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Cape to City project: Using chew cards to map possum and predator distribution across the landscape

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Additional comments?

Contents

Summary

Project and Client

- The Hawkes Bay Regional Council is embarking on a visionary large-scale pest control project, Cape to City (C2C), which aims to reduce predator abundance over 26 000 ha. Building on the success of their long-term Possum Control Area (PCA) programme, the council wishes to deliver more targeted detection-based possum control that will enable resources to be diverted to stoat, ferret and feral cat control.

Objectives

To reduce the long-term cost of possum control in the Hawkes Bay region by:

- Assessing the effect of varying chew card deployment times on the number of kills per positive detection (a measure of effectiveness), and the percentage kill achieved using detection followed by control
- Mapping areas of low, medium and high possum abundance to identify areas where possum control needs to be concentrated and where it could be delayed, plus providing recommendations on future areas to target
- Mapping predator distribution across the study area and comparing the sensitivity of predator chew cards and possum chew cards for detecting predators.

Methods

- Chew cards were deployed for 7, 14 and 28 days and the number of detections and subsequent possum kills at each card (using either Feratox® bait or a kill trap) were used to determine the optimal chew card deployment schedule.
- The percentage kill achieved using chew card detection followed by control at positive detections (i.e. informed control) was assessed by monitoring the fate of radio-collared possums in one of the 14-day study areas.
- Possum and predator detection data from a network of chew cards were spatially analysed to identify hotspots of animal activity to direct immediate control efforts.
- The Land Cover Data Base (LCDB) v4.1 was used to identify possum habitat, and possum detections were analysed in relation to habitat type.

Results

- The percentage of cards chewed during each deployment period was 17.2% (7 days), 23.9% (14 days) and 31.9% (28 days).
- The percentage of cards that detected possums and resulted in a confirmed kill was 1.9% (7 days), 11.6% (14 days) and 1.4% (28 days).

- There was about a 50% kill achieved at the monitored site based on the mortality of radio-collared possums.
- Based on the hot spots of possum activity, areas for priority possum control were identified in the central zone, and along the mid-western and south-eastern boundaries.
- A 100-m buffer (i.e. an extended area) around patches of possum habitat identified from a land cover layer (LCBD) will detect about 70% of possums but reduce the area to be surveyed by 60%.
- Predators had low detection rates (0.3%–3.3%) and were less widely dispersed across the area. Rodents were concentrated in the north-western section of the study area. Mustelids and feral cats were mainly detected in the southern half of the C2C area. This distribution pattern may be due to the different contractors used and their ability to correctly identify predator interference on chew cards.
- Possums were detected mainly on possum chew cards while cats were detected almost exclusively on predator cards. Mustelids and rodents were detected on both card types, although at a significantly higher rate on predator cards compared to the proportion deployed.

Conclusions and Recommendations

- Based on the available data, 14 days appears to be the optimal deployment length for possum chew cards.
- When targeting areas for future possum control, using chew cards in patches of possum habitat greater than 1 ha plus a 100-m buffer around it should detect the majority of possums while considerably reducing the total area needing to be surveyed and controlled.
- Feral cat and mustelid distribution needs further confirmation, which is probably best based on use of camera traps.
- If camera traps are not available predator chew cards should be used for detecting feral cats and either predator or possum chew cards for detecting mustelids and rodents.

1 Introduction

New Zealand is seeking a credible pathway towards the vision of a country free of invasive predators (PFNZ, 2015). To meet this challenge, landscape-scale suppression or eradication of a suite of introduced mammal pests must be achieved. Since 2001 large areas (c. 500 000 ha) of Hawkes Bay have been brought under long-term sustained possum control, with the farming community responsible for carrying out ongoing maintenance control (HBRC 2015a). The Hawkes Bay Regional Council (HBRC) is building on this success with the Cape to City (C2C) project, which aims to achieve a predator-free[1] Hawkes Bay. It focuses on applying low-cost, large-scale predator control across 26 000 ha of farmland between Waimarama and Havelock North with the aim to restore native flora and fauna and add value to farm businesses (HBRC 2015b). The aim is to achieve this by targeting possum control more effectively, and by shifting resources from controlling possums to the wider suite of pests. Identifying areas with low possum densities allows control intervals to be extended from 1 year to 2–4 years with minimal loss of economic and environmental outcomes from the existing programme. Significant biodiversity gains are expected from the control of the additional pests (Norbury & Byrom 2014).

Chew cards (CCs) are a multi-species detection device specifically designed to cheaply map the distribution of low-density small mammal pests, mainly possums, but also rodents and other pest species (Sweetapple & Nugent 2011). Chew cards are lighter than traps and larger survey areas can be covered for the same amount of effort/resources. They also have a higher likelihood of detecting a possum than a leg-hold trap (Sweetapple & Nugent 2011). By initially surveying a large area with CCs, control using either leg-hold traps or poison, such as Feratox®, can then be targeted only to those areas where possums are present (as evidenced by bitten CCs).

This project aimed to determine if there were significant areas of the project area that had very low to low possum abundance that could be spelled from annual control with the resulting savings redirected to controlling predators. Mapping the spatial distribution of high and low possum density areas could also be used to understand which environmental factors (e.g. habitat type) best explain patterns of abundance. This information could then be used to more cost-effectively plan surveillance and control operations in the future.

2 Objectives

To reduce the long-term cost of possum control in the Hawkes Bay Region by:

- Assessing the effect of varying chew card deployment times on kills per detection, and the percentage kill achieved using detection followed by control

[1] At this stage predator-free does not mean an absence of predators but the removal of all or most of their impacts.

- Mapping areas of low, medium and high possum abundance to identify areas where possum control needs to be concentrated and where it could be delayed, plus providing recommendations on future areas to target
- Mapping predator distribution across the study area and comparing the sensitivity of predator chew cards and possum chew cards for detecting predators.

3 Methods

The C2C project area comprises 26 000 ha of highly productive farmland with remnant patches of native forest, blocks of plantation forestry, and riparian vegetation within the Hawkes Bay region between Waimarama and Havelock North (Figure 1). The possum population has been suppressed to <5% RTC (Residual Trap Catch) for several years across the whole area as part of the HBRC's Possum Control Area programme.

Possum and predator (feral cats, ferrets and stoats) distributions were determined across the entire C2C project area by placing possum CCs (baited with peanut butter) on a 100 m × 100 m grid within patches of vegetation and placing predator CCs (with fish-based bait) at every third possum CC (i.e. a 300-m spacing) (Figure 1). Chew cards are small rectangular pieces of plastic corflute, with the peanut butter or fish-based bait pushed into the internal channels to encourage the animal to bite the cards. Chew cards were attached to trees or posts c. 30 cm above the ground (Figure 2). Cards were checked after 14 days. At each positive possum detection, control was undertaken using either Feratox® (primary method) or Possum Master kill traps (near buildings and roads) (Figure 3).

Assessing the effect of varying chew card deployment times on kills per detection, and the percentage kill achieved using detection followed by control.

Within the C2C area, six 900–1000 ha research blocks were established. Within each block, possum and predator CCs were deployed for 7, 14 or 28 days (i.e. one treatment per block, replicated twice; Figure 1). Research blocks had similar habitat, predominately farmland with remnant patches of bush or scrub. One control device (either a Feratox® bait or a kill trap) was put out at each positive possum detection location and left out for a minimum of three nights. Contractors were then supposed to return to the block and record any dead possums found. This was only completed for sites 1B1, 2B and 3B due to errors in the contract specification. Consequently, 1A, 2A, 3A and 1B did not get follow up checks for possums kills.

To assess the percentage of possums killed using detection followed by control, 23 possums in study site 2B (Figure 1) were trapped prior to CCs being deployed. Captured possums were sedated, ear-tagged in both ears, and if they weighed more than 1.5 kg, fitted with a Sirtrack VHF radio collar with mortality sensor (45 g). After the control operation, radio-collared possums were tracked to determine their fate (i.e. dead or alive). Radio-collared possums that survived the control operation were tracked, recaptured and killed.

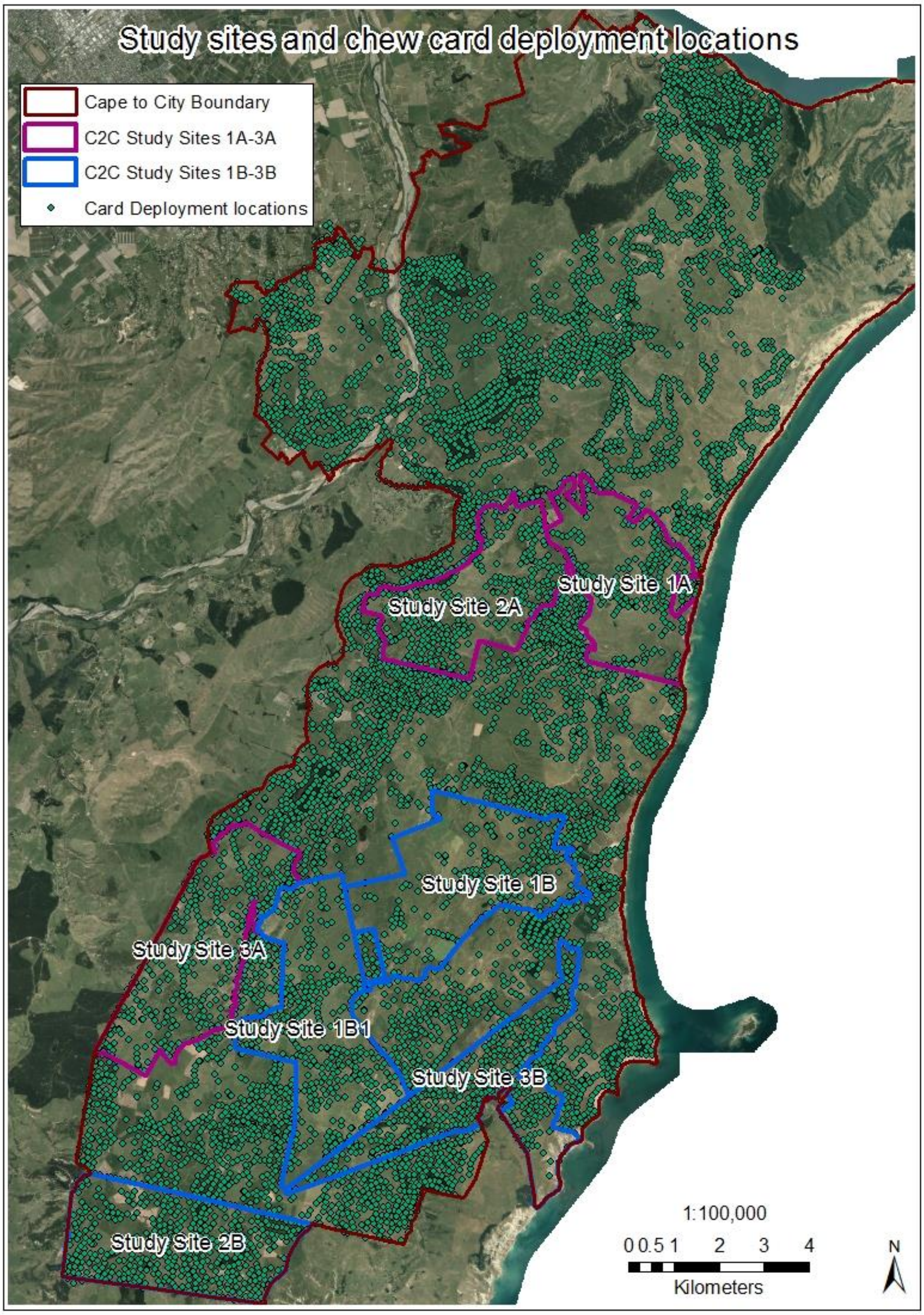

Figure 1 Study site and chew card deployment locations within the Cape to-City (C2C) area. Sites with prefix 1 had chew cards(CCs) deployed for 7 days, sites with prefix 2 had CCs deployed for 14 days, and sites with prefix 3 had CCs deployed for 28 days. The additional 7-day site (1B1) was added to obtain follow up possum kill data from a 7-day detection site. All other CCs were deployed for 14 days.

Figure 2 A chew card showing peanut butter applied to the flutes in the top side of the card. The card is bent and attached to the tree with a nail.

Figure 3 Possum Master kill traps used at some positive detection sites.

Mapping areas of low, medium and high possum abundance to identify areas where possum control needs to be concentrated and where it could be delayed, plus provide recommendations on future areas to target.

Possum detection data from CCs were analysed using the Hot Spot Analysis tool (Getis-Ord Gi* statistic) in ArcGIS 10.2.1. This analysis looks at each CCs within the context of neighbouring CCs. If the CC and its neighbours have high values, and their sum is higher than would be expected by random chance then the area is identified as a statistically significant hot spot (ArcGIS 2012). Each CC included in the analysis is then given a z-score and a p-value, where a significant positive z-score indicates a clustering of high values (i.e. a hot spot), whereas a significant negative z-score indicates a clustering of low values (i.e. a cold spot). We used a fixed distance band (FDB) which describes which CCs should be considered as 'neighbours' and should reflect the likely relationship between CCs in the real world. The analysis was run on the un-aggregated binary data (detection/non-detection). We used an FDB of 1 km for possums to ensure all CCs had at least eight neighbours (which is required for the tool to work correctly). Further, this value is larger than the average possum home range, thus a high number of positive interactions within this radius is likely to indicate more than one possum was present in the area.

The z-scores calculated for each CC were interpolated to a continuous surface using the inverse distance weighted (IDW) tool to help visualise the results. For this analysis, the search radius was limited to 12 nearest neighbours and the FDB value was the same as that used in the hot spot analysis above. This technique calculates the score of each cell in the continuous surface as an average of the nearest neighbours considered within the search radius, weighted by the distance between the cell and the neighbour. Thus, it assumes that the value of the variable (z-score) to be interpolated will be more similar to those recorded in points that are closer than more distant ones.

Finally, we calculated the number of possum CCs deployed and positive detections within possum habitat, as well as within possum habitat plus a buffer of 50, 100 or 200 m. The Land Cover Data Base (LCDB) v4.1 was used to identify vegetation classes considered to be possum habitat. These are listed in Appendix 1.

Mapping predator distribution across the study area and comparing the sensitivity of predator chew cards and possum chew cards in detecting predators.

The predator detection data from CCs were analysed using the Hot Spot Analysis tool (Getis-Ord Gi* statistic) as detailed above. The predator species identified on CCs were feral cats, stoats/mustelids, hedgehogs, rats and mice. There were insufficient data to map hedgehog distribution, rats and mice were combined to map rodent distribution, and stoats and ferrets were combined to map mustelid distribution. The following FDB were used for each species: rodents 600 m, mustelids and feral cats 2 km.

An additional area of interest was the performance of predator-specific CCs with the novel fish-based formulation compared to standard possum chew cards. The number of detections for each species on the two card types was compared to the number of each device deployed using a Chi-square test to assess for statistically significant differences in preferences for each card type.

4 Results

Assessing the effect of varying chew card deployment times on kills per detection, and the percentage kill achieved using detection followed by control.

A total of 10 443 chew cards were deployed across the Cape to City project area (Figure 1). Of these, 80% were deployed for 14 days, and 10% each for 7 and 28 days. From our seven treatment blocks and general surveyed area, the mean percentage of cards chewed was 21% (SD = 15%), 30% (SD = 21%) and 32% (SD = 5%) for 7, 14, and 28 days, respectively.

Unfortunately, the outcomes of control (i.e. number of dead possums found) were recorded only in study sites 1B–3B (Figure 1), which didn’t allow for analysis of the effect of varying card deployment times on kills per detection. Of the three sites that were monitored post-control, the percentage of positive detections that resulted in a confirmed kill was 1.9% (7 days), 11.6% (14 days) and 1.4% (28 days).

Of the 23 possums ear-tagged and/or radio-collared in study site 2B, 18 were still present when contractors deployed CCs. After control, four of these were found by the control contractors to have been poisoned, two were found dead by the research contractor (and assumed to have been poisoned), three were not recovered in subsequent trapping and because they were not collared their fate is unknown, and nine survived the operation (as evidenced by the signal from the VHF collar). At best, a 50% kill was achieved using detection followed by informed control.

Mapping areas of low, medium and high possum abundance to identify areas where future possum control should be concentrated and where it could be delayed.

Possums were detected across most of the study area. The hot spot analysis identified the areas with the highest levels of detections (Figure 4), with significant hot spots of possum activity concentrated in a central zone, the central western boundary and the south-eastern boundary. From these, we identified eight areas where future possum control should be applied (Figure 4).

Chew card detections within identified 'possum habitat' (Appendix 1) accounted for only 35.6% of all possum detections (Table 1). However, 82.9% of all detections occurred within 200 m of identified possum habitat. Creating a buffer of 100 m around possum habitat included 68.7% of all detections but reduced the area surveyed by 60%.

Table 1 The number of possum chew cards deployed and possum detections within the Cape to City project area and within possum habitat with different-sized buffers. Possum habitat was derived from LCDB v 4.1 cover classes listed in Appendix 1.

	# cards deployed	# cards with detections	% cards chewed	% total cards deployed	% total detections	Area (ha)	Proportion of total area
Total C2C area	10443	2505	24.0%			27197	
Habitat with 200-m buffer	7644	2077	27.2%	73.2%	82.9%	16408	60.3%
Habitat with 100-m buffer	5942	1721	29.0%	56.9%	68.7%	10682	39.3%
Habitat with 50-m buffer	4764	1435	30.1%	45.6%	57.3%	7381	27.1%
Habitat	2707	891	32.9%	25.9%	35.6%	3843	14.1%

Mapping predator distribution across the study area and comparing the sensitivity of predator chew cards and possum chew cards in detecting predators.

Feral cats, mustelids and rodents were not detected as widely across the study area as possums (Appendix 2, Figures 5, 6 & 7), although the estimated distribution and abundance might be biased low because some contractors were not proficient in identifying predator bite marks. Based on the data provided from contractors, rodents were clustered in the north-western edge of the project area, while mustelids and feral cats were predominately detected in the southern half of the project area. Detection rates of each species were low across the study area and varied depending on the card type used (Table 2).

Table 2 Detection rates of each species based on percentage of chew cards (CC) chewed

	% Possum CC chewed	% Predator CC chewed	% detections on all CC

Cat	0.04	1.42	0.35
Mustelid	0.2	0.5	0.3
Rodent	3.3	6.0	3.9

Possums were detected significantly more often on possum CCs than the predator CCs ($\chi2$ = 260.9, $P < 0.01$) (Table 3). Feral cats were detected significantly more often on the predator CCs than the possum CCs ($\chi2$ = 107.8, $P < 0.01$). Mustelids and rodents were detected on both card types, but significantly more frequently on a predator CC than would be expected based on the proportion of each card type deployed ($\chi2$ = 4.1, P = 0.04 for mustelids; $\chi2$ = 33.1, $P < 0.01$ for rodents) (Table 3).

Table 3 The percentage detections on each chew card type by animal (n = total number of detections).

Chew card type	Total (n = 10 443)	Possum (n = 2505)	Cat (n = 37)	Mustelid (n = 33)	Rodent (n = 410)
Possum	77.1	90.6	8.1	60.6	65.1
Predator	22.9	9.4	91.9	39.4	34.9

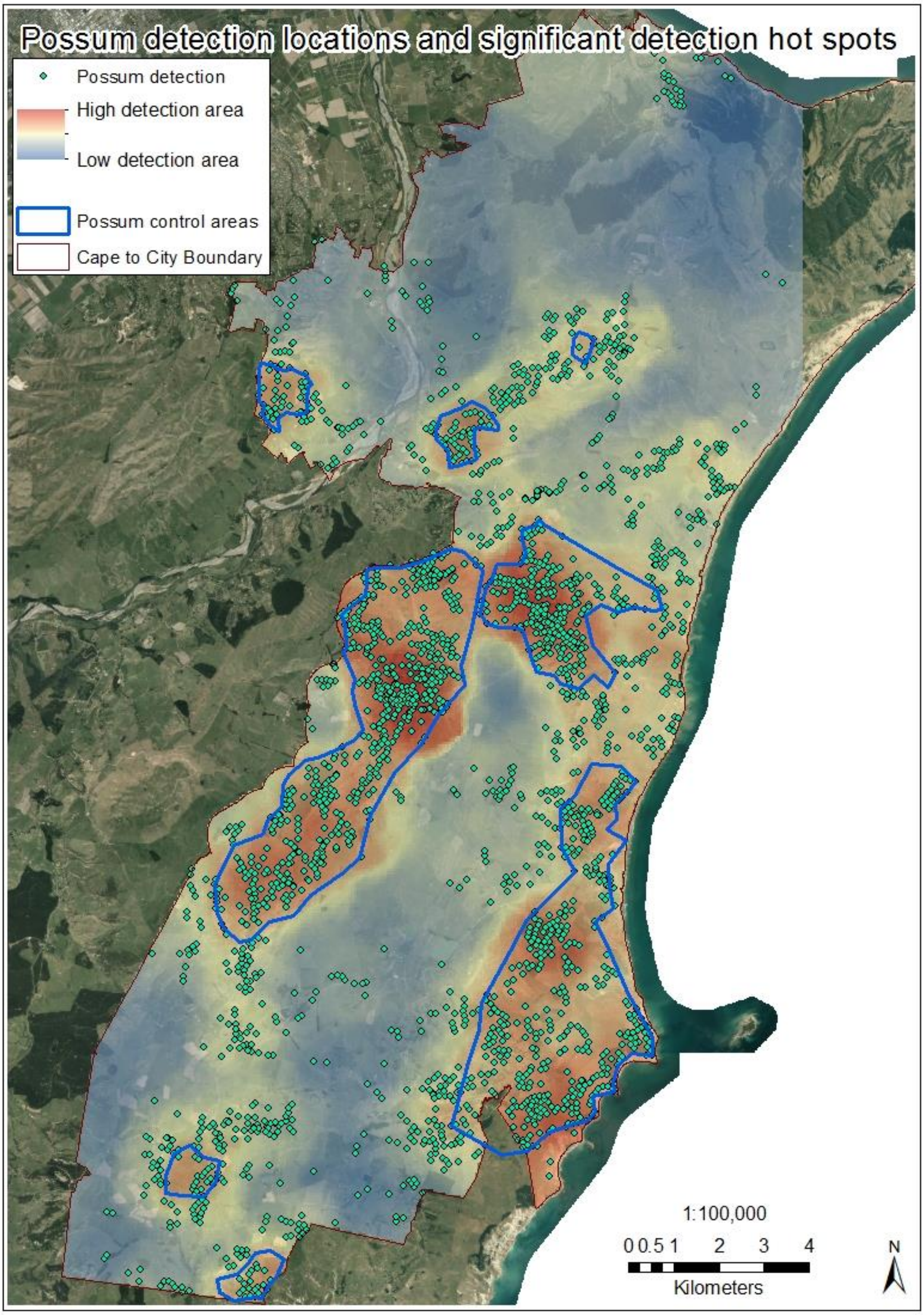

Figure 4 Possum Hot Spot Analysis and suggested areas for future control

5 Conclusions

Possums were widely distributed across the study area, but hot spots were identified in the centre and along the mid-western and south-eastern boundaries. By focusing control on these hot spots, the area of control will be greatly reduced without losing significant area-wide control efficacy. When targeting hot spot areas for future control, CCs and follow-up control should be deployed within LCDB 4.1 possum habitat that includes a 100-m buffer around these habitat patches. This will ensure the majority of possums will be at risk while considerably reducing the total area surveyed and controlled. Although the remaining area has very low to low abundance of possums, further discussion is required on how best to manage these areas. Two possibilities are (1) spell the areas for 2–3 years with no possum control and then address any increase in numbers, or (2) establish possum kill traps at a selection of the same sites as the predator traps to maintain a low intensity maintenance regime.

The proportion of CCs that detected possums increased the longer they were deployed. While this provides better data about the distribution of pests, it most likely over-represents their abundance because the longer CCs are available, the higher the number of multiple interactions. Based on the limited data, 14 days appears an optimal deployment length for CCs, balancing the need to increase sensitivity related to distribution without over-estimating abundance. This is further supported by the ratio of kills to detection, which was higher when CCs were deployed for 14 days compared to 7 or 28 days. However, this result should be viewed cautiously due to the lack of replication. We cannot ascertain whether the low number of bodies recovered at 7 and 28 days was due to the different deployment lengths or other factors such as variation in search effort between individual contractors or differences in detectability between habitat types where possums were detected.

Using CCs followed by Feratox® or kill traps appears to have achieved only a c. 50% kill. Other agencies using detection then control typically set 3–4 leg-hold traps for 3–4 nights and achieve kills from 50% to 80% (P. Sweetaple pers. comm.), somewhat higher than we observed. However, these higher kill rates are for initial control operations. Given control has been applied in this area for several years and the control is now essentially in a maintenance phase, a 50% kill would be more than sufficient to maintain or reduce the residual possum population. Additionally, if such control was applied annually, 50% kill should be more than sufficient to maintain possum numbers at low levels.

Predators had low detection rates and were less widely dispersed than possums across the C2C area. Rodents were concentrated in the north-western section, where there were few possum detections. Mustelids were not widely detected and we only identified one hot spot, which was centred on the south-western boundary. Similarly, we identified hot spots of feral cat activity in the southern section of the Cape to City area. Although it might be expected that these predators would more closely overlay rodent distribution, other food sources, such as rabbits, may be more plentiful in the southern end of the project area. However, it should be noted that although we identified hot spots of rodent activity in the north, there were numerous rodent detections throughout the southern parts as well. This distribution pattern may also be due to different contractors used during the CC survey having different competencies at reading cards.

The small number of predators identified could have been due to several factors such as low predator numbers, lack of experience identifying less common teeth marks or damage to the cards. The teeth marks left by possums and rats on CCs are easy to identify, but because carnivores and mice leave less obvious evidence, they are easily overlooked. Additionally, both possum and rat chew marks could obscure those of other species, but the extent to which this occurs is unknown. Possums were detected mainly on possum cards while feral cats were detected almost exclusively on predator cards. Consequently, if the aim of a survey is to detected feral cats, then predator cards should be used. Mustelids and rodents were detected on both card types, although at a significantly higher rate on predator cards compared with the proportion deployed. Therefore, either card type can be used to detect both species but predator cards are more sensitive to their presence. However, with the increasing use of camera traps (trail cameras) for detecting wildlife, these might be a better multi-species detection tool than chew cards.

6 Recommendations

- Based on the available data 14 days appears to be the optimal deployment length for possum chew cards.
- Concentrate future possum control within the C2C area in and around the polygons identified in Figure 4.
- When targeting areas for future possum control, using chew cards in patches of possum habitat greater than 1 ha plus a 100-m buffer around it should detect the majority of possums while considerably reducing the total area needing to be surveyed and controlled.
- Feral cat and mustelid distribution needs further confirmation and is probably best based on use of camera traps.
- If camera traps are not available, predator chew cards should be used for detecting feral cats and either predator or possum chew cards for detecting mustelids and rodents.

7 Acknowledgements

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Appendix 1 – LCDB v4.1 Vegetation classes considered as habitat suitable for possums

Broadleaved indigenous forest

Deciduous hardwood forest

Exotic forest

Fernland

Flaxland

Forest harvested

Gorse and/or Broom

Indigenous Forest

Manuka and/or kanuka

Matagouri or grey scrub

Mixed exotic shrub land

Sub Alpine shrub land

Tall tussock grassland

Appendix 2 – Predator maps

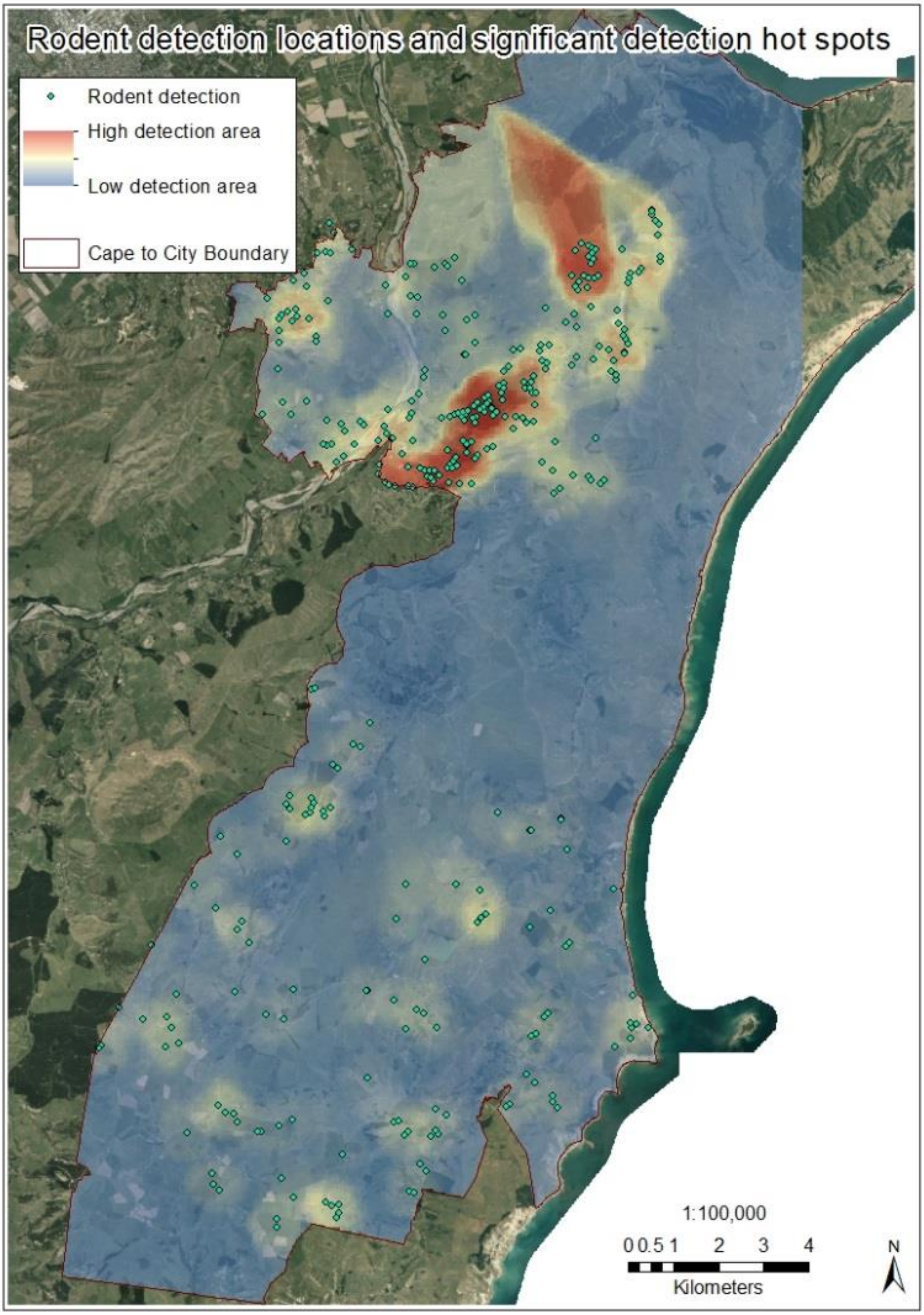

Figure 5 Rodent Hot Spot Analysis

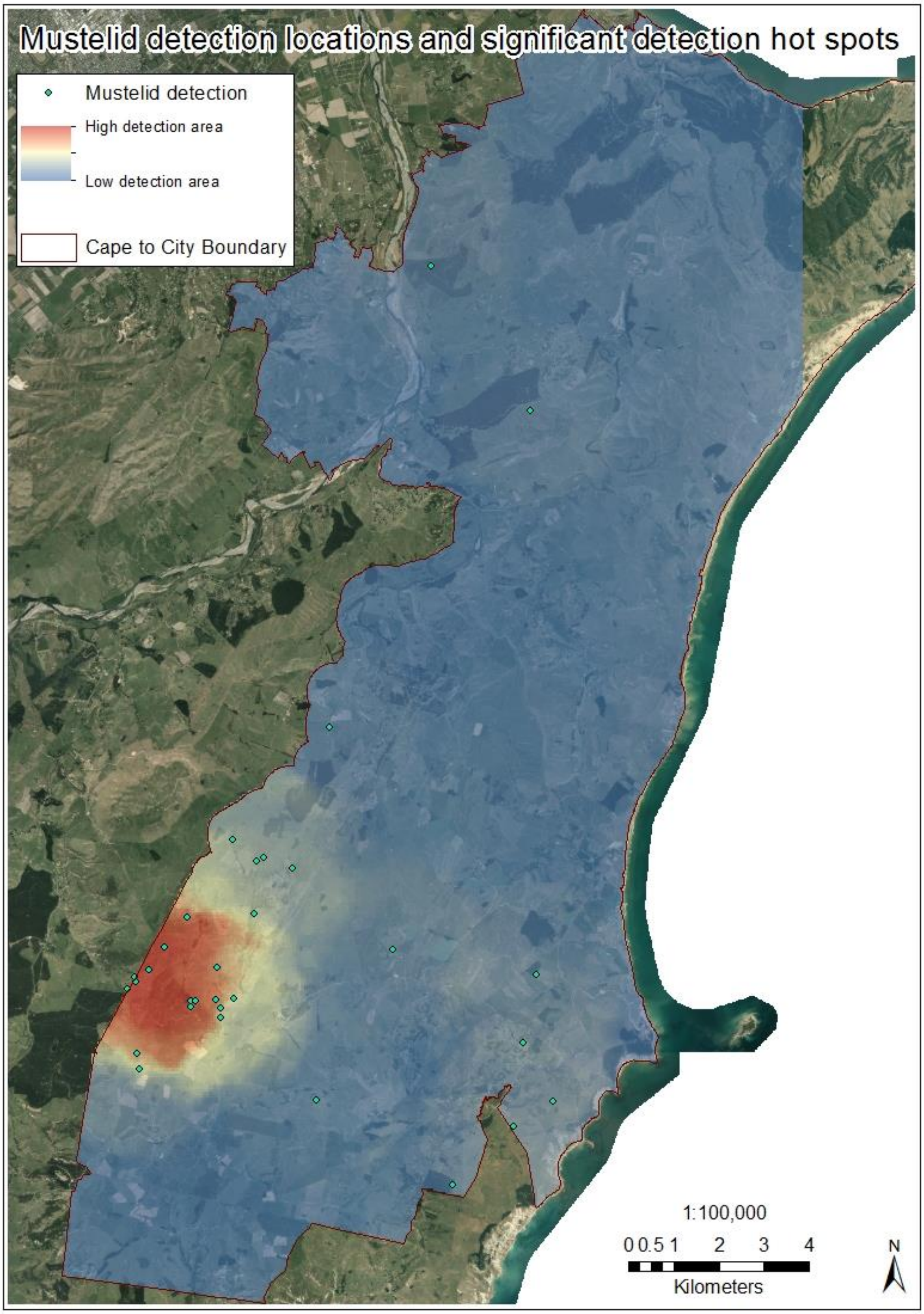

Figure 6 Mustelid Hot Spot Analysis

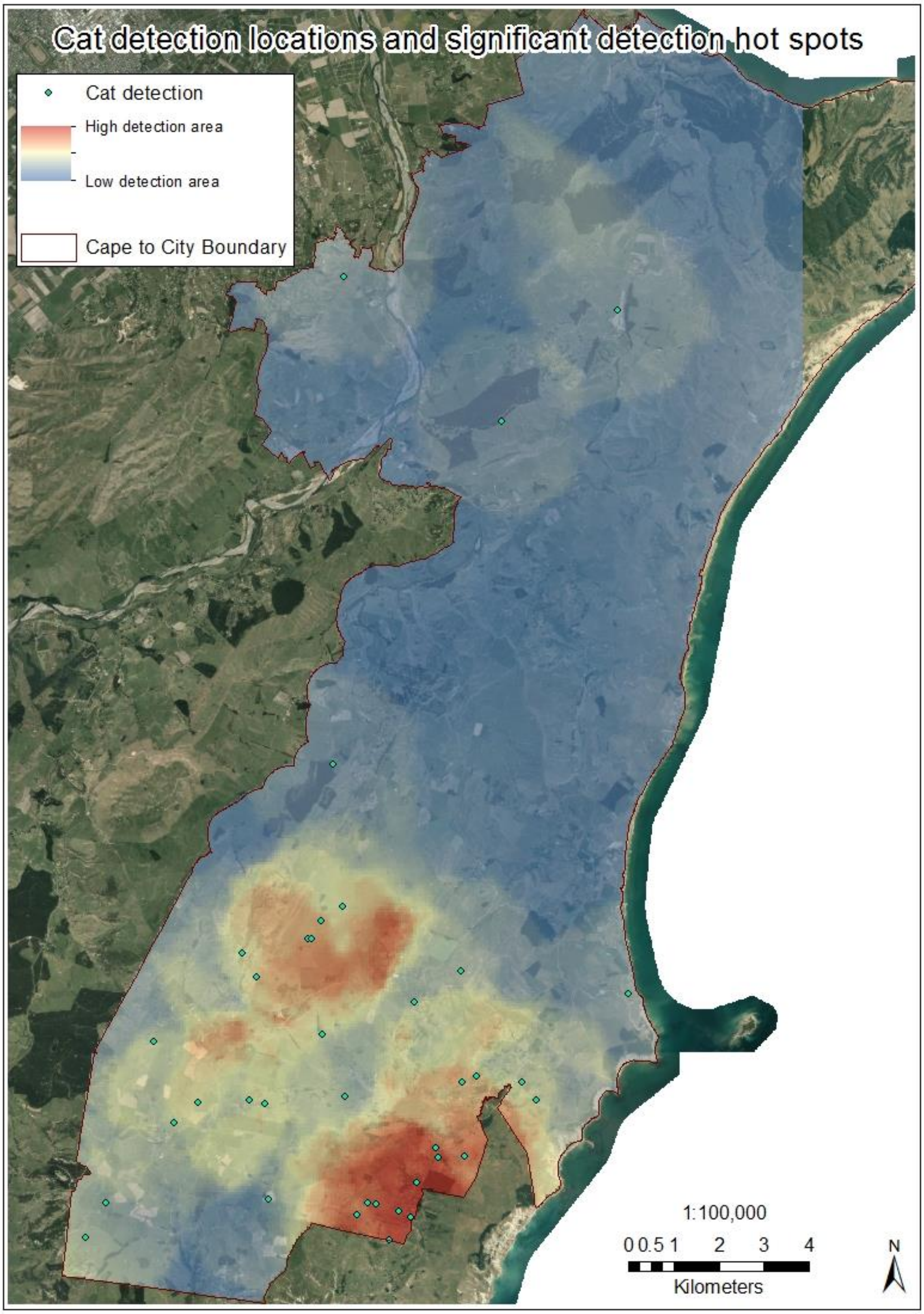

Figure 7 Cat hot spot analysis