

Ship rat reinvasion of Tawhitinui Island

Prepared for The Department of Conservation

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Background

Tawhitinui Island (22ha) lies in Tennyson Inlet off a small settlement at Elaine Bay, approximately 500m offshore. Awaiti Island (2ha) lies a further 200m east (Fig. 1). Both islands are Scenic Reserves and were the focus of intense trials in 1983 and 1982 respectively by Rowley Taylor, Dave Taylor and the D.S.I.R. into the eradication of ship rats (*Rattus rattus*) from New Zealand islands (Taylor 1984). At that time both islands had established populations of ship rats (at a very low density) and western weka, which died of brodifacoum poisoning. Tarakaipa Island (35ha) lies 1km south with mice and pigs (possums eradicated in 1993 by Pete Brady, DOC).

The Department of Conservation has maintained 'rat motels' and 'yellow submarine' bait stations on all three islands, which are irregularly checked for rodent sign. Tawhitinui has 3 motels and 3 bait stations (Fig. 2), Awaiti 1 motel and 1 bait station (Fig. 2), Tarakaipa 2 motels and 0 bait stations (Ward 2005). Motels on Tarakaipa are regularly interfered with by mice. Motels and bait stations are all weka proof, and contained wood shavings to attract rats who might leave sign (faeces).

In 2000 rat sign (faeces) was found in the northern motel on Tawhitinui. It was not possible to date when this happened between 1986 and 2000 (Ward 2005). In February 2004 further sign was found in the motels on Tawhitinui. Subsequently Victor Professional snap-traps (Pest Management Services, Waikanae) were added to all motels on Tawhitinui in an effort to obtain a specimen. Three rats were caught in late February. At this time it was unknown to what extent, and how long ago, rodents had invaded Tawhitinui.

As part of research into the invasion ecology of rats on New Zealand islands University of Auckland and University of East Anglia researchers wished to investigate Tawhitinui to determine the abundance and catchability of ship rats on a recently invaded island.

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Fig. 1: Aerial photograph of Tawhitinui & Awaitei showing contours and height at summit.

Methods

On 6th May 2005 we landed on the north-western beach of Tawhitinui and made camp at a level area along the track on the ridge above the eastern end of the beach. An older camp site in a less accessible area was located by the motel on the north-west point (Fig 2).

On the first night 17 tracking tunnels (Connovation, Auckland) and 16 waxtags (Pest Control Research, Christchurch) baited with peanut butter and rolled oats were placed around the coast and along the main ridge track.

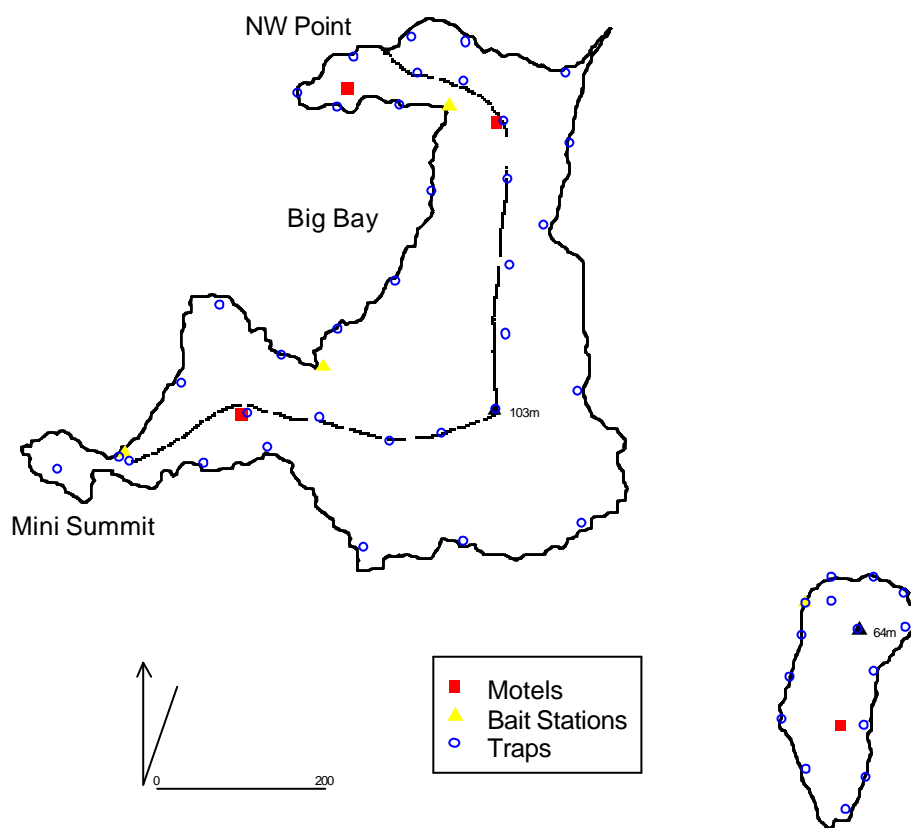


Fig. 2: Map of Tawhitinui & Awaiti showing tracks, traps and DOC stations.

For the following six nights 23 Victor Pro snap-traps were located around the coast and 12 along the main ridge line (Fig 2). These were baited with peanut butter and rolled oats, checked once daily and 'weka-proofed' by covering and facing towards trees and logs, creating a 'U-shaped' entry system which weka would have trouble interfering with without

first disturbing the cover and hopefully setting off the traps, causing no harm to themselves. The spacing of traps approximated a 100m grid across the entire island.

On the final night 16 waxtags were again run along the coast and ridge track.

On the 10th May Steve Ward provided transport on 'Pakaha' to Awaiti, where 13 snap-traps were located around the coast and 2 towards the summit of the island. Five waxtags and two tracking tunnels were also deployed. These were left for 3 consecutive nights before being checked on the 13th May with Karen Mayhew on 'Pakaha'.

Results

Rats were immediately noticed on the first night around the campsite. Two representative juveniles (possibly siblings) caught around the campsite NW point on the 10/05/05 are lodged in Auckland Museum (LM1011 & LM1012).

Monitoring devices

Waxtags were almost 100% disturbed on the first night, indicating a widespread rat population across the entire island. Identical levels of disturbance were found on the final night. Tracking tunnels were not weka-proof and generally were not highly tracked (2/3 not disturbed by weka detected rats). No recent rodent sign was found in any of the three motels.

Night	Tracking Tunnels				Wax tags		
	Tracks present	Tracks absent	Weka disturbed	Total	Touched	Untouched	Total
7/05/2005	8	4	5	17	15	1	16
13/05/2005	-	-	-	-	15	1	16

Table 1: Summary of results from rat presence indicators

Trapping results

	Date	Rats	BG	TNC	Rats per 100 CTN
Tawhitinui	8/05/2005	13	8	13	59.1
	9/05/2005	13	8	11	56.5
	10/05/2005	15	4	6	61.2
	11/05/2005	4	3	9	14.0
	12/05/2005	4	3	4	12.9
	13/05/2005	4	4	7	13.6
	Total		53	30	50
Awaiti	10-13/05/2005	8	5	5	94.1

Table 2: Summary of daily trap status and daily trapping success per 100 corrected trap nights (CTN)

One additional rat was live trapped from seven traps on the first night (7th May).

		Average weight (g)		Average HBL (mm)		Average TL (mm)	
			Range		Range		Range
Tawhitinui	Male (<i>n</i> =23)	135 ± 57	51-212	167 ± 27	120-208	187 ± 30	115-229
	Female (<i>n</i> =29)	137 ± 53	45-266	164 ± 22	110-191	193 ± 30	137-246
Awaiti	Male (<i>n</i> =1)	68	-	136	-	151	-
	Female (<i>n</i> =5)	101 ± 47	66-170	157 ± 20	131-185	181 ± 22	160-209

Table 3: Morphometric measurements of all rats caught by sex

Population demographics

On Tawhitinui 23 males, 29 females and 2 unknowns were caught, and on Awaiti 1 male, 5 females and 2 unknowns were caught. Adult to juvenile and male to female capture ratios were generally similar on Tawhitinui, except more adults of both sexes were caught in the ridge/forest location, as was found on similarly reinvaded Motutapere (MacKay and Russell 2005). On Awaiti more juveniles were caught.

	Sex	Age	Location		Total
			Coastal	Ridge	
Tawhitinui	M	Adult	10	3	13
		Juvenile	9	1	10
	F	Adult	12	6	18
		Juvenile	8	3	11
Unknown		1	1	2	
Awaiti	M	Adult	0	0	0
		Juvenile	1	0	1
	F	Adult	1	1	2
		Juvenile	3	0	3
Unknown		2	0	2	

Table 4: Numbers of adult and juvenile rats caught in each habitat type classified by sex (*n* = 23 coastal, 12 ridge & 13 coastal, 2 ridge)

Some females had discernable ginger fur around their pubic areas. No rats were in reproductive condition, nor were any pregnant or lactating females found.

Some rats could be clearly classified as adult or juvenile based on sexual characteristics. This was not possible for all rats so weight was used to classify these animals as adults or juveniles. All rats 130g or above were classified as adults. This distinction is very arbitrary; the most effective way to age rats is to examine their teeth.

Weka

Over 50% of rats visually checked had some form of injury attributable to weka. Most were incidences of scarring or joint swelling on the tail, although three rats had stumpy tails where the end had been removed and one juvenile had a missing right hind leg (Auckland Museum LM1013).

In total at least 30% of TNCs were attributable to weka, which equates to 7.5% of traps triggered nightly by weka, on an approximate 100m grid.

Two weka were found dead on the island, both dead by triggered traps. Presumably they were stunned by the closing motion of the trap as they withdrew their peck (hence not being caught in traps). One with minor rat gnaw to the left eye is lodged with the Auckland Museum (Temporary Tax. 04-77), while the other was fed upon by native bird predators (harrier and morepork), which had removed the guts through the cloacal region and plucked some feathers from around this region.

A third weka was heard setting off a rebaited trap at 8am on the 12th May on the south-western end of the island. This stunned animal was found in spasm on the beach. It was restrained until it had recovered from shock, and released at which time it ran into a small cave on the shore. Later that morning a bird was observed struggling to remain afloat in the channel by the north-western landing bay. Presumably the same weka had been caught in the cave by the incoming tide and washed out. Jamie MacKay dived in and recovered the animal, which was convulsively shivering. It was retained for an hour passively by James Russell who warmed it up, after which time it ran under a shaded area on the beach where it remained lucidly for the rest of the day. By nightfall it had moved away.

Conclusions

Rats were ubiquitous on both Tawhitinui and Awaitei. It was originally unknown how old the invasion on Tawhitinui was. Neil McLennan (Elaine Bay; 03 5765251) confirms seeing a rat on the foreshore some time in 2002, which given the current large populations on both islands suggests they have been established for some time, at least since 2001, although extensive trapping in February 2001, probably early in the invasion, caught no rats (Ward 2005). This was also the case during the invasion of Motutapere (Chappell 2004). This suggests the invasion is approximately 4 years old. It is most likely rats colonised Awaitei from Tawhitinui, although populations genetics will be need to confirm this. The rats caught on Awaitei were smaller (suggesting juvenile dispersal) and surprisingly female biased (in capture anyway).

Trapping success (CTN) was very high for the first 3 days, at levels that can only be found on offshore islands. This may in part be due to the wide trap spacing (same number of rats, less traps, means a greater proportion of traps may catch rats). On the fourth day trapping success declined markedly to levels more commonly found on the mainland. This probably represents subordinate rats being caught, or possibly new rats migrating into the trapping area. Perhaps on the mainland the dominant rats caught early on are replaced by other dominant species (e.g. stoats, cats), and so rats can only ever be caught at a subordinate species rate (~10%).

Trapping success was very similar to the recently reinvaded Motutapere, starting above 50% but declining to around 10%. On Motutapere more closely spaced traps were run for longer however (MacKay and Russell 2005). Morphology of ship rats on Tawhitinui is very similar to those on Motutapere, except for smaller tails on average, possibly attributable to weka damage. Morphology falls within the range of those described in Innes (2005), though juveniles by arbitrary weight were included here. No scrotal males or lactating/pregnant female rats were found during this May sampling, as found throughout the rest of New Zealand (Innes 2005).

Assuming an approximate 100m grid coverage of half of Tawhitinui (22ha), and trap saturation on Awaiti (2ha), a minimum number caught density estimate is over 4 rats/ha⁻¹ for both islands. Identical rat detection device interference both before and after trapping suggests that rat density was much higher, with many rats still present and possibly only a small proportion of the population sampled.

During trapping some small rats may have managed bait take without setting off traps (causing some BG but not TNC), but generally the Victor Professional snap-traps even catch mice with little bait take (Russell 2005). They are the preferred trap to previous Supreme Ezeset. On Tawhitinui the Victor Professional traps were almost invariably catching rats across the eyes/snout region, resulting in death, but often a lot of blood. This may not have been a clean killing method. It is unknown whether this was attributable to wariness in the rats, or the method of weka-proofing traps requiring rats to flex into the trap. All three species of rats were killed by the neck in the Bay of Islands at a similar time (King 2005).

There was no change in levels of rat interference with waxtags from before to after the trapping. This was surprising and suggests the population of rats on Tawhitinui Island is much greater than the 54 caught, even though a decline in trapping success was observed. Catch-effort modeling suggested a population size of 63 with 95% log-normal confidence interval [50, 79] and individual nightly capture probabilities of 26% constant throughout the trapping period, suggesting that less than ten more rats would be caught before trapping success declined to zero. Given how many rats were probably still on the island, this estimate seems nonsensical, suggesting that catch-effort modeling is flawed through not being able to account for behavioural changes in rats observed here that other more advanced models (e.g. mark-recapture) can account for.

Neil McLennan confirms that weka were present on Tawhitinui around the mid 1990s, hence taking around less than a decade to recolonise. If weka are present on an island then placing waxtags approximately 1m off the ground should prevent interference. This height is excellent for ship rats and Norway rats at high density have been seen also taking these (J. Russell pers. obs.). This was not tested however. Motels are weka-proof but require long-life baiting to remain attractive to invading rats. Victor Professional back side-entrance trap covers (Connovation, Auckland) would be suitable for preventing weka disturbance of snap-traps. Philproof clear heavy-duty plastic tunnels (Philproof, Hamilton) would also be suitable for preventing weka interference of tracking cards.

During the week the vessel 'kaka' was observed moored in Big Bay long-lined to the Southern bay. The skipper John Ward was a ranger on Resolution Island in Fiordland during

the 1970s and claimed to know about the rat problem on islands (Moors *et al.* 1989), although no rat shields were present on the ropes. Despite this and other vessels visiting the island, it is still most likely the island was reinvaded from the adjacent mainland, given the calm natures of the Marlborough Sounds waters (Russell and Clout 2005).

Recommendations

- Eradicate ship rats from Tawhitinui and Awaiti, most likely with an aerial drop of brodifacoum.
- During eradication of ship rats, weka may be live-captured to prevent poisoning, although western weka are stable around the region and would most likely reintroduce themselves within 10 years.
- Maintain yearly checks on 10 permanent Philproof tunnels (weka proof) and rodent motels (recognising they need regular baiting), and possible use of rodent detection dogs.
- If invasion is suspected place fresh tracking cards and deploy an island-wide grid of approximately 30 waxtags containing 10-15% peanut butter. Check both tracking cards and waxtags after one week.
- If invasion is detected respond with island wide trapping (not just around sign) of approximately 30 traps.
- These invasion detection and response methods are interim and not guaranteed to work. Check the latest DOC Island Biosecurity SOP for current best practice methods.

Acknowledgements

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Appendix 1: Bird List

Following Taylor (1984)

Bellbird	+++
Black-backed gull	++
Kereru	+
Fantail	+++
Black shag	+++
Pied shag	++
Finches	+
Waxeyes	+++
Grey Warbler	++
Blackbird	+ (2)
Penguins	+++
Morepork	+++ (3--6)
Kingfisher	+
Greenfinch	++
VOCs	+ (3)
Weka	+++ (10--15)
White-faced heron	+ (2)

+, ++, +++ indicates few, several and many (rare, more than once, daily)

Observed over 7 days and nights.