	Howald e*t al*. 2005
Bering Sea							
Rat I., AK	2900	n	2008	brod	a	Y	Howald pers. comm.
Bay of Islands, AK (12 I.)	0.1-17.8	n	2003	diph	b, h	most F or R?	Dunlevy and Scharf 2007
Caribbean Sea							
Monito I., PR	15	r	1993, 1998-99	brod, broa	b, h	1st F, 2nd Y	Garcia e*t al*. 2002
Steven Cay, USVI	0.8	r	1983	diph	h	Y	Pierce pers. comm.
Dog Cay, USVI	4.8	r	1983	diph	h	Y	Pierce pers. comm.
Kalkun Cay, USVI	1.4	r	1982	diph	h	Y	Pierce pers. comm.
Ruth Cay, USVI	14	r	2007	none	t	Y?	Pierce pers. comm.
Green Cay, St. Croix, USVI	5.2	r	2000	none	t	Y?	Pierce pers. comm.
Buck I., St Croix, USVI	72.7	r	1999-00	diph	b, h	Y	Witmer e*t al*. 2007a
Dutchcap Cay, USVI	12.9	r	2004	diph	b, h	Y	Pierce 2007
Saba I., USVI	12.3	r	2003	diph	b, h	Y	Pierce 2007
Capella I., USVI	9	r	2005	diph	b, h	Y	Pierce 2007
Buck I., St. Thomas, USVI	16.8	r, n	2005	diph	b, h	Y	Pierce 2007
Congo Cay, USVI	10.6	r	2004, 2006	diph, brod	b, h	both F	Hall *et al.* 2006, Pierce 2007
Gulf of Mexico							
Egmont Key, FL	112	r	2009	diph	b, h	Y	Hall pers. comm.
Grassy Key, FL	400	c	2007-cont	zinc	b, t	F	Hall pers. comm.
Chesapeake Bay							
Blackwater NWR	5200	y	2004	none	t, sn, sh	Y?	Kendrot and Sullivan 2009

Raptors and/or scavengers have sometimes been taken into captivity or temporarily relocated to reduce their exposure to animals consuming the bait (Howald *et al*. 2005). Endemic species of rodents can be held in captivity and a breeding colony can even be established. Collecting and removing or burying rodent carcasses can reduce risks of secondary poisoning, but often few carcasses are found because many rodents die underground. If single aerial broadcast-baiting with brodifacoum pellets is effective for rodent eradication then that approach may reduce the time bait is available to non-target animals versus repeated placement of bait by hand or in bait stations or several broadcasts. In the United States, generally two aerial bait drops are used to help assure a successful eradication. Valued or protected animals on some islands may require that bait is not placed in some areas (e.g., enclosures or pens); in these cases, invasive rodents are removed from the bait-protected areas by the use of live-traps or other means. Similar measures may also be instigated to protect fresh water bodies from bait ingress. Extra diligence must be exercised when threatened or endangered species are present as these species are protected under federal and/or state laws (e.g., Endangered Species Act, Migratory Bird Protection Act).

In general, impacts to non-target species during invasive rodent eradications should be considered in terms of population-level effects, rather than the effects to individuals, and in terms of the "greater good' that is achieved from a successful eradication. While there will probably always be some losses of non-target animals, proper precautions should minimise such risk and allow for the rapid recovery of affected populations (Howald *et al*. 2005). Those involved with successful invasive rodent eradications on islands are often surprised at how rapidly the island's flora and fauna recover after rodents are removed (Witmer *et al*. 2007a).

CONCLUSIONS

Seabird populations, sea turtle populations and other island resources warrant protection from invasive rodents. The recovery of fauna and flora on uninhabited islands after a successful rodent eradication is particularly notable (Witmer *et al*. 2007a). The significant impacts of introduced rodents on native flora and fauna have been repeatedly demonstrated. Invasive rodents are very adaptable, can exploit a wide array of resources as food and cover, and can increase reproduction very quickly when and where abundant resources exist (Macdonald *et al*. 1999). While invasive rodents will continue to pose challenges to land and resource managers, they can be controlled or even eradicated with a well-planned and adequately-supported effort using rodenticides. With proper planning, non-target losses will be minimal and these populations, along with other island resources, will often recover quickly after the rodents have been removed.

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REFERENCES

Carter, J. and B. P. Leonard. 2002. A review of the literature on the worldwide distribution, spread of, and efforts to eradicate the coypu *(Myocastor coypus)*. *Wildlife Society Bulletin 30*: 162-175.

Dunlevy, P., and L. Scharf. 2007. Eradication of Norway rats using Ramik Green in the Bay of Islands, Adak Island, Alaska. Unpublished Report. USDI Fish and Wildlife Service, Homer, Alaska. 52 pp.

Ebbert, S. E. and Byrd G. V. 2002. Eradications of invasive species to restore natural biological diversity on Alaska Maritime National Wildlife Refuge. In: Veitch, C. R. and Clout, M. N. (eds.). *Turning the tide: the eradication of invasive species*, pp. 102-109. IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

Engeman, R.; Woolard, J.; Perry, N.; Witmer, G.; Hardin, S.; Brashears, L.; Smith, H.; Muiznieks, B. and Constantin, B. 2006. Rapid assessment for a new invasive species threat: the case of the Gambian giant pouched rat in Florida. *Wildlife Research 33*: 439-448.

García, M. A.; Diez, C. E. and Alvarez, A. O. 2002. The eradication of *Rattus rattus* from Monito Island, West Indies. In: Veitch, C. R. and Clout, M. N. (eds.). *Turning the tide: the eradication of invasive species*, pp. 116-119. IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

Hall, P.; Eisemann, J.; Steen, F.; Witmer, G. and Boyd, F. 2006. Project report: roof rat (*Rattus rattus*) eradication report: Congo Cay, U. S. Virgin Islands. Unpublished Report, Updated January 10, 2007. USDA Wildlife Services, Auburn, Alabama. 11 pp.

Howald, G.; Donlan, C.; Galvan, J.; Russell, J.; Parkes, J.; Samaniego, A.; Wand, Y.; Veitch, D.; Genovesi, P.; Pascal, M.; Saunders, A. and Tershy, B. 2007. Invasive rodent eradication on islands. *Conservation Biology 21*: 1258-1268.

Howald, G.; Faulkner, K.; Tershy, B.; Keitt, B.; Gellerman, H.; Creel, E.; Grinnell, M.; Ortega, S. and Croll, D. 2005. Eradication of black rats from Anacapa Island: biological and social considerations. In: Garcelon, D. and Schwemm, C. (eds.). *Proceedings of the 6th California Islands Symposium*, pp. 299-312. National Park Service Technical Publication CHIS-05-01, Institute for Wildlife Studies, Arcata, California.

Howald, G.; Samaniego, J.; Bucklew, S.; McClelland, P.; Keitt, B.; Wegmann, A.; Pitt, W.; Vice, D.; Campbell, E.; Swift, K., and Barclay, S. 2004. Palmyra Atoll rat eradication assessment trip report. Island Conservation, Santa Cruz, California. 61 pp.

Hygnstrom, S.; Timm, R. and Larson, G. 1994. *Prevention and control of wildlife damage*. University of Nebraska Cooperative Extension Service, Lincoln, Nebraska.

Kendrot, S. and Sullivan, K. 2009. An update of eradication progress for nutria in Chesapeake and Delaware Bay Wetlands. Unpublished Report. USDA Wildlife Services, Cambridge, Maryland. 12 pp.

Long, J. 2003. *Introduced mammals of the world*. CSIRO Publishing, Collingwood, Australia.

Macdonald, D.; Mathews, F.; Berdoy, M. and Deporter, M. 1999. The behavior and ecology of *Rattus norvegicus*: From opportunism to kamikaze tendencies. In: Singleton, G.; Hinds, L.; Leirs, H. and Z. Zhang (eds.). *Ecologically-based management of rodent pests*, pp. 49-80. Australian Centre for International Agricultural Research, Canberra, Australia.

Meerburg, B.; Singleton, G. and Kijlstra, A. 2009. Rodent-borne diseases and their risks for public health. *Critical Reviews in Microbiology 35*: 221-270.

Moors, P. and Atkinson, I. 1984. Predation on seabirds by introduced animals, and factors affecting its severity. *ICBP Technical Publication No. 2*: 667-690.

Murphy, J. and Ohashi, T. 1993. Report of rat eradication operations conducted under specific emergency exemption to use weatherblok containing brodifacoum and assault containing bromethalin in a field situation on Rose Atoll National Wildlife Refuge, American Samoa. Unpublished Report. USDI Fish and Wildlife Service, Honolulu, Hawaii. 18 pp.

Parkes, J. and Murphy, E. 2003. Management of introduced mammals in New Zealand. *New Zealand Journal of Zoology 30*: 335-359.

Pierce, J. 2007. Exotic species control at offshore refuges, U.S. Virgin Island. Unpublished Report. USVI Department of Planning and Natural Resources, Division of Fish and Wildlife, St. Thomas, U.S. Virgin Islands. 6 pp.

Russell, J.C.; Towns, D.R.; Anderson, S.H. and Clout, M.N. 2005. Intercepting the first rat ashore. *Nature 437*: 1107.

Smith, D.; Shiinoki, E. and VanderWerf, E. 2006. Recovery of native species following rat eradication on Mokoli'i Island, Oah'u, Hawai'i. *Pacific Science 60 (2)*: 299-303.

United States Department of the Interior Fish and Wildlife Service. 2010. Environmental Assessment – Invasive species eradication for habitat restoration on Tangik, Poa, and Sud Islands, Alaska. Unpublished Report. USDI Fish and Wildlife Service, Homer, Alaska. 46 pp.

Veitch, C. R. and Clout, M. N. (eds.). 2002. *Turning the tide: the eradication of invasive species*. IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

Witmer, G.; Boyd, F. and Campbell, E. 1998. Rat management for endangered species protection in the U.S. Virgin Islands. In: Baker R and Crabb C. (eds.). *Proceedings of the 18th Vertebrate Pest Conference*, pp. 281-286. University of California, Davis, California.

Witmer, G.; Boyd, F. and Hillis-Starr, Z. 2007a. The successful eradication of introduced roof rats from Buck Island using diphacinone, followed by an irruption of house mice. *Wildlife Research 34*: 108-115.

Witmer, G.; Burke, P.; Pitt, W. and Avery, M. 2007b. Management of invasive vertebrates in the United States. In: Witmer, G.; Pitt, W. and Fagerstone, K. (eds.). *Managing vertebrate invasive species: proceedings of an international symposium,* pp. 127-137. USDA/APHIS/WS, National Wildlife Research Center, Fort Collins, Colorado.

Witmer, G.; Eisemann, J. and Howald, G. 2007c. The use of rodenticides for conservation efforts. In: Nolte, D.; Arjo, W. and Stalman, D. (eds.). *Proceedings of the Twelfth Wildlife Damage Management Conference*, pp. 160-166. Corpus Christy, Texas.

Witmer, G.W. and Fuller, P. 2011. Vertebrate species introductions in the United States and its territories. *Current Zoology 57*: 559-567.

Witmer, G.W. and Hall, P. 2011. Attempting to eradicate invasive Gambian giant pouched rats (*Cricetomys gambianus*) in the United States: lessons learned. In: Veitch, C. R.; Clout, M. N. and Towns, D. R. (eds.). *Island invasives: eradication and management*, pp. 131-134. IUCN, Gland, Switzerland.