Landcare Research
Manaaki Whenua

Study design to assess the effects of fur harvest on Crown land in reducing post-control possum population recovery on adjacent council-administered land

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1 Introduction

In May 2013, Landcare Research scientists facilitated a workshop that brought together representatives of Horizons Regional Council (HRC), the Department of Conservation (DOC) and the fur harvest industry to explore options for testing the effects of harvest on reducing the numbers of dispersing, or cross-boundary ‘spillover’ possums (Envirolink Report 1282-HZLC95). The workshop participants agreed to test the concept using a study design developed by Landcare Research and aligned to ongoing HRC possum control operations (PCO). Based on subsequent discussions between partner agencies and preliminary simulation modelling, this report outlines the agreed study design to be implemented initially in 2014–15.

2 Background

Possums are managed using differing control strategies on lands administered by regional councils and by DOC. The Biosecurity Act 1993 was amended in late 2012, which altered the position of the Crown with regard to its responsibilities in relation to regional pest management plans (RPMP). Section 5 of the Act now requires the Crown to comply with ‘good neighbour rules’ within these plans. Good neighbour rules are designed to address the external effects of pests spilling over onto adjacent properties and causing unreasonable costs to the occupier of that land. The larger intent of requiring Crown compliance is to help ensure that RPMPs are effective at controlling pests across broad landscapes, without being compromised by adjacent uncontrolled areas on Crown land. One such pest is the brushtail possum (*Trichosurus vulpecula*), which may be abundant in some Crown-administered forest blocks adjacent to agricultural land on which a regional council controls, or regulates control of possum numbers.

There is therefore increasing pressure on both parties to act as a ‘good neighbour’ and to coordinate the timing and intensity of possum management as, without coordination, there may be significant opportunity cost to either or both managing agencies. One potential approach to reduce costs while contributing to shared outcomes is to incorporate fur recovery by professional trappers into management strategies and to take account of the impact of this fur harvesting in reducing possum numbers and spillover effects. The efficacy of this approach is yet to be tested. Any test will require collaboration between management agencies, possum hunters and wildlife scientists.

3 Objective

- To design a study to test the efficacy of fur harvest on reducing the numbers of dispersing, or cross-boundary ‘spillover’ possums, aligned with operational possum control by Horizons Regional Council and the Department of Conservation.

4 Overview of study design

Farmland blocks in HRC PCO areas adjacent to DOC forest land will receive routine HRC possum control. To determine whether possum control by harvest on DOC land reduces post-control population recovery rates in the PCO blocks we will compare possum recovery rates in ‘treatment’ blocks, where possums are harvested on adjacent DOC land, with ‘non-treatment’ blocks adjacent to un-harvested DOC land. The design is based on the untested assumptions that spillover possums make a significant contribution to post-control population recovery and that normal intensities of fur harvest reduce possum densities such that density-dependent dispersal is constrained. Density-dependent dispersal may play some role in initial recovery following control (Ji et al. 2004; Nugent et al. 2010), especially for yearling males (Ramsey 2005), but most evidence suggests that dispersal is not a key driver of population recovery, particularly for adult possums (Cowan & Rhodes 1992). Although the study question is relatively simple, operational testing is relatively complex and will require coordination of harvest (with DOC facilitating access to forest blocks), possum control operations, and pre- and post-control monitoring of possum relative abundances on adjoining PCO farmland.

5 Operational design

The following operational requirements are summarised in Figure 1 (appended after References).

- Harvested forest blocks should be 500 ha in size and *at least 1 km* from any other harvested or un-harvested study blocks. Possums will be harvested up to the boundary within HRC-managed land.
- Harvest methods may include trapping or application of cyanide paste (Feratox®) depending on operator assessment of local conditions.
- Harvest will follow normal practice and continue in a forest block until the operator decides it is no longer economically viable.
- In harvested DOC blocks, pre- and post-harvest relative possum abundances will be estimated using trap-catch indices (TCI) based on standard NPCA protocols. In un-harvested DOC blocks, a single TCI estimate will be obtained at approximately the same time as the post-harvest estimate in the harvested blocks.
- The relative abundances of possums on the council PCO blocks will be monitored (using standard TCI protocols) prior to, immediately after and one year after control operations to establish: (i) baseline possum abundances; (ii) control effectiveness and starting points for recovery, and (iii) population recovery rates, respectively. Ideally, monitoring should also be carried out 2 years post-control to allow for the possibility that conditions after one year might, by chance, not be optimal for in situ possum recovery thus making recovery difficult to detect robustly. It is acknowledged that funding constraints might limit monitoring capability.

6 Statistical requirements – how many blocks?

In an experimental study such as the one proposed here, experimental blocks will exhibit some intrinsic degree of variation. This is especially true in field settings where there is limited control over environmental variables and also because the response variable in this study (post-control recovery rate of possum populations) is likely to show spatial and temporal variation. It is therefore critical that treatments are replicated so that treatment effects (fur harvest on DOC land) can be separated from normal 'background' variation. Defining the number of replicates (study blocks with and without harvest) is important for both statistical and economic reasons: too few and the study will be unable to detect anything other than a very large effect attributable to fur harvesting; too many and monitoring resources will be wasted. To help determine an appropriate number of study blocks, it is useful to estimate how the ability of the study to detect a real change in relative abundances, i.e. the 'statistical power,' will vary with the number of blocks. There is a common convention for setting a threshold for statistical power at 0.80, i.e. an 80% chance of detecting a specified real difference.

In December 2013, Landcare Research scientists met with HRC staff to discuss the availability of monitoring data that could be used in a power analysis to predict the number of replicates required in this study. Unfortunately, minimal pre- or post-control possum monitoring is done by the council, so we had to estimate post-control population recovery using an existing possum spatial model.

We used the spatially-explicit, individual-based possum population model developed by Ramsey and Efford (2010). Briefly, the model simulates individual possums, where each individual has a home-range centre and a home-range-utilisation area about that centre. An individual's home range remains fixed for life unless the possum disperses. The model assumes that all juvenile possums disperse once they become independent from their mother although the distribution of dispersal distances meant that, in agreement with field observations, most female young tend to settle near their natal range (63% within 1 km) while the majority of males (74%) move over 2 km away (Cowan & Clout 2000). The model allows a population to be defined in terms of its habitat-specific carrying capacity (maximum uncontrolled density) and growth rate. Various trapping regimes can then be imposed on a population using estimates of predicted catch rates.

We simulated post-control recovery of possums on a farmland block of approximately 1100 ha (based on the mean block size from information supplied by HRC). Average possum carrying capacity in the farmland habitat was assumed to be 1.4 possums/ha of total area and control operations were assumed to reduce the possum trap-catch index (TCI) to ~1.5% within habitat patches. In adjacent forest blocks, carrying capacity was assumed to be 10.0 possums/ha. The model produced estimates of possum density and TCI for the block, based on captures on 13 standard NPCA trap-lines, as the simulated population recovered. The probability of a trap catching a possum is a chance event which the model simulates by random draws based on G_0, a combined probability of catching a possum on one night at the centre of its home range and of where a trap is in relation to that home range centre. Each 'run' of the model therefore produces a slightly different result. To summarise this built-in variation we ran the model 1000 times and calculated the mean and the standard deviation (variability around the mean) for TCI one year post-control. These estimates were then used in a power analysis which, essentially, asks the question, 'Given the inherent variability in a measure, what size difference in abundance would we detect for *x* number of blocks?'

The model predicted a mean TCI of 1.69 on controlled farmland blocks one year after control. Assuming that the harvest on adjacent DOC land removes immigration's contribution to population growth on the farmland block, the minimum number of blocks required to detect a relative difference in TCI between blocks with (un-harvested) or without (harvested) immigration is shown in Table 1.

Table 1 Predicted detectable differences in post-control trap-catch index between treatment and non-treatment blocks

Number of blocks per treatment	Difference in absolute TCI (%) able to be detected between harvested and unharvested blocks	Equivalent to a percentage difference in TCI between blocks of:
2	5.06	299
3	2.75	162
4	2.13	126
5	1.81	107
6	1.61	95
7	1.46	86
8	1.35	80
9	1.26	74
10	1.19	70
11	1.13	66
12	1.07	63
13	1.03	61
14	0.99	58
15	0.95	56
16	0.92	54
17	0.89	52
18	0.86	51
19	0.84	49
20	0.81	48

Key points:

- If TCI in blocks with immigration one year post-control is double that in treatment blocks (i.e. 100% difference), 6 blocks *per treatment* are required.
- If TCI with immigration is 75% greater than without, 9 blocks per treatment are required.
- To detect a 50% difference, 19 blocks per treatment are required.
- Pre-control possum monitoring should be done on the farmland adjacent to both treatment (adjacent to harvested DOC land) and non-treatment (adjacent to un-harvested DOC land) blocks prior to control operations to assess the effectiveness of those operations. This is important in estimating relative post-control recovery rates.
- The ideal design includes pre- and post-PCO control monitoring. The reasons are as follows:

    i. Pre-control monitoring – this will indicate whether all of the PCO blocks can sustain approximately the same possum densities. If one block was, in some way, less favourable possum habitat irrespective of control then that block may show poor post-control population recovery that is unrelated to whether or not harvest occurs on adjacent DOC estate. Given that financial constraints may limit the number of blocks that can be monitored in any one year, accounting for an unusual block early on may help deal with any confounding effects of ‘block quality’ in analysing the data.

    ii. Immediate and plus-one-year post-control monitoring is essential in all blocks because it is the difference between these values that allows estimation of the rate of post-control population recovery in a PCO block.

- If funding constrains this ideal protocol, then losing the pre-control surveys is perhaps less critical to the design, but this runs the risk of having large amounts of unexplained variability in the effects that may preclude the detection of a real effect of harvest.
- It is not important to run the full design in one year if resources are too limited – half of the blocks could be run in one year and the other half in the next year so long as there are an equal number of treatment and non-treatment blocks run in each year.

In summary, we cannot predict in advance the likely magnitude of any reduction in post-control possum population recovery caused by reducing immigration of spillover possums and therefore cannot predict with certainty the number of blocks required to detect that change. The simple recommendation is to use as many replicates as possible, but certainly no fewer than six pairs (harvested and un-harvested) per year.

The above point leads to questions over the duration of the study. It is likely to be advantageous to spread the operational costs of the study over more than one financial year. The key point is that the basic study design should be repeated in any subsequent years (Figure 2 – appended after References). Running a second, or third, year of the study would require careful coordination of pre- and post-harvest and control monitoring (i.e. the Year 1 control plus 1 year TCI monitoring on PCO blocks and the pre-control TCI monitoring on Year 2’s blocks) to spread costs.

7 Data collection and management

In order for results and conclusions from the study to be reliable and therefore useful, monitoring data must be collected in a standardised and consistent manner. Therefor all pre- and post-harvest and pre- and post-control monitoring of possum relative abundances must be carried out following standard National Possum Control Agencies (NPCA 2008) guidelines for TCI monitoring (available at http://www.npca.org.nz/images/stories/NPCA/PDF/a1_monittrapc_201110_web.pdf). Trap-catch data should be recorded on standard data sheets as shown on p. 25 of the NPCA protocol.

For the fur harvest, we need to know daily catch rates on lines. This would require harvesters to record:

i. The number of traps (or bait sets) on the line

ii. The number of possums captured (or poisoned) per day

iii. The number of traps sprung, but empty, and other species captures per day

Ideally, all devices (traps and poison baits) should have their locations recorded on GPS units.

Also, because the phase of the local possum breeding cycle during which harvest and control take place may affect dispersal and recovery dynamics, it would be valuable for all trappers to record the numbers of pouch young encountered in checking traplines or recovering carcasses. Additional information on operational costing and bulk fur prices will be useful at the conclusion of the study to assess the economic sustainability of maintaining harvest as a method for maintaining possum populations at lower levels.

Subject to the availability of ongoing research funding, copies of all monitoring data will be forwarded to Landcare Research for analysis and interpretation.

8 Next steps

Following agreements from all research partners on the scope and general design of the proposed study, the next stage will be to identify study sites within those HRC PCO blocks scheduled to receive possum control in the next financial year. This will likely require a hierarchical approach where blocks that are both due for control and adjoin conservation land are first identified. From these, sites need to be assigned as ‘treatment’ blocks, where possums are harvested on adjoining conservation land, and ‘non-treatment’ blocks, where no harvest takes place on adjoining conservation land, but possum relative abundance is monitored. Next, HRC staff and fur harvesters need to prepare detailed operational plans so that monitoring, control and harvest activities are carried out in a coordinated sequence following the design outlined above.

9 References

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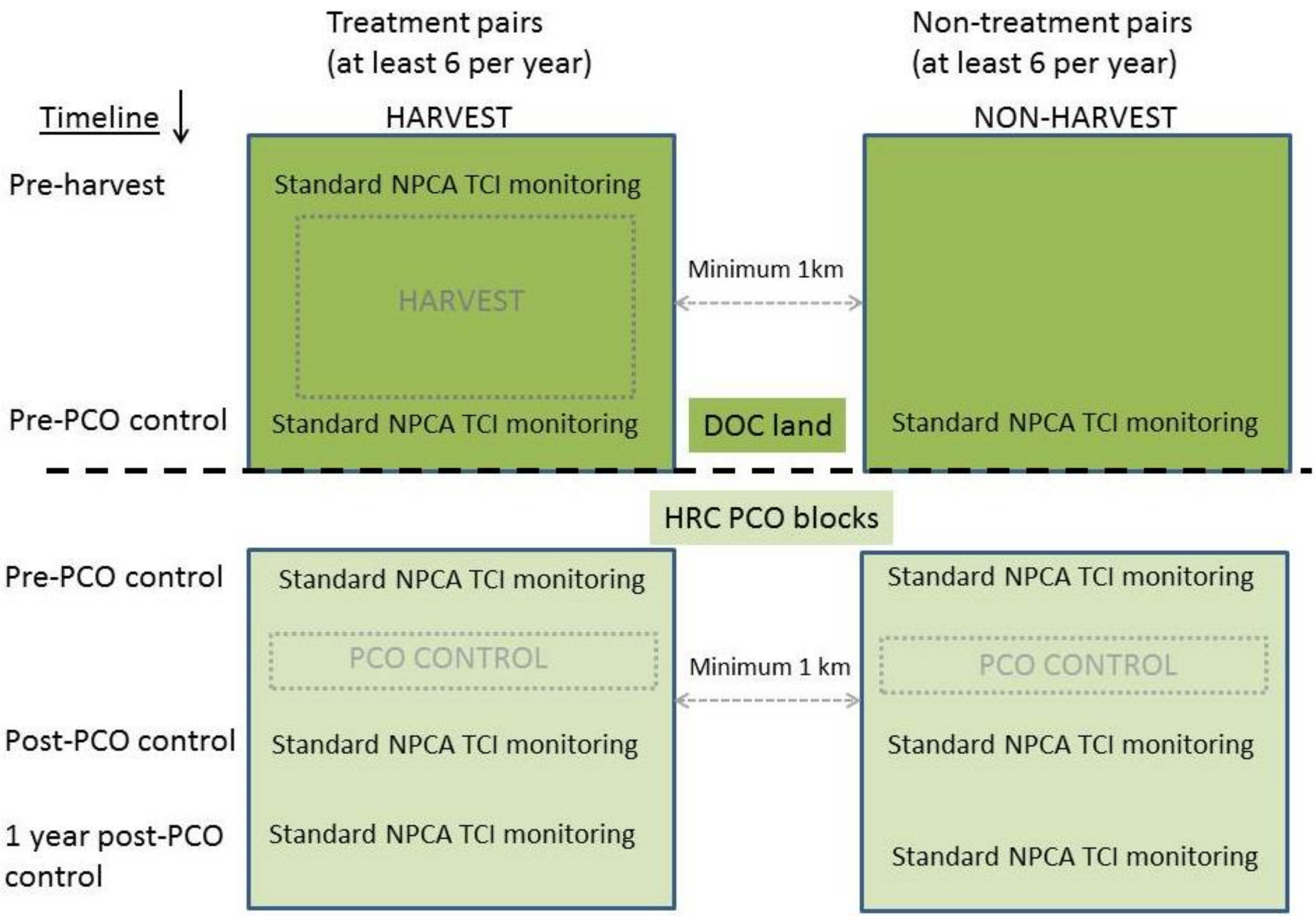

Figure 1 Summary of study design requirements for testing effectiveness of cross-boundary harvest in reducing post-control possum population recovery.

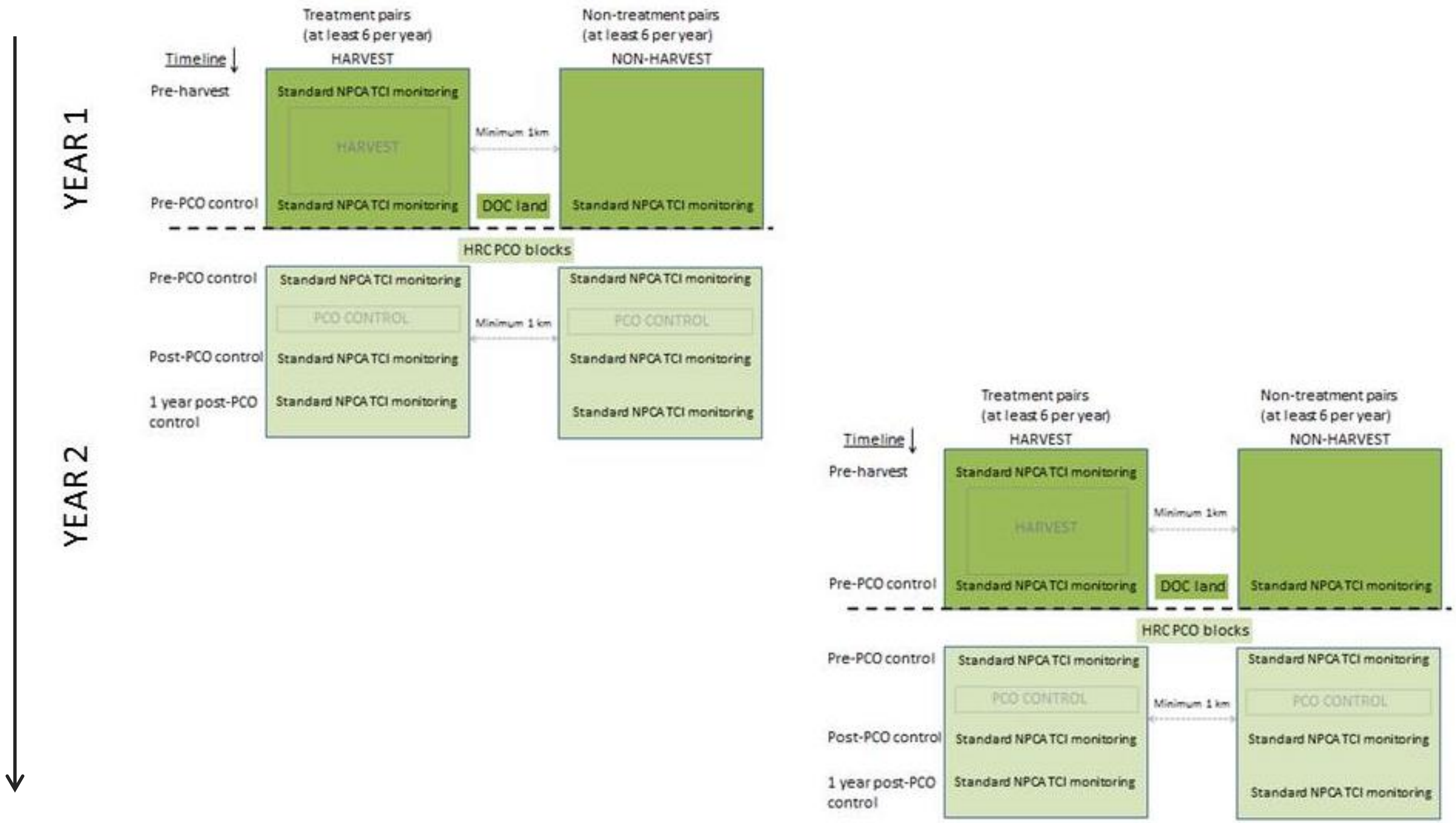

Figure 2 Study design for running study in subsequent years.

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