Efficacy of a community-led rat control programme at Lake Taupo, New Zealand

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SUMMARY

A long-running pest management programme was tested to determine to what extent rats were removed from a 50 ha managed area on the shore of Lake Taupo, North Island, New Zealand. It was confirmed that the trapping protocol employed was effective in catching rats by setting a new trap line in a non-managed area where rats were undisturbed; 64 rats were caught over 10 days. Damage to fake nests, a reliable indicator of the presence of rats, peaked after eight days when 31 of 40 nests were destroyed in one night. The same protocol was then applied in the managed area in comparable forest. Here no rats were caught, and fake nests remained untouched. It was also confirmed that the lack of captures in the managed area was due to effective pest control, rather than to widespread trap avoidance, by using three other methods of monitoring rat presence. It was concluded that the community-led programme was effective in removing rats from the managed area during the nesting season.

BACKGROUND

The community led Pukawa Wildlife Management Trust is based on the south-western edge of Lake Taupo, in the central North Island of New Zealand. Work was undertaken with the Trust to test the efficacy of the standard rat control techniques that are widely implemented around New Zealand.

Black rats *Rattus rattus* are by far the most abundant non-native invasive pests in North Island forests. The Trust, like many other community groups and conservation authorities, is interested in confirming whether it is achieving control of local rat populations and, in consequence, improving local biodiversity protection. It has a network of volunteers running 378 traps and 180 poison bait stations protecting about 50 ha around the village of Pukawa.

The Trust's operation, like most conventional low-level trapping operations, uses a combination of standard single-catch traps, permanently set, plus poison bait stations in spring and summer. Traps are set year-round, and have caught almost 5,000 rats over 10 years, ranging from 348 to 641 a year. In addition, yellow plastic 'Rat Cafés' (poison bait stations containing Ditrac (diphacinone) blocks), designed to be accessible only to rats and mice (Gillies *et al.* 2006) are left in place year-round, but loaded with toxic baits only from August to February. Both traps and bait stations are inspected periodically, but seldom more often than weekly.

This system is disadvantaged by two problems. First, a trap that is set off cannot catch again until the next inspection (Figure 1), so when rats are most abundant, a large number may escape capture. Second, individual rats may vary in their reactions to traps or bait: some may learn to ignore permanent control sites, while others that have had a near escape in the past may be particularly trap or bait shy. Trap records alone will not detect these individuals, and the number of carcases found does not represent the number of rats killed by poison baits. Hence, managers can never be sure whether a lack of trap captures means that all pests have been removed, or that some (perhaps many) animals are present but simply not caught, and/or there has been rapid replacement of those removed.

This paper describes a series of actions and their consequences undertaken together in December-January 2012-2013, designed to measure whether or not the Trust's current pest management programme does in fact remove most rats from the managed area.

Figure 1. A black rat escaping capture by DOC200 trap because another rat was captured first (Photo by Kevin Loe).

ACTION

Firstly, it was necessary to test whether the current pest control regime is effective in a typical fragment of North Island forest where rats were bound to be present in natural numbers because there has been no recent pest control. Therefore a new

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trap line was established at Waihi Kahakahroa 3B2A, a nearby block of unmanaged forest on Maori Trust Land, 2 km from the comparable forest managed by the Trust over the previous ten years. Here, the following widely used, standard methods were employed to remove rat populations in New Zealand, and to check for survivors:-

1. DOC 200 traps. These are approved humane traps (Warburton *et al.* 2008), which always have to be set in a wooden box. The bait is placed in the back of the box, where it can be seen and sniffed from outside through a back wall of wire mesh, but not reached except by entering a small hole in the front mesh and walking across the trap treadle. Whole hen's eggs have become the standard trap bait used wherever daily trap inspections are not possible (Dilks *et al.* 1996). But even whole eggs deteriorate eventually, so the Trust has for some years used white ping pong balls alongside a block of artificial scent lure (Mustelid & Cat Lure, from Cyanide Trappers Ltd, RD2 North Amberley, Canterbury). This strategy depends on the untested assumption that pests are attracted into a trap by a visual cue plus an unrelated scent, rather than by the sight and scent of eggs. Estimates of trap capture rate are conventionally calculated as the number of captures/100 trap nights, after correcting for the number of sprung traps unavailable to the second and subsequent visitors in a night by subtracting half a trap-night for every capture (Cunningham & Moors 1983).

2. Tracking tunnels. Black plastic tunnels and pre-inked Black Trakka© cards are supplied by Gotcha Traps, Auckland (http://www.gotchatraps.co.nz/). Previous research suggests that a one-night tracking index taken immediately before trapping begins can reliably indicate the approximate population density of rats in North Island bush in summer (Innes *et al.* 2010a). During and after a conventional operation, tracking tunnels are routinely used to check for survivors.
3. WaxTags©. These consist of a small block of wax containing an attractive scent (http:// www.nopests.co.nz/) on which animals frequently leave distinguishable tooth marks. The wax is attached to a plastic tag which is nailed to a tree or to the front of a trap box. The system was designed for monitoring possums, and has been confirmed as accurate by calibration against conventional density estimates (Thomas *et al.* 2007). It also records tooth marks left by rats.
4. Fake nests and eggs. One hundred fake eggs (Boulton & Cassey 2006) were made by hand from clay, shaped and painted to resemble the eggs of quails (*Coturnix* sp.) and varnished to give a hard exterior surface. They each had one end of a fine elastic tethering thread, 12 mm long, embedded inside the egg. The free end was tied to a fake nest (a cup of wire netting lined with dry leaves collected from around the nest site), and the fake egg was placed inside alongside two real quail eggs. The finished assembly was installed in a suitable tree or bush at 1.6-2.0 m from the ground, one between each trap site.
5. Cameras. One still camera (Moultrie GameSpy Digital camera Model 135) and two video cameras (LTL Acorn trail model 520A, trigger delay 0.8 sec, Figure 1), were set to record remotely whether any animals visited a site without being caught or taking bait.

In early December 2012 the new trap line was set out in the unmanaged block, using 40 DOC 200 traps 15 m apart, in two halves of 20 traps each, all with a single WaxTag© attached to the box. Each morning for 10 consecutive days the traps and wax tags were checked and replaced as required. Forty fake nests were installed in trees randomly between each trap box at

Table 1. Rat captures during December 2012. The standard index of density (captures/100 corrected trap nights, C/100 CTN, subtracting half a trap-night for every occupied trap) and results of the deployment of fake nests are shown separately for the unmanaged and managed areas.

	Unmanaged area	**Managed area**
Tracking tunnels set, one night	15	9
Tracking papers marked	4 rats (27%), no mice	0 rats, 3 mice (33%)
N traps set (total TN)	40 (300)	17 (130)
Misses[1]	58	0
Rats caught (CTN)	64 (236)	0
Rats caught/ 100 CTN	27.1	0
Fake nests deployed	40, renewed daily	17, all untouched
Rat tooth marks and real egg/s gone	64	0
Rat tooth marks and real egg/s untouched	13	0
Fake egg intact and real egg/s gone	44	0
Fake egg gone and real egg/s untouched	9	0
Both fake and real egg/s gone	40	0
Total fake nests damaged	164	0

[1] Total available trap-nights on which visiting rats failed to enter a trap, but left tooth marks or scats.

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1.6-2.0 m from the ground, each nest with a fake tethered egg and two real quail eggs, and a Wax Tag © at the base of the nest tree, all checked daily and replaced as necessary. Fifteen tracking tunnels were set 50 m apart on for one night, 4-5 December to record a density index for the rats present before any trapping began.

In the immediately subsequent 10 days, the exact same process was repeated within the Trust's managed area, using nine tracking tunnels set on 14-15 December followed by 17 DOC 200s set on 15-24 December. No other trap lines were closer than 100 m away.

CONSEQUENCES

Unmanaged Area: Here, the preliminary one-night tracking tunnel index recorded four visits by rats (27%) and one unidentified animal, but no mice. Tracking index values up to about 30% correspond to a population of 3-5 rats/ha over the first 6 nights of trapping, a typical figure for this habitat and season (Blackwell *et al.* 2002; Innes *et al.* 2010a).

The new trap line (300 trap nights) captured 64 rats over 10 nights (Table 1), plus two hedgehogs and one stoat. On one half of the line, 40 rats were caught in 20 traps, and only one trap site caught nothing throughout, whereas the other half of the line made 27 captures, including the stoat and two hedgehogs, and six trap sites caught nothing. Because the samples were so small, there was no significant difference between the halves in trap capture rate (sign test; p=0.38), but the data do illustrate the patchy distribution of animals through apparently similar forest (Watkins *et al.* 2010).

Damage to the 40 fake nests, recorded in five categories (Table 1), was distributed evenly along the line. Damage was relatively light for the first five days, but increased over time as rats discovered them. The greatest damage was on night eight (when 31 of 40 nests available were damaged) and then decreased as the number of rats available declined. In all, 164 fake nests were destroyed over 10 days.

Video recordings documented rats at nests, and clearly illustrated their ability to remove eggs from nests and cut through the fake egg tethers. Wax tags set in nest trees showed toothmarks of rats 57 times, possums 65 times, and were unidentified three times.

Managed area: Two weeks later, an exactly equivalent operation was run with identical methods using a trap line on the Trust's managed area that had been established in 2003 and set year-round ever since. In the managed area, nine tracking tunnels set for one night (14-15 December) recorded three visits by mice but no rats. No rats were captured in 130 trap nights, and all 17 fake nests remained untouched for the whole 10 days. Wax tags detected the presence of a rat at one nest site and two trap sites, one night each, and possums at three sites, one night each.

Therefore, this operation provided strong but not replicated evidence that very few rats were surviving in the managed area. This conclusion was examined further by testing for trap avoidance and/or rapid reinvasion along the existing trap lines by three further independent methods.

Firstly, from 2-11 January 2013, a test was undertaken to determine whether trap position is critical. This was done by repositioning every second trap in a sequence of 36 DOC 200 traps to ensure that the entrance to the new site is easily accessible from cover or from an animal runway further from human disturbance. The other traps were approached and handled but replaced in the same position. A single WaxTag© was attached to each trap and at random between each trap on trees along the trap line at about 200-300 mm from the ground. For 10 consecutive mornings each trap and each wax tag was checked for tooth marks, and replaced as required. No rats were captured in relocated traps, and only one in a trap in its original position, although wax tags indicated that a very few rats were present.

Secondly, from 18-24 December 2012, a test was undertaken to determine whether rats could be surviving in potential refuge areas between established trap lines, previously equipped only with poison bait stations. This was done by installing tracking tunnels, fake nests, wax tags and video cameras at two sites at least 180 m from any other control line for six nights. Both sites and their camera recordings were checked daily. No rats were detected in either refuge site. One stoat was filmed by the video camera.

Thirdly, from 21-22 to 30-31 January 2013, a test was undertaken to determine whether a visual lure could be made more attractive by adding a scent. On two existing trap lines at opposite ends of Pukawa village, each with 30 DOC 200 traps, every alternate ping pong ball visual lure was sprayed every second day, with fish oil on one line, and peanut oil on the other. Fifteen fake nests were installed per trap line, each with a tethered egg and two real quail eggs between the boxes. A single WaxTag© was attached to each box and at the base of each nest tree, and one randomly between each trap box. Each morning traps, nests and wax tags were checked, cleared, replaced as need be. One rat was caught on each of the two lines, but none of the 30 fake nests was damaged.

DISCUSSION

We showed that (1) the system used by Pukawa Wildlife Management Trust was effective in trapping rats where these were present in an unmanaged area; and (2) when this same proven system was applied inside the management area, it caught no rats at all. We used multiple independent methods to monitor the potential presence of trap/bait shy rats. They offered strong confirmation that very few rats were present but simply avoiding the traps and poison. We conclude that Pukawa Wildlife Management Trust's management strategy, employing traps year-round plus poison from September onwards, had indeed reduced the potential number of rats present surviving in or reinvading the Pukawa bush in spring to very low levels.

Without widespread and on-going predator management, the number of native forest birds on the New Zealand mainland is predicted to continue to decline – especially the (at least) 17 species that need protection, of which only seven are getting any (Innes *et al.* 2010b). The task is far too large for official agencies to tackle, so in practice the only effective front-line troops are community-led conservation groups. Our study provides heartening reassurance that the work of groups such as the Pukawa Wildlife Management Trust is effective in achieving this much-needed local protection.

The scale of the destruction wrought by black rats in forests throughout New Zealand may be compared with the dramatic and well-publicised consequences of the oil spill from the wreck of the *Rena*, a container ship that ran aground on a reef off the port of Tauranga, in the North Island of New Zealand, in the spring of 2010. That was, according to Greenpeace, a

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'shocking', one-off event that killed more than 20,000 birds in the Bay of Plenty over the summer of 2010-2011 (Hill 2012). But in New Zealand nationally, rats and possums kill many more than that number of forest birds, mostly eggs and chicks, every night (JG Innes, pers comm, based on Hill's comparison).

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