greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Terrestrial Ecology State of the Environment monitoring programme

Annual data report, 2015/16

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Contents

1. Introduction

This report summarises the results of the Terrestrial Biodiversity State of the Environment (SoE) monitoring programme for the period 1 July 2014 to 30 June 2016 inclusive. The Terrestrial Biodiversity SOE programme incorporates annual monitoring of terrestrial ecological integrity at sampling sites across the region.

This report details the results of terrestrial biodiversity monitoring undertaken at 18 sites in 2014/2015 and 18 sites in 2015/2016. It is not the intention to provide an in-depth discussion of results, conclusions or implications in this report, as it is a data report only.

2. Overview of the terrestrial biodiversity SoE monitoring programme

A framework for monitoring terrestrial biodiversity by regional councils was developed nationally in 2011 (Lee and Allen 2011). The concept of 'ecological integrity' was agreed as the key indicator of ecological health. Ecological integrity is the full potential of indigenous biotic and abiotic features, and natural processes, functioning in sustainable communities, habitats, and landscapes (Lee et al. 2005). Ecological integrity is measured through determining the following three components:

- Species occupancy - are the species present that should be there?
- Indigenous dominance– are the key natural ecological processes being maintained by native biota?
- Ecosystem representation – are the full range of ecosystems in the region being maintained?

The Pressure-State-Response model provides a suitable framework for State of the Environment monitoring and reporting and has been recognised as a useful approach to indicator development and reporting worldwide. This model asks three fundamental questions:

- What are the pressures on the environment?
- What is the state of the environment?
- What is being done about these issues?

The following biodiversity indicators using the Pressure-State-Response model emerged as relevant for regional council biodiversity monitoring requirements in terrestrial ecosystems:

State and condition
1. Land under indigenous vegetation, and 2. Biodiversity condition

Threats and pressure
3. Weed and animal pests, 4. Habitat loss 5. Climate change

Effectiveness of policy and management
6. Biodiversity protection, 7. Pest management and 8. Ecosystem services

Community engagement
9. Protection and restoration, and 10. Weed and pest control

Some biodiversity indicators can be measured using GIS layers (e.g. changes in indigenous land cover) or by gathering existing data (e.g. the number of care-groups involved in pest control), but other information requires the collection of data from the field. This annual data report relates to field data collected annually during the summer months, but it is to be noted that the indicators being measured and reported here are part of the wider indicator framework detailed above.

2.1 Monitoring objectives

The aim of the Terrestrial Biodiversity SOE monitoring programme is to measure the state and trend of ecological integrity across the Wellington region. The monitoring described here is aims to monitor:

1. the state of biodiversity as reflected in the structure and composition of the vegetation, and avian community, and

2. the pressure by weeds and animal pests based on their regional distribution and local abundance, and

3. the effectiveness of pest management based on the abundance (richness, basal area and density) of indigenous plants susceptible to introduced herbivores and the abundance of indigenous bird guilds (herbivores, insectivores, ground dwelling) that are susceptible to introduced herbivores and carnivores.

This data report provides information from the first two years' of fieldwork. The state of the ecological integrity of the region will not be able to be reported until the fifth year of data collection completes the measure of plots across the region. Subsequent sampling will then begin to re-measure sites, allowing trends to be examined.

2.2 Monitoring network

The monitoring network is based on an 8 x 8km national grid of points, 127 of which fall in the Wellington region (Figure 2.1). The 8 x 8km sampling grid was set up to inform the national Land Use and Carbon Accounting System (LUCAS) maintained by the Ministry for the Environment (MfE). The Department of Conservation (DoC) subsequently adopted the grid as the basis for their Tier I Biodiversity Monitoring and Reporting System (BMRS). Birds, vegetation and pests are sampled by DoC on the 8km x 8km sampling grid on DoC managed lands.

In the Wellington region, MfE and DoC monitor at 49 of the 127 potential sample sites. Greater Wellington has agreements with those agencies to use their data and aims to sample the remaining 78 sites over a five year time period (see Figure 2.1). In practical terms, only one 77 points will be surveyed, as one point cannot be sampled as it is in the middle of Lake Wairarapa. Greater Wellington is also monitoring birds and pests at LUCAS sites that are not located on DoC land, as MfE samples vegetation only for carbon accounting purposes.

In the first year of the GWRC sampling programme (2014/2015), 18 sampling points were monitored (3 DoC, 2 LUCAS and 13 GWRC). Access was refused at two private land sites. In the second year (2015/2016), there were six refusals and 18 sites monitored (3 DoC, 3 LUCAS and 12 GWRC).

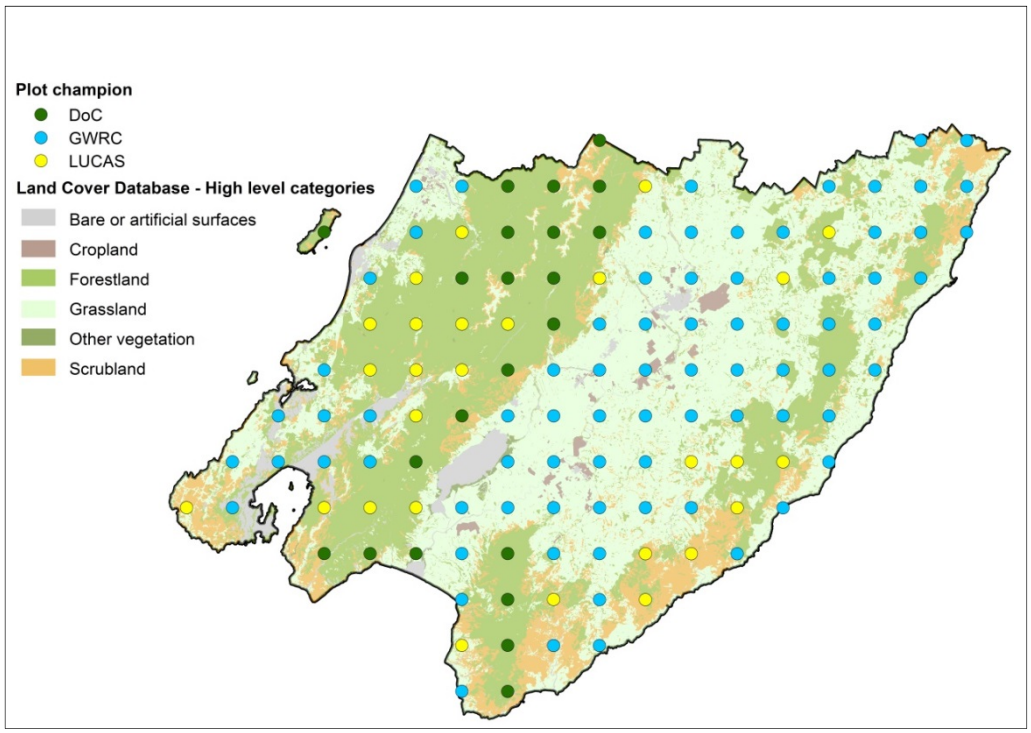

Figure 2.1: Sampling points on the national 8 x8 km national grid

2.3 Monitoring variables

Vegetation, bird species and pest animals are monitored at each of the sampling sites on the 8 x 8km grid. The core sampling site is laid out as shown in Figure 2.2 and monitored following DoC sampling procedures (Department of Conservation 2016a, 2016b). The monitoring methodology is outlined below with further detail provided in Appendix A. An example of a field sample layout is shown in Figure 2.3.

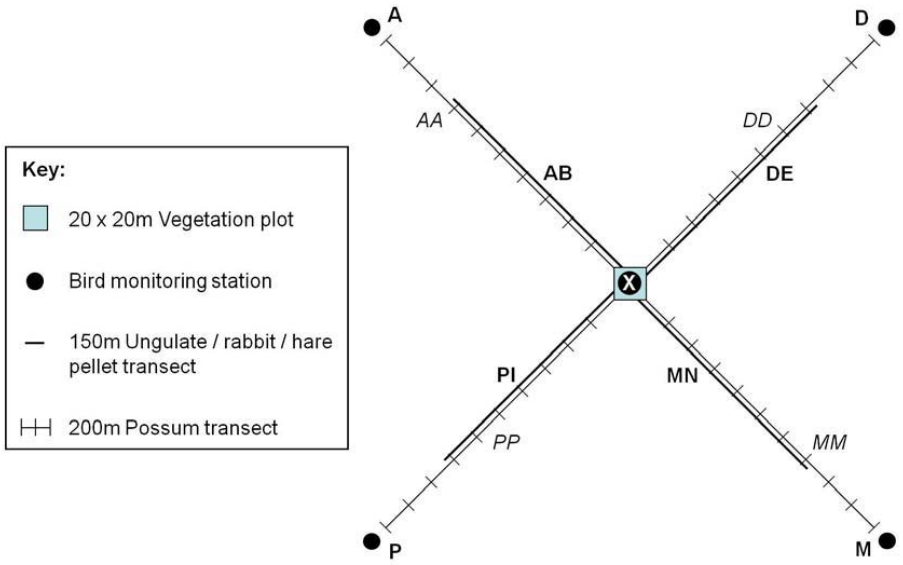

Figure 2.2: Monitoring layout for vegetation, pests and birds at each sampling point

2.3.1 Vegetation

The number and types of plant species (composition) and structure (different growth stages) of all vegetation is recorded within a 20 x 20m plot.

2.3.2 Birds

Bird counts are conducted at five stations at each site (one near the plot and the other four at 150m away, at locations that radiate out from the corners of the plot). Two sets of five minute bird counts are completed, with one count that includes a distance measurement between the count station and the birds recorded.

Figure 2.3: Example of plot layout in a production landscape

2.3.3 Pests

Possums, deer, goats, rabbits and hares are monitored at each sampling location. Possum monitoring is currently completed using chew cards on 200m long transects that radiate from the corners of the plot. The methodology for possum monitoring has changed between 2014/2015 and 2015/2016. DoC used leg-hold traps for the possum transects in 2014/2015, while GWRC used wax tags. This is because GWRC were working largely on farmland and leg-hold traps could not be used. Wax tags were deployed in the nearest possum habitat to the plot within a radius of 500m. In the second season (2015/2016) GWRC also included chew cards along the 200m transects radiating from the corners of the plot and have now transitioned to only using chew cards.

The presence of goats, deer, rabbits and hares is measured using pellet counts on transects that are established parallel to the possum monitoring transects.

3. Results

3.1 Vegetation

Of the 36 sites surveyed in the Wellington region in the 2014/2015 and 2015/2016 field seasons, 17 (47 percent) were dominated by indigenous plant species and 19 (53 percent) by exotic plant species (Figure 3.1; Appendix B, Table B1). Vascular plant species richness in the plots ranged from 15 to 86 species with an average of 43 species per plot.

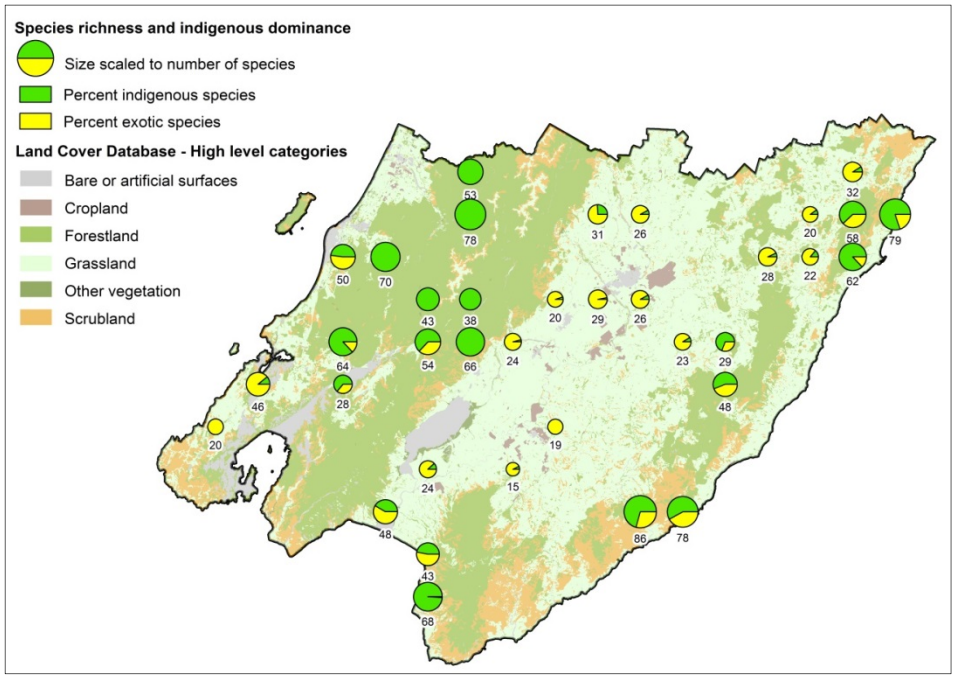

Figure 3.1: Plant species richness and indigenous dominance in the plots sampled in 2014/2015 and 2015/2016

3.2 Birds

Of the 36 sites where birds were surveyed in the Wellington region in the 2014/2015 and 2015/2016 field seasons, 16 (44 percent) were dominated by indigenous bird species and 20 (56 percent) by exotic bird species (Figure 3.2; Appendix B, Table B2).

Forty three bird species were encountered in the first two seasons of this SOE monitoring. Twenty four of these species were indigenous (56 percent) and the other 19 species were exotic (44 percent). The number of bird species encountered at each of the 36 sites ranged from nine to 25 species with an average of 16 species per sampling point.

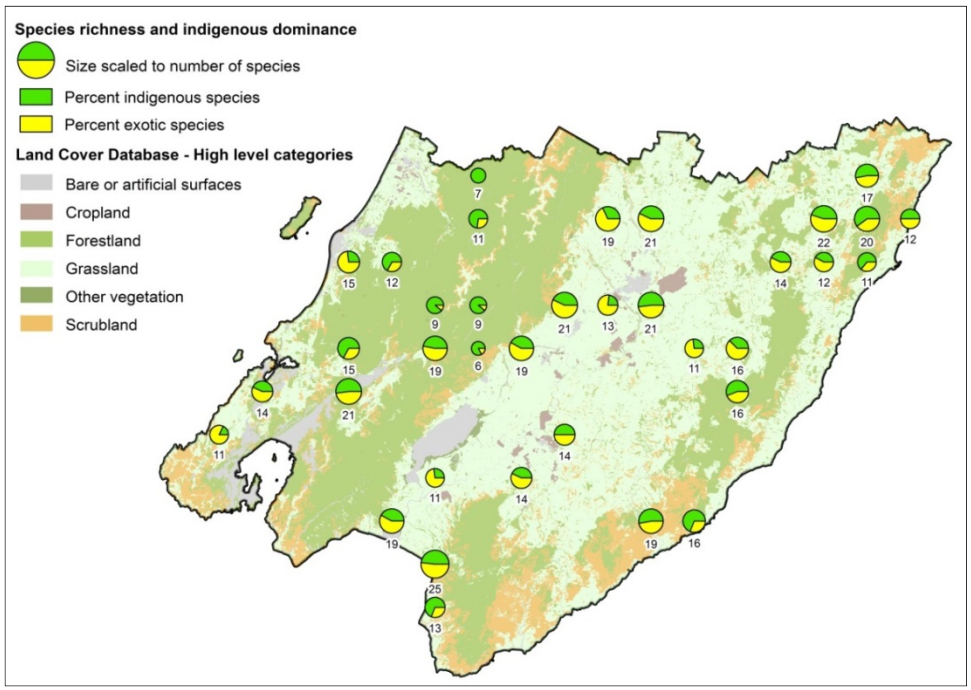

Figure 3.2: Bird species richness and indigenous dominance at the 36 sites sampled in 2014/2015 and 2015/2016

3.3 Possums

Possum densities were generally low, with six exceptions (Figure 3.3, Appendix B, Table B3). Of the high possum density sites, half were in production forest landscapes. The other three sites were on conservation land, in an urban area and on a sheep and beef farm.

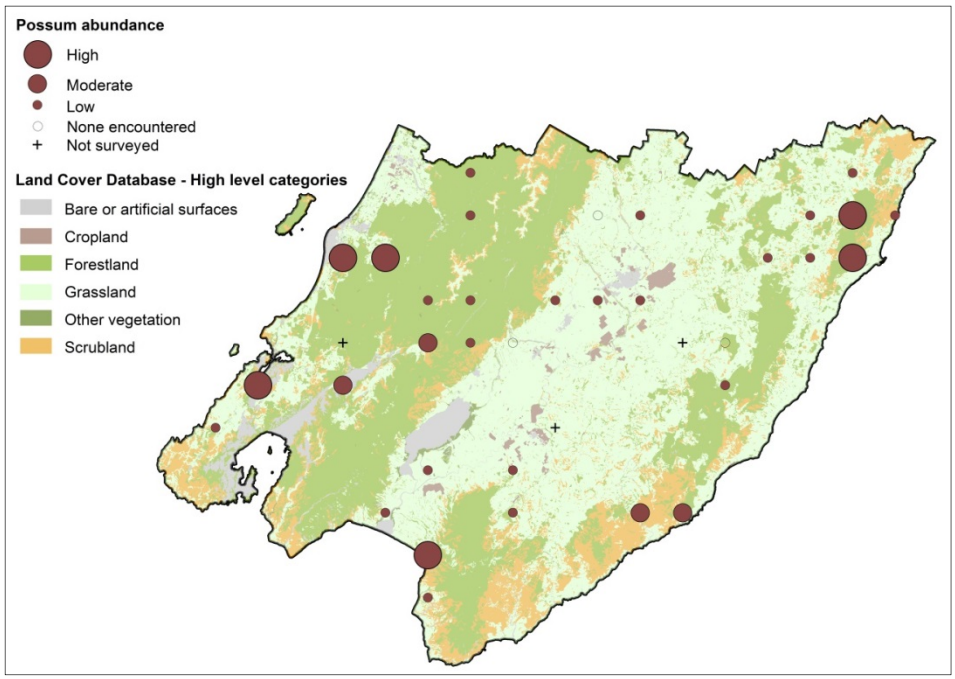

Figure 3.3: Density of possum recorded by chew cards, leg-hold traps and wax tags at the sites sampled in 2014/2015 and 2015/2016 (High = ≥20%; Moderate = 10%-19%; Low = <10%)

3.4 Ungulates and lagomorphs

Deer and goat pellets were most frequently recorded along the east coast with low numbers encountered through the Tararua Ranges (Figure 3.4; Appendix B, Tables B4 and B5). Lagomorphs (rabbits and hares) and livestock (cattle and sheep) were both recorded from nearly two thirds (22/36) of the sites sampled. Pigs were present at 10 of the 36 sites sampled (Appendix B, Table B4).

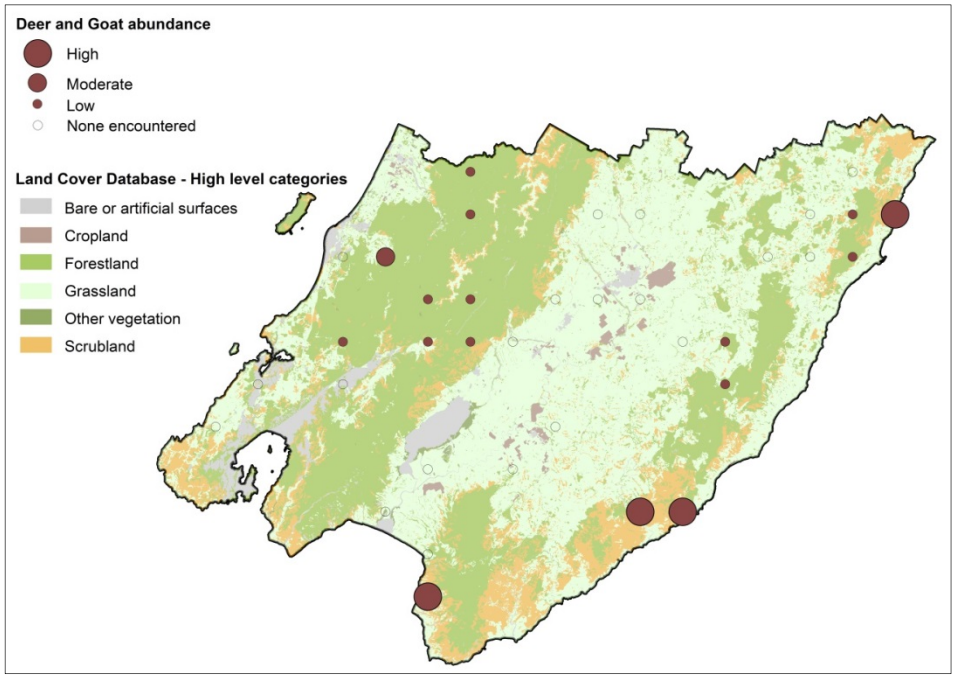

Figure 3.4: Numbers of quadrats with deer and goat pellets out of the 120 quadrats sampled at each site in 2014/2015 and 2015/2016

Acknowledgements

The field team who collected this data included Grant Redvers and Luke Crouch who set up the plots and were the lead monitors for the possum and ungulate monitoring. Jacqui Bond and Jenny Dolton were the programme botanists in the first field season (2014/2015) and Finn Michalak and Yong Tang in the second field season (2015/2016). Robin Toy completed bird monitoring in both seasons. Nikki McArthur advised on the establishment of the programme, while Owen Spearpoint provided guidance on the vegetation sampling method, and Sara Moylan helped with wax tag and chew card identification. Owen audited the first season's vegetation surveys and Ian Payton the second season.

 Information on the Department of Conservation's sites sampled was supplied by Meredith McKay and on the LUCAS plots by Joanna Buswell. Elise Arnst provided downloads from the National Vegetation Survey Database.

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Appendix A: Sampling methods

A1. Vegetation

At each site the monitoring team establish a permanently marked 20m x 20m vegetation plot, divided into 16 (5m x 5m) subplots (Figure A1). In each plot all the trees and tree ferns (>2.5cm Diameter at Breast Height [DBH]) are tagged and have their diameters recorded. The exception to this is production forests, where trees are measured but not marked as there is a concern that marking trees could influence the management at the site. Saplings (> 1.35m and <2.5m tall) are counted for each species in the plot. Circular understory plots (0.5m radius) are positioned half way along the boundaries of the subplots that lie within the 20m x 20m plot boundary. This gives 24 ($0.8m^2$) understory plots in which all species <1.35m tall are counted (Department of Conservation 2016a).

A2. Birds

Bird counts are conducted at five stations at each site, one at Point P (southwestern corner) of the 20m x 20m vegetation plot and the other four at the ends of each of the possum monitoring transects as shown in Figure 2.2. Bird counts are conducted as two sets of five minute counts, in one of which the distance to the bird is recorded at each count station (Department of Conservation 2016b).

A3. Possums

Possum monitoring transects (each 200m long) are laid out at 45^o angles from each of the corners of the 20m x 20m vegetation plot (Figure A2). Ten chew cards are placed on trees or spikes 20cm-30cm above the ground, spaced at 20m intervals along each of these four possum monitoring transects (i.e. 40 cards per site). Cards are left out for one dry night and the bite marks on cards identified to determine what pests are in the area. DOC settled on one night so that cards could be deployed and collected during the same trip to remote locations to keep the cost down (Department of Conservation 2016b).

When DOC started monitoring their Tier I plots, possum monitoring was completed using leg-hold traps. These were however not an option in production landscapes where livestock may be injured. DoC have recently converted to chew cards at all sites as these are considered easier to deploy (Forsyth et al. 2015).

Greater Wellington used wax tags for possum monitoring in its first two seasons of monitoring, but also used chew cards in its second season. Greater Wellington will discontinue using wax tags and continue with chew cards. The wax tags were not placed on the lines off the corners of the vegetation plot as per the protocol, but were run as four lines of ten wax tags each, spaced at 20m intervals, in the nearest wooded areas. Wax tag lines were not sampled if there were no wooded areas close by and fewer lines were sampled if there was not enough wooded area to locate all four lines in. The chew cards are used in all habitats. Although established primarily to monitor possums, the chew cards also record the presence of rats and mice.

Ungulates

Ungulate pellet density transects (each 150m long) are established parallel to the pest species transects off the corners of the vegetation plot, spaced 3.5m apart. These transects start at the next sub-plot corner clockwise around the vegetation plot from the possum monitoring transect (Figure A2). Each line consists of 30 quadrats, spaced at 5m intervals (i.e. 120 quadrats per site). Each quadrat has a 1m radius ($3m^2$) in which all

ungulate dung pellets are recorded. Nested within this quadrat is an inner sub-quadrat with a 0.18m radius ($0.1m^2$) in which all hare and rabbit pellets are counted. In the first season the team realised that they could not reliably distinguish deer and goat pellets, so these have been combined in the monitoring results described here (Department of Conservation 2016b).

Site descriptions data are recorded with the intention of revisiting sites on a five year rotation.

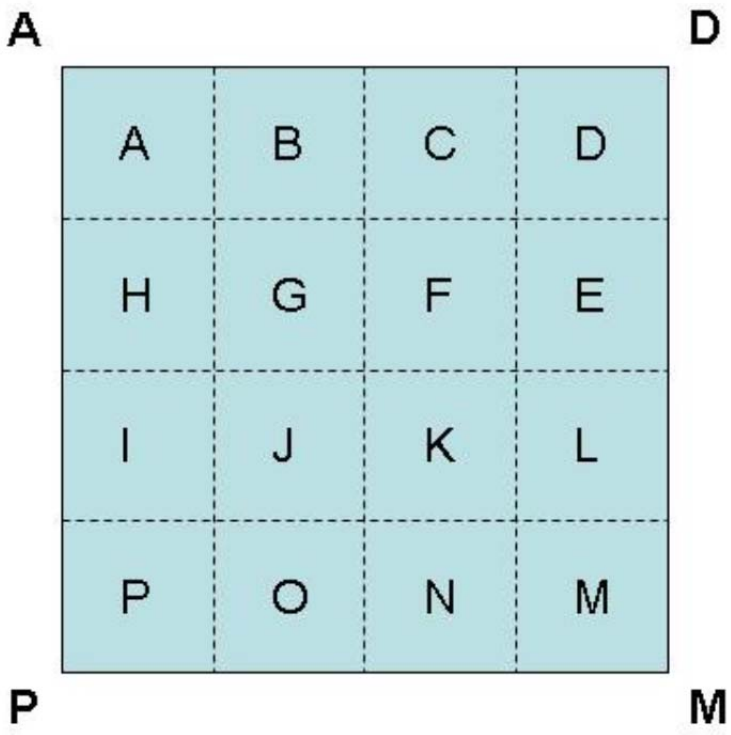

Figure A1: Outline of 20m × 20 m vegetation plot, illustrating the labelling system used to identify each corner of the plot and each of the 16 (5m × 5 m) subplots within it

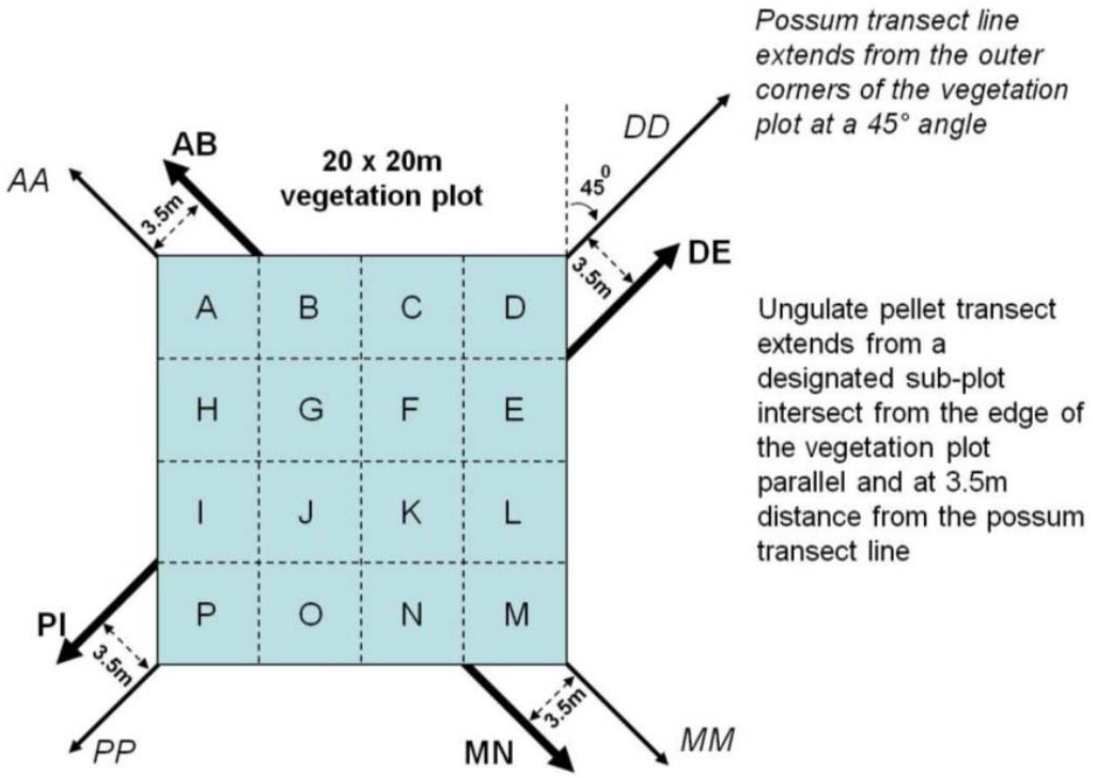

Figure A2: Location of possum transect lines in relation to pellet transects and the vegetation plot layout.

Appendix B: Data tables

1. Vegetation

Table B1: Species richness and indigenous dominance of plant species sampled in 20m x 20m plots at each site

Plot ID	Indigenous species	Exotic species	Unknown species	Total species
CH100	0	20	0	20
CI99	5	41	0	46
CK96	24	26	0	50
CK98	55	8	1	64
CK99	18	10	0	28
CL96	70	0	0	70
CL102	19	27	2	48
CM97	43	0	0	43
CM98	34	20	0	54
CM101	3	21	0	24
CM103	20	23	0	43
CM104	66	1	1	68
CN94	53	0	0	53
CN95	77	1	0	78
CN97	38	0	0	38
CN98	66	0	0	66
CO98	1	23	0	24
CO101	1	14	0	15
CP97	1	19	0	20
CP100	0	19	0	19
CQ95	8	23	0	31
CQ97	1	28	0	29
CR95	2	24	0	26
CR97	2	24	0	26
CR102	60	25	1	86
CS98	2	21	0	23
CS102	45	33	0	78
CT98	20	9	0	29
CT99	27	21	0	48
CU96	2	26	0	28
CV95	2	18	0	20
CV96	3	19	0	22
CW94	3	29	0	32
CW95	36	22	0	58
CW96	54	8	0	62
CX95	63	16	0	79

2. Birds

Table B2: Species richness and indigenous dominance of bird species recorded in five minute bird counts at each site

Site	Indigenous species	Exotic species	Total species
CH100	9	2	11
CI99	8	6	14
CK96	11	4	15
CK98	5	10	15
CK99	10	11	21
CL96	4	8	12
CL102	11	8	19
CM97	1	8	9
CM98	10	9	19
CM101	8	3	11
CM103	13	12	25
CM104	4	9	13
CN94	0	7	7
CN95	3	8	11
CN97	1	8	9
CN98	1	5	6
CO98	11	8	19
CO101	8	6	14
CP97	12	9	21
CP100	7	7	14
CQ95	13	6	19
CQ97	10	3	13
CR95	12	9	21
CR97	10	11	21
CR102	9	10	19
CS98	8	3	11
CS102	5	11	16
CT98	10	6	16
CT99	7	9	16
CU96	8	6	14
CV95	12	10	22
CV96	7	5	12
CW94	8	9	17
CW95	8	12	20
CW96	4	7	11
CX95	6	6	12

3. Possums

Table B3: Numbers of possums, rats and mice recorded from one night of trapping using different devices ("-" indicates that the site was not sampled using that technique)

Site	Leg-hold trap catch		Wax tag records				Chew card records			
	Possum	No. traps	Possum	Rat	Mouse	No. tags	Possum	Rat	Mouse	No. cards
CH100	1	40	-	-	-	-	-	-	-	-
CI99	-	-	14	0	1	40	-	-	-	-
CK96	-	-	21	4	1	40	-	-	-	-
CK98	-	-	-	-	-	-	-	-	-	-
CK99	-	-	4	1	0	39	0	0	0	40
CL96	11	39	-	-	-	-	-	-	-	-
CL102	-	-	-	-	-	-	0	0	0	35
CM97	-	-	-	-	-	-	0	0	5	40
CM98	-	-	4	2	1	40	1	1	2	40
CM101	-	-	1	0	0	20	-	-	-	-
CM103	-	-	8	8	8	40	2	0	2	40
CM104	1	40	-	-	-	-	-	-	-	-
CN94	-	-	-	-	-	-	1	0	0	40
CN95	1	31	-	-	-	-	-	-	-	-
CN97	-	-	-	-	-	-	1	1	3	40
CN98	-	-	-	-	-	-	3	0	0	40
CO98	-	-	0	1	3	40	0	2	0	40
CO101	-	-	3	0	0	20	-	-	-	-
CP97	-	-	1	1	3	38	0	0	0	40
CP100	-	-	-	-	-	-	-	-	-	-
CQ95	-	-	0	1	3	30	0	0	0	40
CQ97	-	-	0	0	2	30	1	0	0	40
CR95	-	-	2	1	1	40	-	-	-	-
CR97	-	-	0	0	6	30	0	0	0	40
CR102	-	-	7	0	1	40	-	-	-	-
CS98	-	-	-	-	-	-	-	-	-	-
CS102	-	-	6	1	0	40	-	-	-	-
CT98	-	-	0	1	7	40	0	0	1	40
CT99	-	-	3	0	0	40	0	0	0	40
CU96	-	-	1	0	0	20	0	0	0	40
CV95	-	-	0	4	7	30	1	1	2	40
CV96	-	-	1	0	4	40	-	-	-	-
CW94	-	-	2	1	2	40	0	0	0	40
CW95	-	-	14	2	0	40	-	-	-	-
CW96	-	-	11	4	2	40	-	-	-	-
CX95	-	-	1	0	3	40	-	-	-	-

4. Ungulates

Table B4: Numbers of 3m² quadrats that pellets were present in at each site

Site	Deer & Goats	Rabbits	Hares	Cattle	Sheep	Pigs	Quadrats sampled
CH100	0	27	10	0	106	0	120
CI99	0	0	0	0	0	0	120
CK96	0	0	0	6	1	0	120
CK98	2	2	0	0	0	0	120
CK99	0	0	0	0	0	20	120
CL96	17	0	0	0	0	1	120
CL102	0	1	1	0	0	0	115
CM97	9	0	0	0	0	0	120
CM98	1	7	0	33	0	3	120
CM101	0	0	2	36	82	0	120
CM103	0	0	1	15	49	0	120
CM104	42	0	0	0	0	3	120
CN94	4	0	0	0	0	0	120
CN95	6	0	0	0	0	0	120
CN97	6	0	0	0	0	0	117
CN98	9	0	0	0	0	0	120
CO98	0	3	0	33	59	0	120
CO101	0	3	5	70	103	0	120
CP97	0	2	0	32	0	0	120
CP100	0	2	7	55	97	0	120
CQ95	0	0	8	17	65	0	120
CQ97	0	5	1	4	86	0	120
CR95	0	2	3	85	0	0	120
CR97	0	19	17	36	0	0	120
CR102	33	1	3	0	18	2	120
CS98	0	0	0	45	81	0	120
CS102	35	0	0	5	17	3	120
CT98	4	0	4	0	0	3	120
CT99	6	0	3	0	0	1	120
CU96	0	0	2	20	8	0	120
CV95	0	0	9	47	92	0	120
CV96	0	12	16	10	115	1	120
CW94	0	10	22	19	103	0	120
CW95	3	0	0	2	9	0	120
CW96	10	0	0	0	0	0	120
CX95	45	0	1	0	10	9	120

Table B5: Number of individual pellets counted at each site for deer and goats in 3m² and rabits and hares in 0.1m²

Site	Deer & Goats	Rabbit	Hares	Quadrats sampled
CH100	0	304	3	120
CI99	0	0	0	120
CK96	0	0	0	120
CK98	8	3	0	120
CK99	0	0	0	120
CL96	131	0	0	120
CL102	0	0	0	115
CM97	55	0	0	120
CM98	1	7	0	120
CM101	0	0	0	120
CM103	0	0	0	120
CM104	597	0	0	120
CN94	16	0	0	120
CN95	82	0	0	120
CN97	0	0	0	117
CN98	139	0	0	120
CO98	0	9	0	120
CO101	0	2	1	120
CP97	0	1	0	120
CP100	0	1	0	120
CQ95	0	0	8	120
CQ97	0	65	0	120
CR95	0	0	0	120
CR97	0	8	12	120
CR102	622	2	59	120
CS98	0	0	0	120
CS102	1059	0	0	120
CT98	264	0	21	120
CT99	269	0	10	120
CU96	0	0	37	120
CV95	0	0	35	120
CV96	0	50	2	120
CW94	0	6	40	120
CW95	20	0	0	120
CW96	174	0	0	120
CX95	552	0	2	120