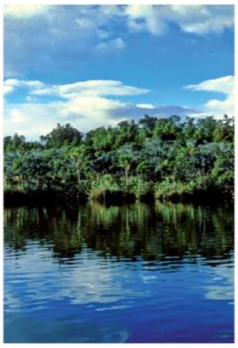

Optimising a kill trap network for cost-effective control of predators in the Hawkes Bay

Landcare Research
Manaaki Whenua

Optimising a kill trap network for cost-effective control of predators in the Hawkes Bay

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As the client, I felt involved in and consulted on the project from the start.	☐	☐	☐	☐	☐
I was kept in the loop about the progress of the project, including any issues or delays.	☐	☐	☐	☐	☐
Any issues I raised or input I provided were dealt with in a responsive way.	☐	☐	☐	☐	☐
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The project met our quality standards.	☐	☐	☐	☐	☐

What impressed you most about this project?

What improvements do you suggest for future projects?

Additional comments?

Contents

Summary

Project and Client

Hawke's Bay Regional Council (HBRC) currently controls a suite of predators (viz. ferrets, stoats and feral cats) within their Poutiri Ao O Tane pest control programme using a network of kill traps. HBRC would like to know if the current density of traps could be optimised to deliver the same control effectiveness, but with fewer traps and therefore lower cost. HBRC contracted Landcare Research to review Poutiri Ao O Tane trap location in 2014–15 and capture data and determine if the trap network could be optimised. The report fulfils Landcare Research's 2014/2015 contracted Milestones 2.6 and 2.7 with Hawke's Bay Regional Council.

Objectives

Determine how the Poutiri Ao O Tane trap network might be optimised for the maintenance control phase by using existing Poutiri Ao O Tane trap data in a simulation model, including three or four scenarios for optimal trap spacings and frequency of checks (30 June 2015).

Methods

- Trap location data and predator capture data were provided by Wildlife and Environmental Trapping Advancements (WETA) for each month from November 2011 to May 2014.
- The final 12 months of data were used to best represent the maintenance phase rather than the initial knockdown phase, and captures were binned in monthly groups to reflect a schedule of checking traps every month.
- Five levels of trapping effort relative to the original layout were simulated: (1) all traps, (2) 75% of traps, (3) 50% of traps, (4) 33% of traps, and (5) 25% of traps. Furthermore, for each of these levels of trapping, we also simulated captures depending on whether the maximum trap capacity at each trap location was 1, 2, 3 or 4 animals.
- An individual-based model was used to simulate captures, and the mean proportion of the original observed number of animals captured was recorded for each of 500 iterations.

Results

- The proportional catch of target species declined with decreasing trapping intensity: 95% of the observed number of target species individuals were caught with 75% of the original number of traps, 89% with 50%, 83% with 33% and 76% with 25%.
- Increasing the trap capacity at each site had no effect on the proportion of target animals captured.
- Of the 690 traps deployed, 71% did not capture any target species in the 30 months from December 2011 until May 2014, 19% caught one target animal, 6.5% caught two, and only three traps caught five animals.

Conclusions

- The simulation results indicate that up to 50% of traps could be removed and still maintain capture of over 90% of the target animals currently trapped.
- In general, the simulation predictions are likely to be conservative because there was no attempt to selectively remove traps based on their past performance.
- Increasing the trap capacity at each site had no effect, which was surprising, but is likely due to a combination of the relatively low density of both target and non-target species (i.e. no localised aggregations), and the length of time between trap checks (i.e. one month was not sufficient for traps to become saturated).
- This initial analysis of the Poutiri Ao O Tane trap data indicates there are potentially significant savings to be made, at least in the maintenance phase of a long-term predator control programme.
- The results need to be treated cautiously because a single capture probability value (g0) was used for the three target predator species, especially for feral cats for which there are few empirical estimates of g0.

Recommendations

Poutiri Ao O Tane:

For continuing the Poutiri Ao O Tane trapping network it is recommended that:

- 40–50% of traps are closed, with preference for closure given to those traps that have had no captures in the past three years.
- Trap sites selected to remain open should have two traps set at each site in order to validate model predictions.
- Traps are checked at monthly intervals for the first 4 months (to compare capture rates with previous data) and as long as capture rates are not higher, then checked at 3-monthly intervals.
- The bait/lure used maintains its effectiveness for 3 months.
- Attempts are made to minimise the number of non-target captures, to reduce potential trap competition between non-target and target species.
- The percent kill obtained from each trapping period is measured to determine the population number for each target species.

Cape-to-City:

For the planned establishment of a kill trap network over the 26 000-ha Cape-to-City predator control programme, it is recommended that:

- Kill traps are established following the same rules as for Poutiri Ao O Tane, but at a lower trap density (70–75% of what is currently in place at Poutiri Ao O Tane).

- Traps are checked at monthly intervals for 6–12 months (depending on capture rates) and then at 3-monthly intervals.
- The bait/lure used maintains its effectiveness for 3 months.
- After 12–18 months (depending on results from Poutiri Ao O Tane), 25-30% of traps are closed for subsequent maintenance control.

Trap network optimisation:

To optimise kill trap networks, it is further recommended that:

- The simulation is improved to account for habitat patchiness and therefore possible predator patchiness across the landscape.
- Three-month capture data are used once these become available.
- Multiple traps at a site should be tested again with the 3-month data.
- Removal of traps from the network is informed by each trap's trapping history, with traps having no captures removed in preference to those traps that have had multiple captures.
- More robust empirical values for g0 are generated, especially for feral cats, and that simulation examines how sensitive the model predictions are to variation in this parameter.

1 Introduction

Hawke's Bay Regional Council (HBRC) currently controls a suite of predators (viz. ferrets, stoats and feral cats) within their Poutiri Ao O Tane pest control programme. This programme covers approximately 15 000 ha and has an infrastructure (network) of about 690 DOC 250 kill traps. Trap-site selection was based on ease of access (to minimise costs) and typical spacing between traps (i.e. 200–300 m). For this programme and for the planned roll-out of a similar programme (Cape-to-City), HBRC would like to know if the same control effectiveness could be delivered with fewer traps and therefore at lower cost. HBRC contracted Landcare Research to review Poutiri Ao O Tane trap location in 2014–15 and capture data and determine if the trap network could be optimised. The report fulfils Landcare Research's 2014/2015 contracted Milestones 2.6 and 2.7 with Hawke's Bay Regional Council.

2 Background

Permanent networks of kill traps have the potential to provide long-term, cost-effective control of vertebrate pests. However, like any network that is established with multiple devices, there is a possibility that the initial number of devices is higher than required for long-term maintenance of a low density pest population. That is, some of the devices may have become redundant, and their removal might reduce the cost of checking and maintaining the network, without reducing its effectiveness. HBRC has been running the Poutiri Ao O Tane predator trapping programme since November 2011, with traps checked, cleared, and rebaited monthly. The initial trap network was established by contractors who had two objectives: (1) maximise effectiveness, and (2) minimise costs. The first objective was achieved by spacing traps at 200–300m, which is currently accepted practice, and the second objective was achieved by locating traps along farm access roads and tracks to enable rapid travel between traps.

The first phase of the programme was to reduce predator numbers, and traps were checked monthly during this phase. For the maintenance phase, which is just starting, checking is being reduced to once every three months, at least initially, to determine if this checking frequency is adequate (this will depend on how quickly traps fill).

All trap locations were verified by GPS and all captures recorded at each check, and these data could be used in an individual based spatial model to determine if a similar number of individual predators could be captured with fewer trap sites (1 trap per site), or with a combination of fewer trap sites but with multiple traps at each site.

3 Objectives

Determine how the Poutiri Ao O Tane trap network might be optimised for the maintenance control phase by using existing Poutiri Ao O Tane trap data in a simulation model, including three or four scenarios for optimal trap spacings and frequency of checks (30 June 2015).

4 Methods

Trap location data and predator capture data were provided by Wildlife and Environmental Trapping Advancements (WETA) for each month from November 2011 to May 2014. Although the traps captured a wide range of species, including feral cats, ferrets, stoats, possums, rabbits, ship and Norway rats, mice, hedgehogs, and weasels, the main targets were ferrets, stoats and feral cats. Trap site GPS data were used to locate each trap site in the simulated landscape, but the animals captured and their locations were only used to generate an estimate of the actual population the animals were captured from (see below).

We used only the final 12 months of data, because by this stage the capture rate was assumed to better reflect the maintenance phase, rather than the initial knockdown phase, and this was supported by the lower number of captures in the third year compared to the first (Figure 1). Captures were binned in monthly groups to reflect a schedule of checking traps every month. For each month, we first used an individual-based model (Warburton & Gormley 2015) to simulate captures, to determine the posterior distribution of the number of target and non-target species likely present in the area that would have resulted in the number of captures observed for both target (ferrets, stoats, and cats,) and non-target species (rats, hedgehogs, rabbits, and possums).

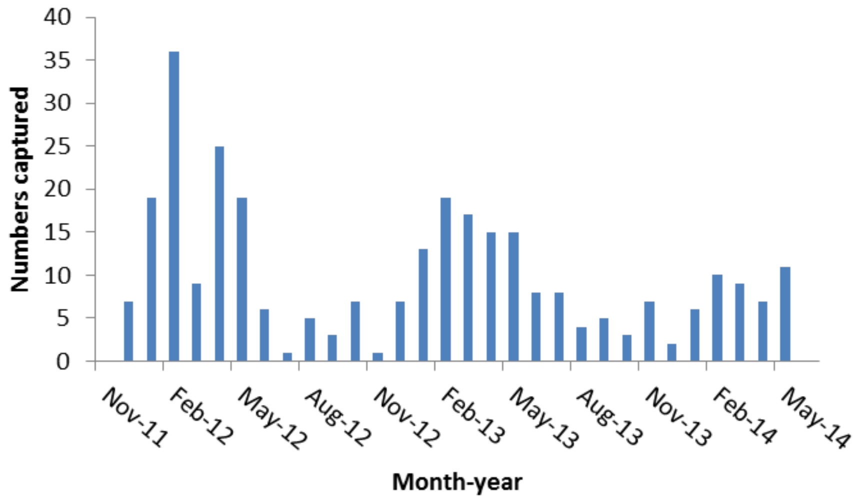

Figure 1 The total number of target predators (feral cats, ferrets and stoats) captured in each month from November 20111 to May 2014.

We then sampled from the posterior distribution of background population size with animals distributed randomly across the trapping area, and simulated captures under five levels of trapping effort relative to the original layout: (1) all traps, (2) 75% of traps, (3) 50% of traps, (4) 33% of traps, and (5) 25% of traps. For each of these levels of trapping, we also simulated captures depending on whether the maximum trap capacity at each trap location was 1, 2, 3 or 4 animals (i.e. setting 1–4 traps at a location).

The individual-based model used to simulate captures (Warburton & Gormley 2015) assumes that each animal occupies a circular home range, and that the probability of an animal being caught in any empty trap on a given night declines with the distance between its home range centre and the trap (Ball et al. 2005).

The model was run for 30 nights for each of 12 one-month periods, and the mean proportion of the *original* observed number of animals captured for that data set was recorded for each iteration. The model was run for 500 iterations for each combination of parameters, and the overall mean proportion of the original animals captured for any data set then reported.

The entire process was run for values of sigma (σ; scalar of home range size) of 400 m for the target species (stoats, ferrets and cats) and 40 m for most non-target species (rats, hedgehog and rabbits) and 65 m for possums. All species (both target and non-target) had a g0 value of 0.05 (g0 is the probability of catching an animal in a trap set for one night at the centre of its home range).

These values were chosen based on the ranges reported in published literature and reports (Table 1), but it is acknowledged that, especially for feral cats, more robust empirical values are required.

Table 1 Values of g0 and sigma, σ, for the target species (table adapted from Glen and Byrom 2014)

Species	*g0 (min–max)*	*σ (min–max)*	*Device*	*Season*	*Reference*	*Location (habitat)*
Stoat	0.024–0.113	162–482	Hair tube/genotype ID	Summer	Efford et al. (2009)	Matakitaki Valley (red beech forest)
	0.03	518	Hair tube/genotype ID	Winter	Clayton et al. (2011)	Resolution Is (mixed coastal forest to alpine)
	0.04–0.077	429–891	Live trap	Summer	Smith et al. (2008)	Fiordland (beech forest)
	0.017–0.047	521–726	Live trap	Summer	Smith et al. (2008)	Fiordland (alpine grasslands)
Ferret	0.079	466	No1 leghold	Summer and Autumn	Norbury & Efford (2004)	Otago (semi-arid grasslands)
Feral cat	0.0028-0.0188	311	DOC 250 baited with rabbit meat	12 months covering three periods of different trappability	Anderson unpubl.	Macraes flat (dry grasslands)
	0.074 (0.001 – 0.696)	-	Camera traps	12 months	Al Glen pers comm.	Hawkes Bay farmland

4.1 Assumptions and modelling limitations

There were several assumptions made to enable the data to be modelled:

1. The three target species (ferrets, stoats, and feral cats) all had similar home range sizes and capture probabilities. This enabled the species to be grouped and modelled as a generic predator. That is, one value for sigma and g0 was used across all three target species.

2. Animals were located across the simulated trapping area at random (i.e. there was no attempt to constrain their home range centres to habitat).

3. The overall percent kill achieved by any trapping event and the total population numbers were unknown (as it was for the real data), so effectiveness was determined by the animals caught in a simulation as a proportion of total animals actually caught in the field in any selected month.

4. Capture probabilities (g0) stayed constant over the period selected for the simulation (i.e. bait attractiveness remained constant).

5. Non-target species captured (rats, rabbits, hedgehogs and possums) were included in order to provide competition for traps. The population number of non-targets was estimated so that the number of non-target captures was similar to the actual captures in the field.

6. All trap sites were equally attractive. That is, we made no attempt to either remove traps that had not captured anything over the life of the programme or keep those that had captured.

7. We could not simulate the capture process across more than one month because we did not know the actual population sizes of target and non-target animals. That is, we could have used the cumulative catch over a three-month period, but this would have required us to assume they were all available for capture at the start of the first month, which was unlikely.

5 Results

The proportional catch of target species declined with decreasing trapping intensity (i.e. from all traps to 25% of traps), but appeared largely unaffected by an increase in trap capacity (i.e. increasing the number of traps from one to four at each site) (Figure 2). Reducing the percentage of traps to 75% and 50% reduced the mean proportional catch to 95% and 89%, respectively, but neither was significantly less than 100% (Figure 2). Further reduction in trapping effort (i.e. 33% and 25% of traps used) resulted in mean proportional catches of 83% and 76%, respectively, with both of these reductions being significantly less than 100%.

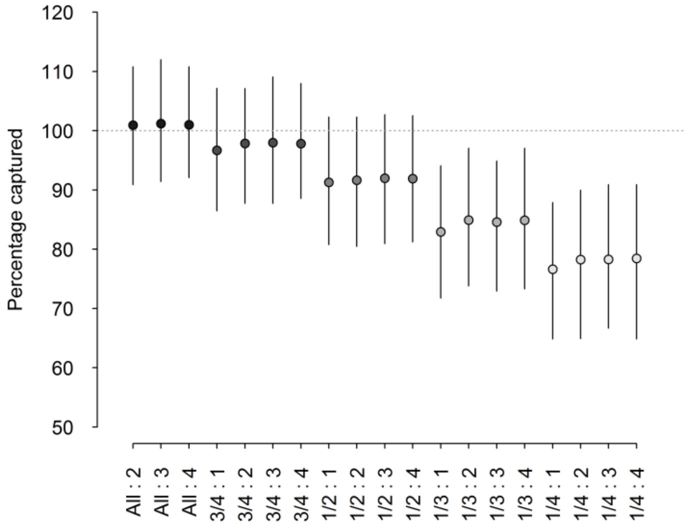

Figure 2 Target animals captured as a percentage of target animals captured under the current trapping configuration (i.e. all trap sites with 1 trap per site), averaged across 12 × one month trapping sessions for a range of trapping configurations. Vertical lines indicate the 5% and 95% percentile for each configuration, labelled as no. of original trap-sites: no. of traps at each site, e.g. ¾:2 = 75% of trap sites with 2 traps at each site. Note y-axis scale is from 50% to 120%.

For non-target species, the percentage of observed animals caught was very similar to the reduction in trap numbers (i.e. when 75%, 50%, 33% and 25% of the original traps were used, the percentages captured were 78%, 53%, 36% and 27% respectively) (Figure 3). As for the target species, the percentage of the observed individuals caught was also unaffected by trap capacity (i.e. number of traps at a site) (Figure 3).

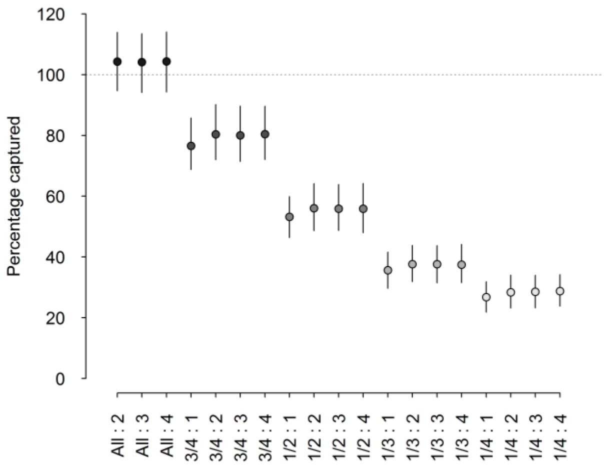

Figure 3 Non-target animals captured as a percentage of non-target animals captured under the current trapping configuration (i.e. all trap sites with 1 trap per site), averaged across 12 × one month trapping sessions for a range of trapping configurations. Vertical lines indicate the 5% and 95% percentile for each configuration, labelled as no. of original trap-sites: no. of traps at each site, e.g. ¾:2 = 75% of trap sites with 2 traps at each site.

Of the 690 traps deployed, 71% had not captured any target species in the 30 months from December 2011 until May 2014. Nineteen percent caught one target animal, 6.5% caught two, up to a maximum of five target animals caught by just three traps over the entire period. Some preliminary analyses suggest that traps that caught a target animal in any given fixed length period were twice as likely to catch another target animal in a subsequent period of similar length. For example, on average only 10% of traps that had no captures in any six month period had captures in the next six month period, compared to 22% of traps that had a capture in the first six month also having a capture in the next six months. Similarly, of the 568 traps that had no captures in the first six months of the study, 82% had no captures for the remainder of the study.

6 Conclusions

The simulation results indicate that even when 75% of traps are removed, close to 80% of the actual target animals caught could still be captured. However, if the proportion captured needed to be maintained above 90% of what was actually captured then 25% of traps could conservatively be removed (i.e. 95% captured) or up to 50% could be removed if a less conservative approach was chosen (i.e. 89% captured).

In general, the simulation predictions are likely to be conservative because there was no attempt to selectively remove traps based on their past performance. That is, 70% of traps had caught no target species in 30 months of trapping, in contrast to 3.5% of traps that captured at least three animals. If the low-capture traps were removed in preference to those traps that had captured several times, the overall effectiveness of the modified trap network might be greater than simulated.

The lack of an effect of increasing the trap capacity at each site was surprising, but is likely due to a combination of the relatively low density of both target and non-target species (i.e. no localised aggregations), and the length of time between trap checks (i.e. one month was not sufficient for traps to become saturated). We note, however, that in our simulations animals were located randomly across the landscape – if animals were clustered in areas around traps or in habitat patches, trap saturation would be more likely.

This initial analysis of the Poutiri Ao O Tane trap data indicates there are potentially significant savings to be made, at least in the maintenance phase of a long-term predator control programme. This potential saving results primarily from each of the target predators (ferrets, stoats, and feral cats) having larger home ranges, enabling wider inter-trap spacings to be used than in the initially established trap network. It is not known whether the initial knockdown phase would have been as effective with a reduction in trap density. However, given the very low number of target species captured (and their generally low densities), it is likely that some reduction in trap density could be made without loss of network effectiveness.

Available data on g0 and sigma values are highly variable, and without carry out sensitivity analyses it is unknown how changes in these values, especially for feral cats for which there are very few values, affects the model predictions.

7 Recommendations

Poutiri Ao O Tane:

For continuing the Poutiri Ao O Tane trapping network it is recommended that:

- 40–50% of traps are closed, with preference for closure given to those traps that have had no captures in the past three years.
- Trap sites selected to remain open should have two traps set at each site in order to validate model predictions.
- Traps are checked at monthly intervals for the first 4 months (to compare capture rates with previous data) and as long as capture rates are not higher, then checked at 3-monthly intervals.
- The bait/lure used maintains its effectiveness for 3 months.
- Attempts are made to minimise the number of non-target captures, to reduce potential trap competition between non-target and target species.
- The percent kill obtained from each trapping period is measured to determine the population number for each target species.

Cape-to-City:

For the planned establishment of a kill trap network over the 26 000-ha Cape-to-City predator control programme, it is recommended that:

- Kill traps are established following the same rules as for Poutiri Ao O Tane, but at a lower trap density (70–75% of what is currently in place at Poutiri Ao O Tane).
- Traps are checked at monthly intervals for 6–12 months (depending on capture rates) and then at 3-monthly intervals.
- The bait/lure used maintains its effectiveness for 3 months.
- After 12–18 months (depending on results from Poutiri Ao O Tane) 25-30% of traps are closed for subsequent maintenance control.

Trap network optimisation:

To optimise kill trap networks, it is further recommended that:

- The simulation is improved to account for habitat patchiness and therefore possible predator patchiness across the landscape.
- Three-month capture data are used once these become available.
- Multiple traps at a site should be tested again with the 3-month data.
- Removal of traps from the network is informed by each trap’s trapping history, with traps having no captures removed in preference to those traps that have had multiple captures.

- More robust empirical values for g0 are generated, especially for feral cats, and that simulation examines how sensitive the model predictions are to variation in this parameter.

8 Acknowledgements

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