Predator and biodiversity response monitoring in Cape to City and Poutiri Ao ō Tāne

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Introduction

The Cape to City and Poutiri Ao ō Tāne programmes both involve wide-scale control of invasive predators (feral cats and mustelids, with hedgehogs as frequent by-catch) in rural or peri-urban landscapes in Hawke's Bay. Selected areas within Cape to City also receive rat control. A principal aim of both programmes is to restore native biodiversity. Predator control has been conducted by Hawke's Bay Regional Council (HBRC) in the Poutiri Ao ō Tāne area since 2011, and in the Cape to City area since 2016. The responses of predator populations, as well as those of native lizards and invertebrates, are being monitored by Manaaki Whenua. Here we report on the pest and biodiversity responses observed in both programmes, up to and including the summer of 2018-19.

This report addresses Te Matau a Maui contract milestones 2.1 and 3.1:

- 2.1. Predator response monitoring at Poutiri Ao ō Tāne and C2C. Report on pest and biodiversity responses (combined with 3.1 below) by May 30, 2019
- 3.1. Biodiversity response monitoring at C2C and Poutiri Ao ō Tāne, including 100 ha of new mānuka plantings on Taurapa station to establish baseline of habitat value. Report on pest and biodiversity responses (combined with 2.1 above) by May 30, 2019

1. Poutiri Ao ō Tāne

Methods

Monitoring commenced in October 2011 on four adjacent pastoral properties in northern Hawke's Bay: Opouahi, Rangiora, Toronui and Rimu stations (Glen et al. 2019). Initially, predator control was implemented on Opouahi and Rangiora stations while Toronui and Rimu stations were non-treatment areas (Fig. 1). Since 2016, predator control has been extended to include Toronui Station, while Rimu Station is no longer included in the monitoring.

In November 2011, HBRC deployed 680 kill traps across the 6,000-ha area. These included 550 DOC-250 traps for mustelids, and 130 Timms traps for cats. Traps were spaced 100 m apart in bush fragments or 200 m apart on cleared farmland. Traps were left in place year-round, and baited with fresh rabbit meat, Erayz® rabbit paste and/or a synthetic, rat-scented lure. Traps were initially checked every three weeks; however, since November 2014, they have been checked quarterly (January, April, June and November). Kill trapping was supplemented in May and August each year with pulses of cat control using a combination of trapping and shooting. After the first year, the Timms traps were removed from the permanent trap network, but continued to be used in the specialist control. In 2016, predator control was extended to include Toronui Station, which had formerly been the non-treatment area.

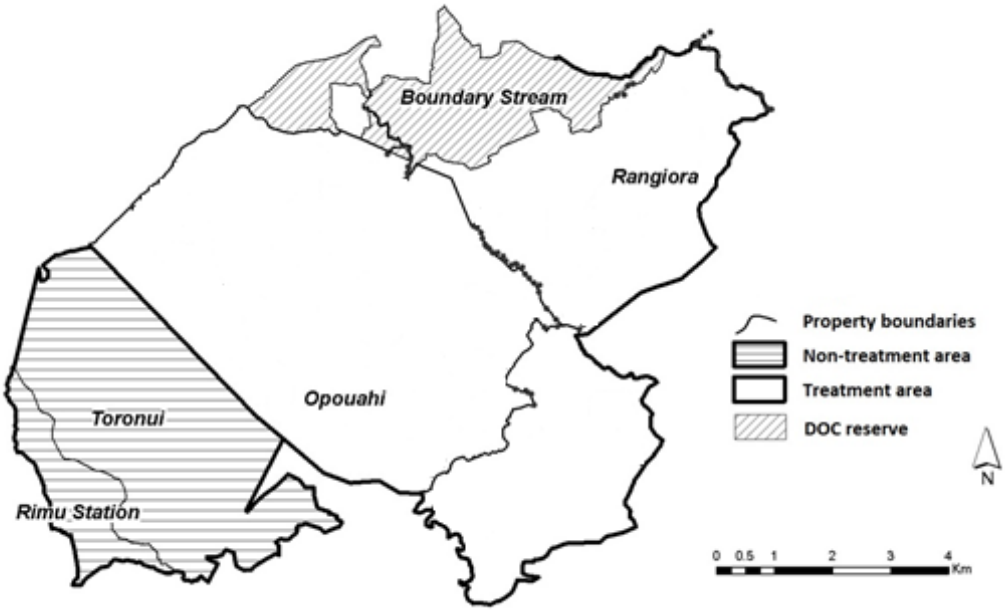


Fig. 1. Map of the monitoring area in Poutiri Ao ō Tāne (modified from Glen et al. 2019).

Predator monitoring
Initially, 15 predator monitoring lines were established in the treatment area and 14 lines in the non-treatment area. From Spring 2014 onwards, only 12 monitoring lines were used in the non-treatment area due to access restrictions on Rimu Station. Most monitoring lines were at least 1 km apart to maximise spatial independence; the shortest distance between any two monitoring lines was 500 m.

Each line consisted of five large tracking tunnels (20 x 20 x 100 cm; Pickerell et al. 2014) spaced 100 m apart; tunnels were left in place year-round. Monitoring lines were checked twice a year (Spring and Summer) from 2011–2014 and, thereafter, once a year (in Summer). At the beginning of a monitoring session, tracking ink was applied to the floor of each tunnel, and sheets of tracking paper were fastened to the tunnel floor at either end. Tunnels were baited with fresh rabbit meat. Tracking papers were retrieved after three days, and footprints left on the tracking papers were identified using field guides (Agnew 2009; Gillies and Williams 2009; www.pestdetective.org.nz).

The relative abundance of predators was assessed by calculating the percentage of monitoring lines where predators were detected.

Lizard and invertebrate monitoring
Footprints of lizards (skinks) were detected in the same tracking tunnels (described above) used for monitoring predators. The relative abundance of skinks was assessed by calculating the percentage of monitoring lines where they were detected.

Invertebrates were monitored using artificial shelters (wētā houses) placed at the first and third point on each monitoring line. Wētā houses were 7.5 cm x 62 cm, with six galleries, a clear Perspex cover and a wooden door (Fig. 2). These were attached to tree trunks at approximately

chest height and left in place year-round. By opening the wooden door we were able to count and identify invertebrates through the Perspex cover. Invertebrates were classed as either: tree wētā, cave wētā, spiders, cockroaches or slaters. For each of these taxa, we calculated the mean number per monitoring line in each sampling season. These were compared between the treatment and non-treatment areas using paired t-tests.

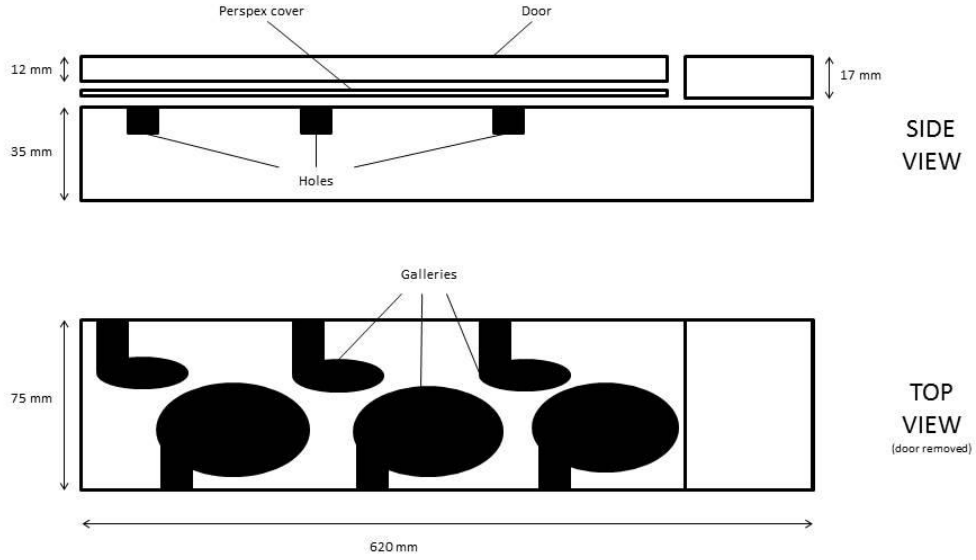


Fig. 2. Schematic diagram of a wētā house used to monitor invertebrates in Poutiri Ao ō Tāne. Invertebrates enter through the holes in the side and shelter in the hollow galleries. When the door is open, invertebrates can be identified and counted through the Perspex cover (from Glen et al. 2019).

Results

Predator monitoring

In Spring 2011, immediately before predator control began, the percentage of monitoring lines showing predator tracks was similar in both areas (Fig. 3). After predator control began, relative abundance of predators was consistently lower in the predator-removal area than in the adjacent non-treatment area, with the exception of one sampling session (Summer 2014-15). Since predator removal was extended to include Toronui Station, the relative abundance of predators has remained similar in both areas (Fig. 3).

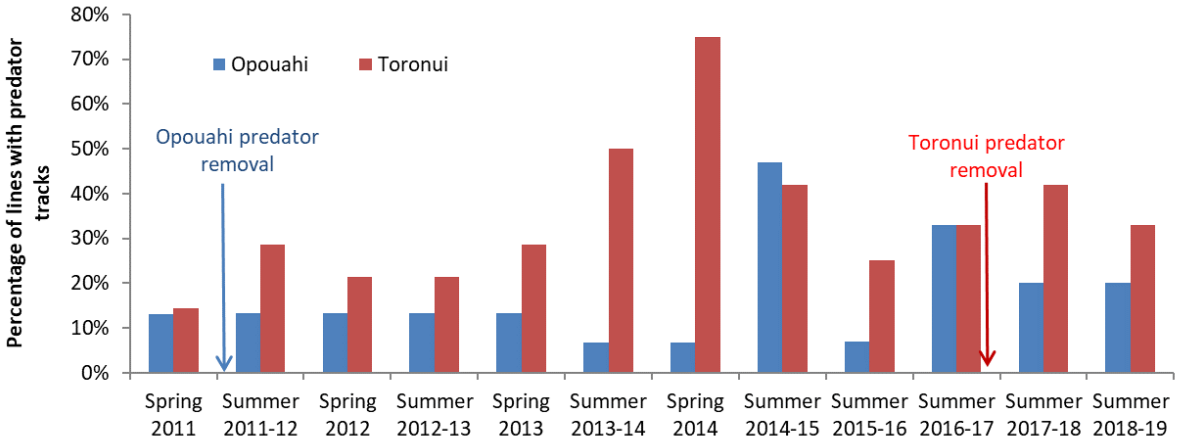


Fig. 3. Percentage of monitoring lines on which tracking tunnels detected predators (cats or mustelids) on Opouahi and Rangiora (blue columns), where predator control began in November 2011, and on Toronui (red), where predator control began in 2016.

Lizard and invertebrate monitoring

No lizards were detected at either site during the pre-treatment sampling in Spring 2011. However, skinks were detected in the predator-removal area in all subsequent sampling seasons, usually on 30–50% of the monitoring lines (Fig. 4). Only one skink has been detected in the non-treatment area, in Summer 2014-15. In the two years since predator removal was extended to include Toronui Station, no skinks have been detected there. Geckos have not been detected at either site.

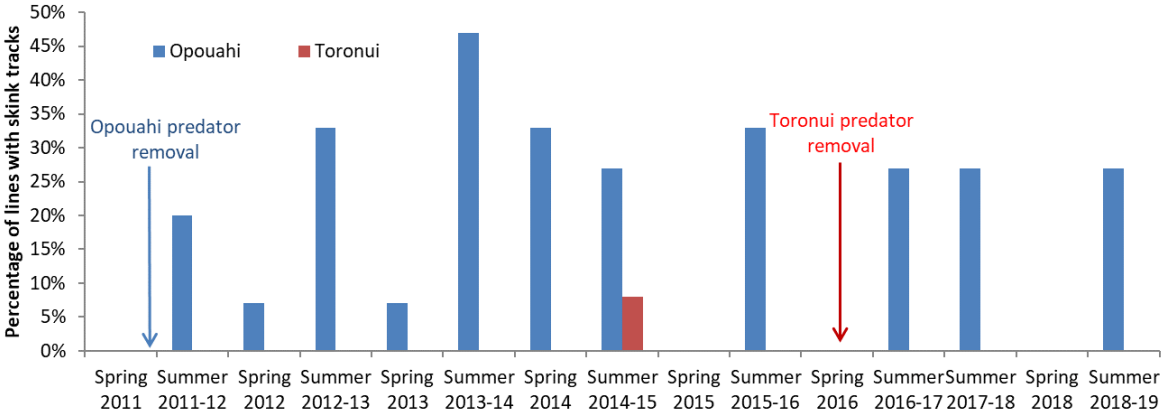


Fig. 4. Percentage of monitoring lines detecting skinks on Opouahi and Rangiora stations (blue), where predator removal began in November 2011, and on Toronui (red), where predator removal began in 2016.

Before predator control was extended to Toronui Station, mean numbers of invertebrates in wētā houses were similar in the treatment and non-treatment areas, with the exception of cockroaches, which were more numerous in the treatment area (Glen and Norbury 2017). This pattern has remained unchanged since predator control was extended.

Discussion

Our results suggest that the relative abundance of predators in Poutiri Ao ō Tāne has increased since 2014. This may be related to the reduced frequency of trap checking and/or high numbers

of rabbits, which support predator populations. The extension of predator control to Toronui has not led to any measurable difference in the relative abundance of predators, lizards or invertebrates.

2. Cape to City

A. Predator suppression

The Cape to City programme aims to supress populations of invasive predators (stoats, ferrets and feral cats) by trapping across 26,000 ha of Hawke's Bay. Rats are also being controlled in some selected areas.

Trapping started in 2016 but it took two years to roll out the trapping network across the whole Cape to City area. Manaaki Whenua is monitoring biodiversity in the Cape to City area, and in an adjacent non-treatment area for comparison. Monitoring is essential to tell us if:

1. predator numbers are being reduced by the trapping, and
2. populations of native species are recovering as a result.

B. Value of mānuka habitat

Planting mānuka offers opportunities to increase the returns on marginal land on farms, while provding a number of environmental benefits, including erosion control, reducing sediment and nutrient loads to waterways, and restoring native habitat for a diverse range of plants and animals over large areas at low cost. However, very little is known regarding the value of mānuka habitat to biodiversity over time.

Therefore, a project has been initiated using conventional and DNA metabarcoding methods to monitor invertebrate community change over time in mānuka-dominated habitats (recently (July 2017) planted mānuka and old-growth mānuka/kānuka) on Taurapa Station within Cape to City. From this project, the DNA of 100 species will be barcoded to increase the number of species barcodes in reference sequence databases.

Methods

A. Predator suppression

Predators are being monitored annually using 37 motion-triggered cameras in the treatment area and 31 cameras in the non-treatment area. Cameras are placed $\geq$ 2 km apart, achieving broad coverage of the study area, and are left in place for 21 days. The results are being assessed using an occupancy modelling approach (MacKenzie et al. 2017). Lizards and invertebrates are being monitored using tracking tunnels, wētā houses, artificial cover objects and tree wraps. These devices are placed 20 m apart in lines of five.

B. Value of mānuka habitat

Invertebrates were sampled using malaise and pitfall traps from four 10 x 10m square plots placed within 1) recently (July 2017) planted mānuka and 2) old-growth mānuka/kānuka on Taurapa Station in December 2018/January 2019. Invertebrates will be sorted and counted to Order level using a binocular microscope. Coleoptera, Diptera, and Hymenoptera will be sorted to recognised taxonomic units and, where possible, given generic and species-level

identifications by an expert diagnostician (Stephen Thorpe, independent diagnostic researcher). After sorting and counting, the specimens from the malaise trap and four pitfall traps from each plot will be pooled into a single bulk invertebrate sample for DNA analyses. In addition, 100 species will be selected for DNA barcoding.

Results

A. Predator suppression

Camera traps

Camera traps have shown that feral cats are common and widespread throughout the treatment and non-treatment areas, while stoats and ferrets have been detected in low numbers. Occupancy modelling estimates that feral cats were present in 54% of the non-treatment area and 59% of the treatment area in Spring 2017 (Fig. 5). Stoats and ferrets were detected by < 10% of cameras. Numbers of stoat and ferret detections were too low for occupancy modelling, so 'naïve' occupancy estimates are shown (Fig. 5). These are simply the percentage of all cameras that detected stoats and ferrets, with no associated confidence intervals.

Trapping began in April 2016, but the roll-out of the trap network was only completed in late 2017, so it is too early to expect any measurable reduction in predator numbers. However, our monitoring results from these early years provide a baseline for comparison in future years. Landscape occupancy of predators is currently similar in the treatment and non-treatment areas.

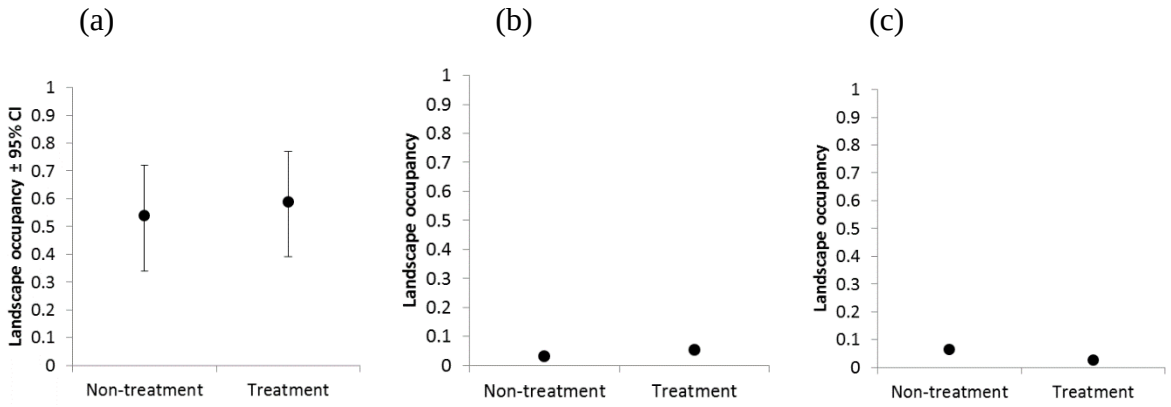


Fig. 5. Estimated proportion of the Cape to City area and adjacent non-treatment area occupied by (a) feral cats, (b) stoats and (c) ferrets in Spring 2017.

As predator populations are reduced by trapping, we would expect native species to become more common and widespread. Manaaki Whenua is monitoring populations of native lizards and invertebrates. Tracking tunnels are being used to monitor both lizards and invertebrates (as well as rodents), wētā houses for invertebrates, and artificial cover objects for lizards. Tree wraps have also been deployed to monitor arboreal geckos. Although these detect large numbers of invertebrates, they have not yet detected any lizards.

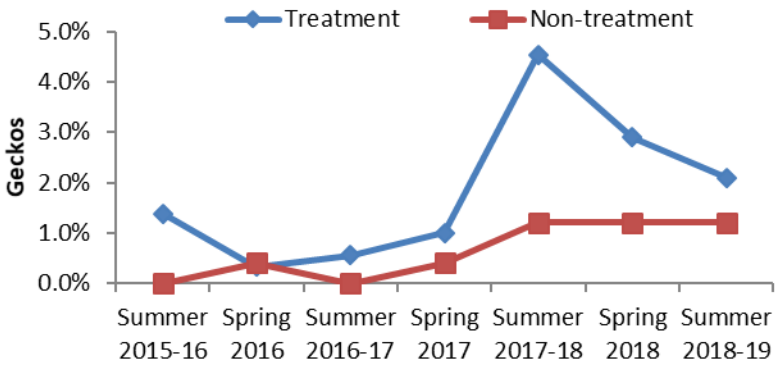
Tracking tunnels

Lizards

Small numbers of geckos have been detected in tracking tunnels in both the treatment and non-treatment areas. Although gecko footprints have generally been more common in the treatment area than in the non-treatment area (Fig. 6a), it is too early to be sure whether this is a response

to predator control. Skinks have been detected in a small number of tracking tunnels, mainly in the treatment area (Fig. 6b).

(a)



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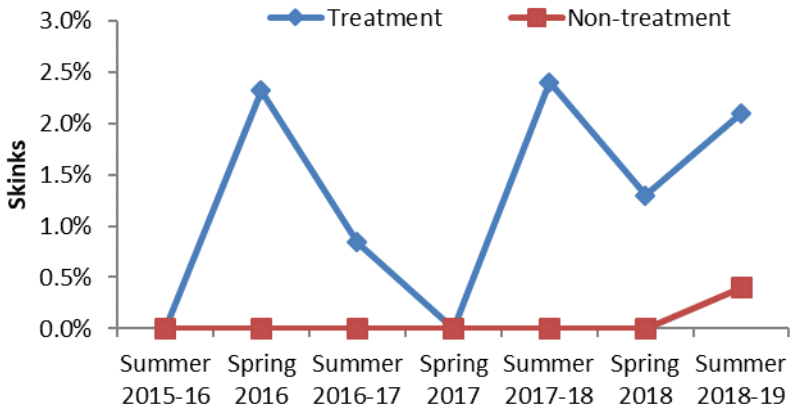


Fig. 6. Percentage of tracking tunnels showing tracks of (a) geckos and (b) skinks in the Cape to City treatment and non-treatment areas.

Wētā

Wētā have been detected in tracking tunnels in both the treatment and non-treatment areas (Fig. 7). Wētā tracking rates have generally been higher in the treatment area.

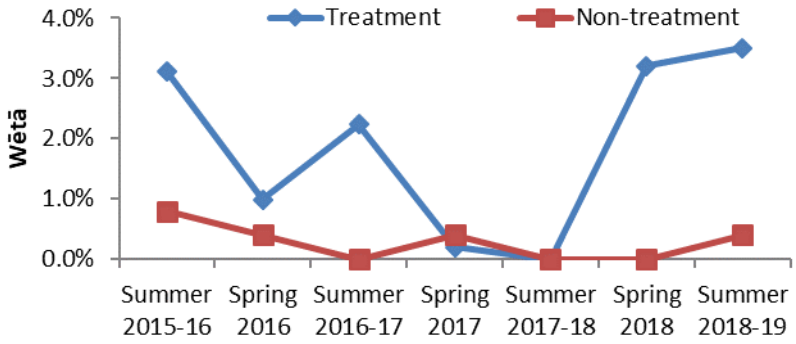
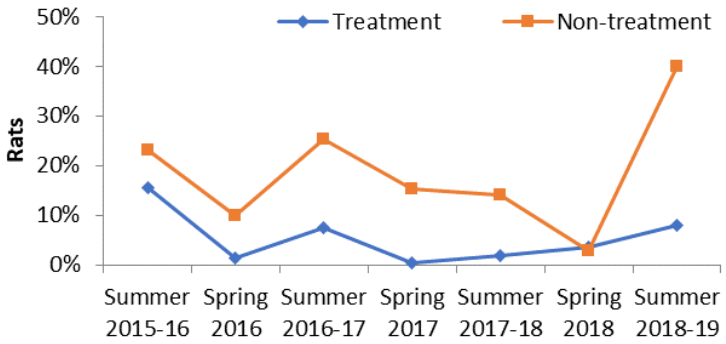


Fig. 7. Percentage of tracking tunnels showing wētā tracks in the Cape to City treatment and non-treatment areas.

Rodents

Rodents are not being targeted for control in most of the Cape to City area, but are often detected in tracking tunnels used for monitoring lizards and invertebrates. Tracking rates of rats are lower in the treatment area than in the non-treatment, while tracking rates of mice are similar in both areas (Fig. 8).

(a)



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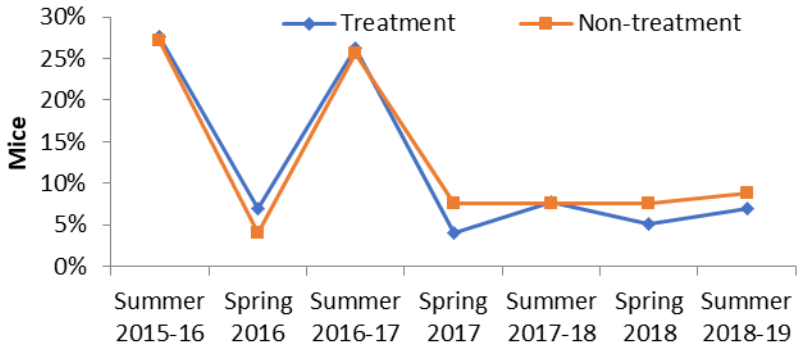


Fig. 8. Percentage of tracking tunnels showing tracks of (a) rats and (b) mice in the Cape to City treatment and non-treatment areas.

Within the treatment area, there are a small number of areas where rats are also being controlled. In Mohi Bush, tracking rates of rats have declined from 62% before rat control to between zero and 31% since control started (Fig. 9).

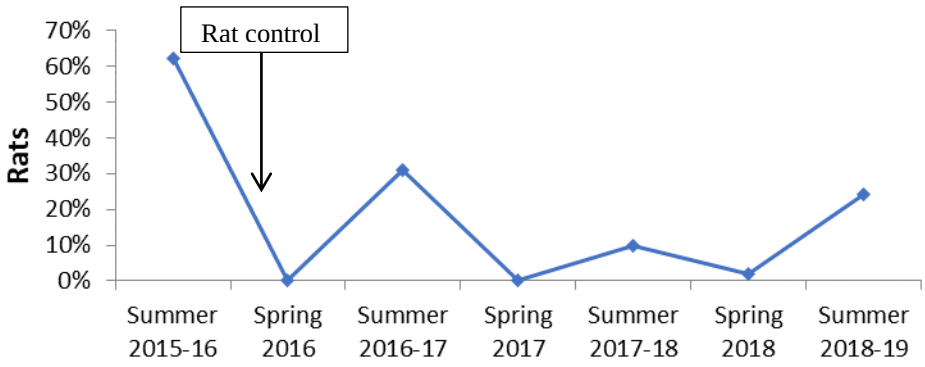
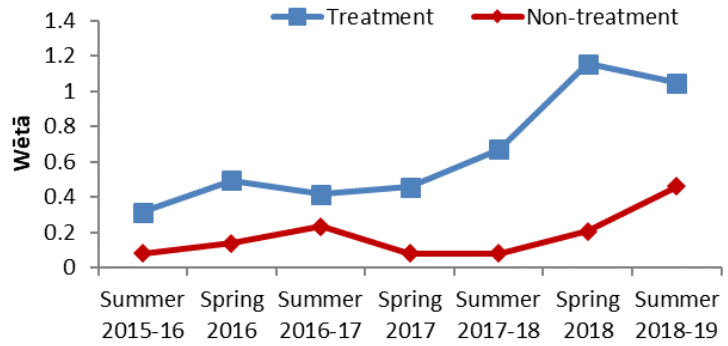


Fig. 9. Percentage of tracking tunnels showing rat tracks in Mohi Bush before and after rat control.

Wētā houses

The average number of wētā found in each wētā house has been slightly higher in the treatment than in the non-treatment area. These have mainly been tree wētā, and small numbers of cave wētā. Numbers of spiders and other invertebrates have been similar in both areas (Fig. 10).

(a)



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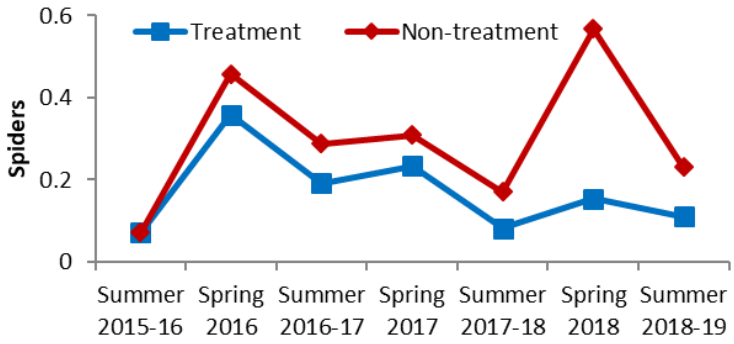

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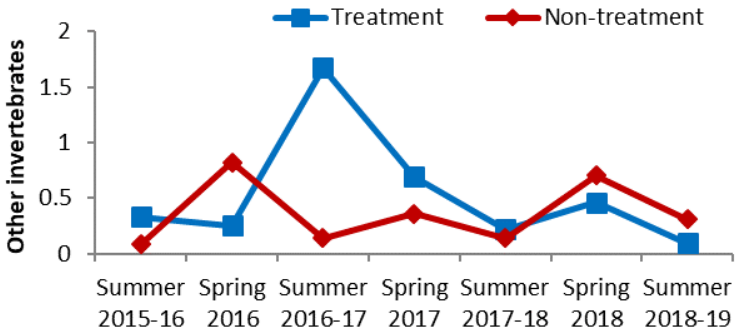
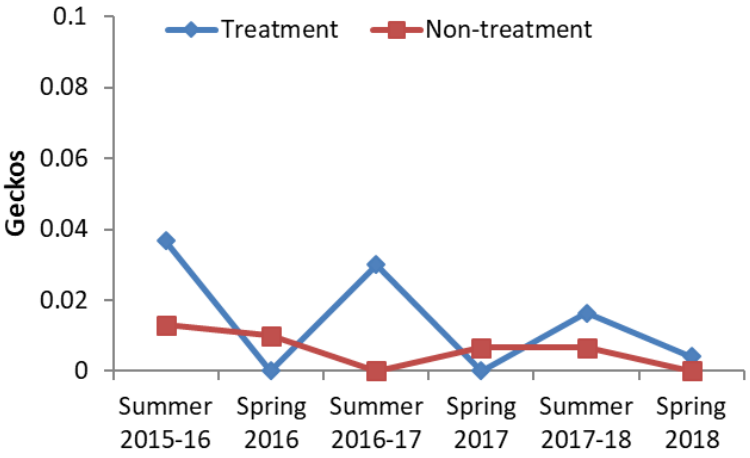


Fig. 10. Average number of (a) wētā, (b) spiders and (c) other invertebrates (e.g. cockroaches, earwigs) found in wētā houses in the Cape to City treatment and non-treatment areas.

Artificial cover objects (ACO's)

ACO's have detected small numbers of geckos in both the treatment and non-treatment area. Like the tracking tunnels, ACO's have detected more geckos in the treatment than the non-treatment area (particularly during summer), but numbers are still too low to make firm conclusions. Skinks have been detected in small numbers only in the treatment area (Fig. 11). ACO data from Summer 2018-19 have not yet been compiled.

(a)



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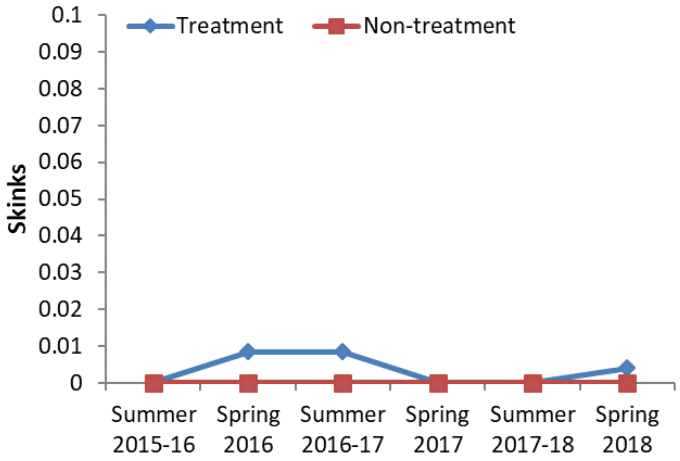

Fig. 11. Average number of (a) geckos and (b) skinks per ACO (artificial cover object) in the Cape to City treatment and non-treatment areas.

While it is still too early to draw any firm conclusions about the effectiveness of the predator control, these preliminary results are encouraging as they confirm that our monitoring methods are detecting a wide range of species. Monitoring will continue each year. Once predator control has had more time to take effect, we hope to see fewer pests and more native species across the Cape to City area.

B. Value of mānuka habitat

A vast number of invertebrates were collected in malaise (some traps had > 5,000 specimens present) and pitfall traps in the two mānuka habitat types. Sorting and counting the samples has taken much longer than anticipated. Preliminary results indicate that similar number of invertebrates were collected in the two mānuka habitat types but further analysis is required to confirm this. A total of 100 species have been selected for DNA barcoding.

Discussion

All monitoring methods being used in the Cape to City programme continue to detect taxa of interest (predators, lizards or invertebrates). Our results continue to indicate little or no difference in predators or native biodiversity between the treatment and non-treatment areas. While cats are common and widespread, stoats and ferrets have been detected only in low

numbers. The lack of difference between the treatment and non-treatment areas is not surprising as traps were not in place across the whole treatment area until approximately a year ago. Differences between the two areas might be expected in future years, such as reduced landscape occupancy of predators and increased abundance of lizards and invertebrates.

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