greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Terrestrial Ecology State of the Environment monitoring programme

Annual data report, 2017/18

Roger Uys
Environmental Science Department

For more information, contact the Greater Wellington Regional Council:

Wellington
PO Box 11646

T 04 384 5708
F 04 385 6960
www.gw.govt.nz

Masterton
PO Box 41

T 06 378 2484
F 06 378 2146
www.gw.govt.nz

GW/ESCI-T-18/140

October 2018

www.gw.govt.nz
info@gw.govt.nz

Report prepared by:	R Uys	Senior Environmental Scientist	
Report reviewed by:	P Crisp	Team Leader, Environmental Science	
Report approved for release by:	L.Baker	Manager, Environmental Science	 **Date**: November 2018

The report may be cited as:

Uys R. 2018. *Terrestrial Ecology State of the Environment monitoring programme: Annual Data Report 2017/18.* Greater Wellington Regional Council, Publication No. GW/ESCI-T-18/140, Wellington.

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 2018 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 19 sites in 2014/2015; 17 sites in 2015/2016; 25 sites in 2016/2017 and 26 sites in 2017/2018. 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 Driver-Pressure-State-Impact-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 Driver-Pressure-State-Impact-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 pressures
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 and ground dwelling) that are susceptible to introduced herbivores and carnivores.

This data report provides information from the first four years of fieldwork. The state of the ecological integrity of the region will be reported after the fifth year of data collection completes the measure of plots across the region. Subsequent monitoring will then begin to re-measure sites, allowing trends to be examined.

2.2 Monitoring network

The monitoring network is based on an 8km x 8km national grid of points, 126 of which fall in the Wellington region (Figure 2.1). The 8km x 8km 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). Vegetation, birds and pest animals are sampled by DoC on the 8km x 8km grid on public conservation land (PCL).

In the Wellington region, MfE and DoC monitor 50 of the 126 potential monitoring sites. Greater Wellington has agreements with those agencies to use their data and aims to monitor the remaining 76 sites over a five-year period (see Figure 2.1). Greater Wellington is also monitoring birds and pests at LUCAS sites that are not located on PCL, as MfE only records the vegetation at non-PCL sites that it monitors.

In the first season of the GWRC sampling programme (2014/2015), 19 sites were monitored (4 DoC, 2 LUCAS and 13 GWRC), with access refused to two private land sites. In the second season (2015/2016), 17 sites were monitored (3 DoC, 3 LUCAS and 11 GWRC), with access refused to six private land sites. The Department of Conservation also sampled the vegetation at an additional site (CS100) for LUCAS in year two, but the birds and pests were only sampled at this site by GWRC in the third year. This site has been counted in the third season of the GWRC sampling programme. In the third season (2016/2017), 25 sites were monitored (8 DoC, 4 LUCAS and 13 GWRC), with access refused to one private land site. In the fourth season (2017/2018), 26 sites were monitored (5 DOC, 1 LUCAS and 20 GWRC), with access refused to one private land site. Due to LUCAS changing from a five year to a ten year

monitoring cycle, GWRC had to monitor one additional LUCAS site in season two and four LUCAS sites in season four (included in the totals above) to ensure that they were monitored within GWRC's five year monitoring cycle.

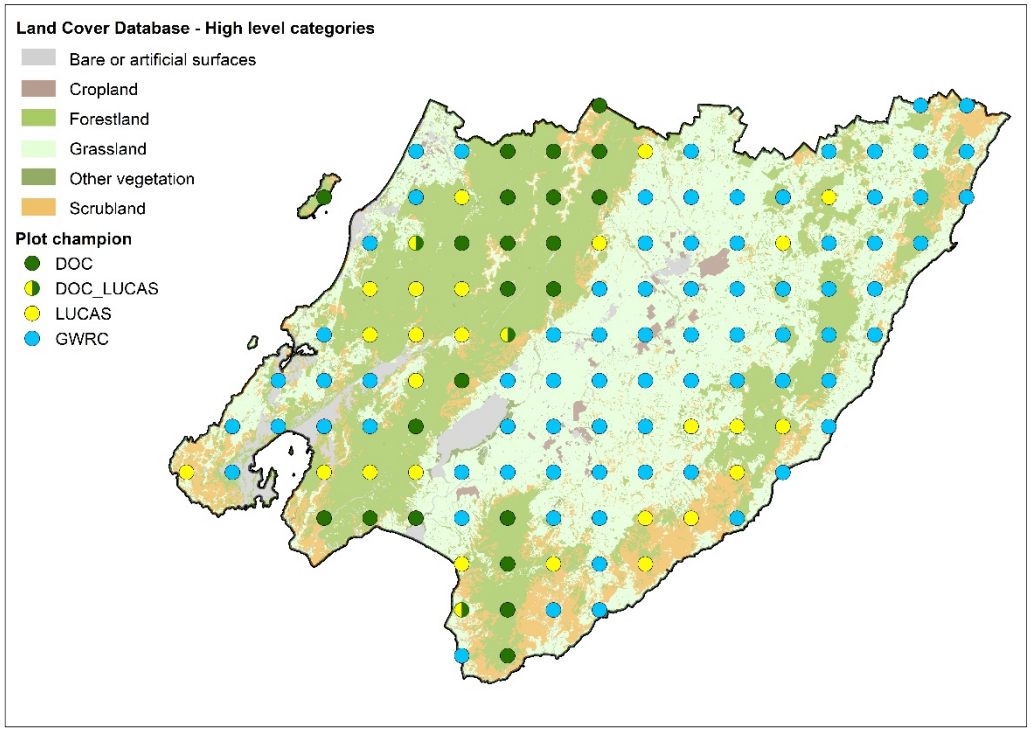

Figure 2.1: Sampling points on the national 8 x8 km national grid

2.3 Monitoring variables

Vegetation, birds and pest animals were monitored at each of the monitoring sites on the 8km x 8km grid. Sites were sampled as shown in Figure 2.2 following DoC monitoring procedures (Department of Conservation 2016a, 2016b). The monitoring methodology is outlined below with further detail provided in Appendix A. An example of a field layout is shown in Figure 2.3.

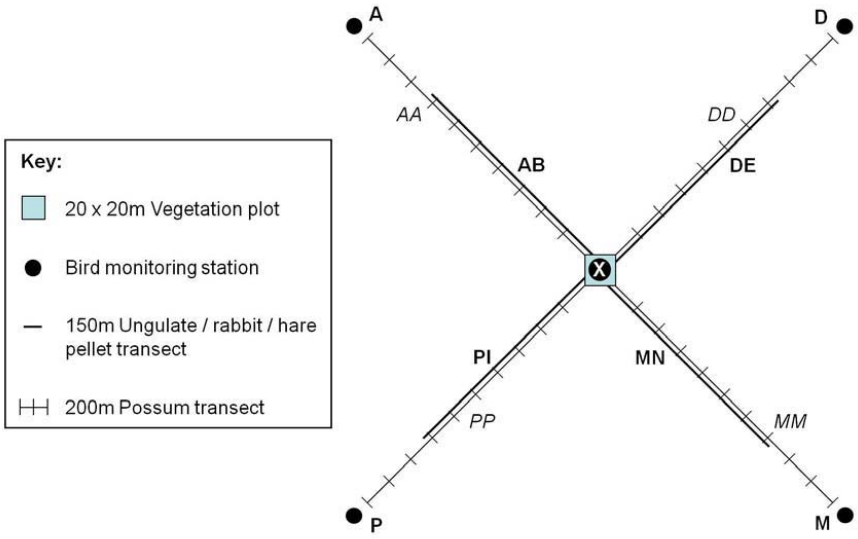

Figure 2.2: Monitoring layout for vegetation, pests and birds at each monitoring point

2.3.1 Vegetation

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

2.3.2 Birds

Bird counts were conducted at five stations at each site (one near the plot and the other four at 220m away, at locations that radiate out from the corners of the plot). Two sets of five minute bird counts were completed, the second count including 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 were monitored at each site. In the first season (2014/2015) DoC used leg-hold traps for the possum transects, while GWRC used wax tags as most of the sites the council was monitoring were on farmland where leg-hold traps could not be used. Greater Wellington deployed the wax tags in the nearest possum habitat (i.e. wooded area) within a 500m radius of the plot. From the second season (2015/2016) both DoC and GWRC changed to monitoring possums using chew cards placed along 200m transects radiating from the corners of the plot. Greater Wellington continued its wax tag method in conjunction with the chew cards in the second season, but discontinued the use of wax tags from the third season (2016/2017), continuing with chew cards alone.

The presence of goats, deer, rabbits and hares was measured using pellet counts on transects that were established parallel to the possum monitoring transects. Greater Wellington recorded livestock dung and pellets separately to that of deer and goats, but these were combined in the ungulate counts by DoC.

3. Results

3.1 Vegetation

Of the 87 sites monitored in the Wellington region between the 2014/2015 to 2016/2017 field seasons, vegetation plots at 47 sites (54 percent) were dominated by indigenous plant species and 40 sites (46 percent) were dominated by exotic plant species (Figure 3.1; Appendix B, Table B1). Sixteen sites (18 percent) had no exotic species present – these sampling points were mostly in the Tararua and Rimutaka Forest Parks. Vascular plant species richness in the plots ranged from 15 to 121 species with an average of 48 species per plot (20m x 20m).

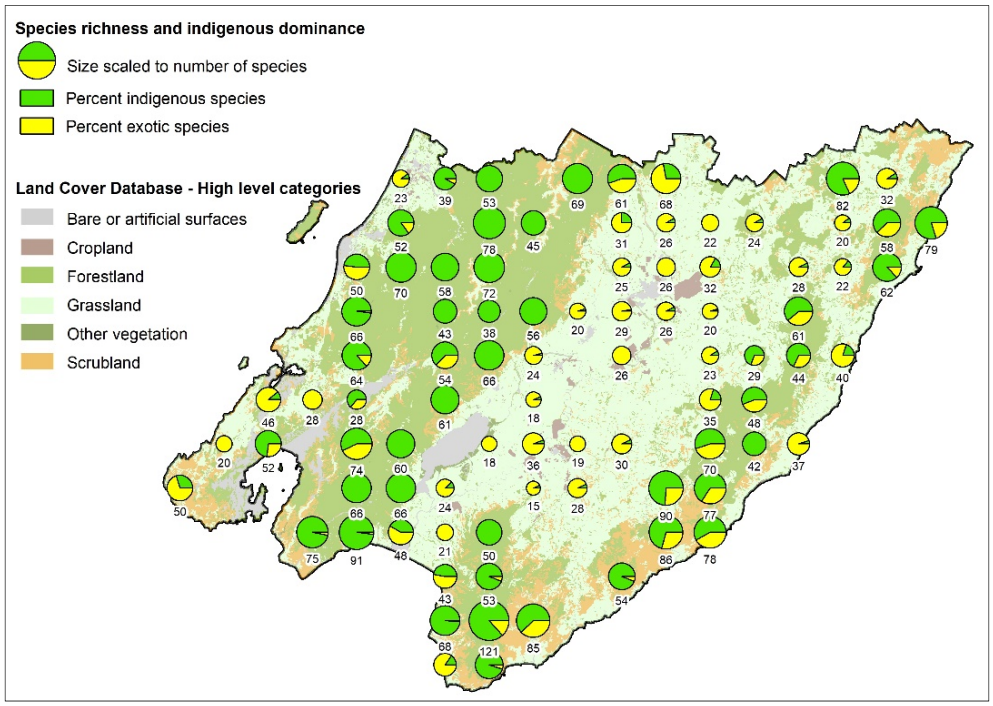

Figure 3.1: Plant species richness (numbers below points) and indigenous dominance in the plots monitored in the spring/summers of 2014/2015 to 2017/2018

3.2 Birds

Of the 87 sites where birds were monitored in the Wellington region during the 2014/2015 to 2017/2018 field seasons;

- 42 sites (48 percent) were dominated by indigenous bird species,
- 39 sites (45 percent) were dominated by exotic bird species, and
- 6 sites (7 percent) had equal numbers of indigenous and exotic species (Figure 3.2; Appendix B, Table B2).

The number of bird species encountered at each of the 87 sites ranged from five to 25 species with an average of 15 species per site. Two sites (2 percent) in the Tararua Forest Park had no exotic species present.

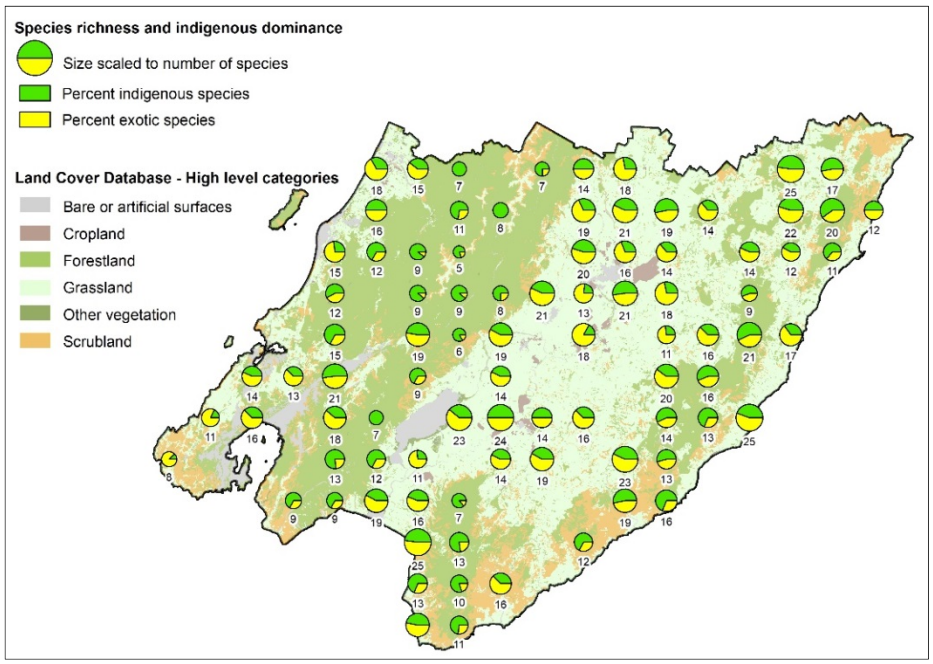

Figure 3.2: Bird species richness and indigenous dominance at the sites monitored in the spring/summers of 2014/2015 to 2017/2018

3.3 Possums

Possum densities were generally low, except for 10 sites where bite marks were recorded on more than 20 percent of the monitoring devices (Figure 3.3, Appendix B, Table B3). Of the high possum density sites (>20% possum tracking), four were on production forest land; two were on public conservation land; two were on sheep and beef farms; one was in indigenous scrub and one was in an urban area.

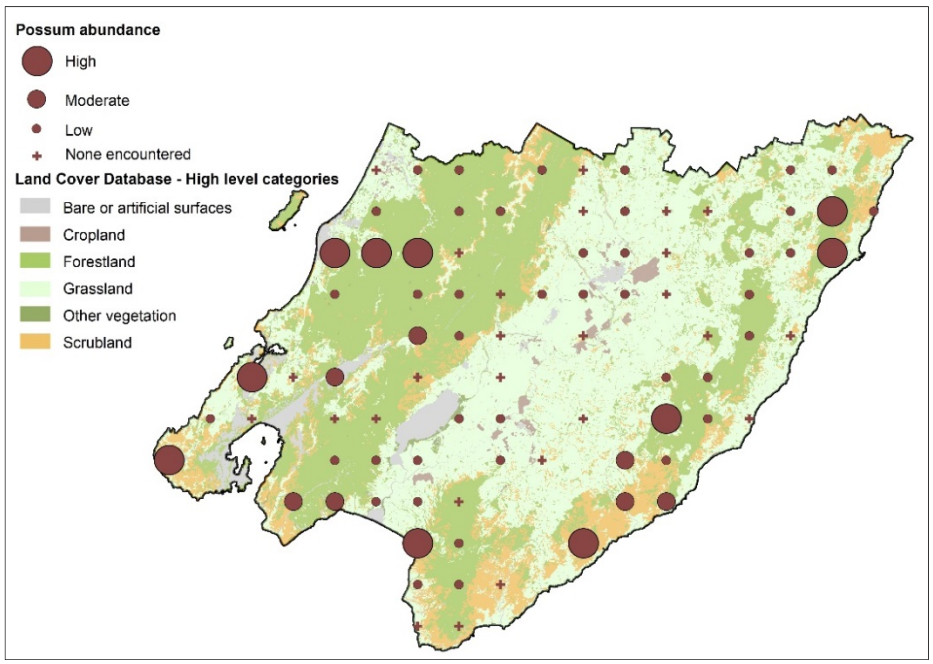

Figure 3.3: Density of possum recorded by chew cards, leg-hold traps and wax tags at the sites monitored in the spring/summers of 2014/2015 to 2017/2018 (High = ≥20%; Moderate = 10%-19%; Low = <10%)

3.4 Ungulates and lagomorphs

The highest frequencies of deer and goat pellets were recorded along the east coast with low numbers encountered across most of the region (Figure 3.4; Appendix B, Tables B4 and B5). Lagomorphs (rabbits and hares – 45/87 sites) and livestock (cattle and sheep – 49/87 sites) were both recorded from just over half of the sites monitored. Pigs were encountered at 18 of the 87 (21 percent) sites (Appendix B, Table B4).

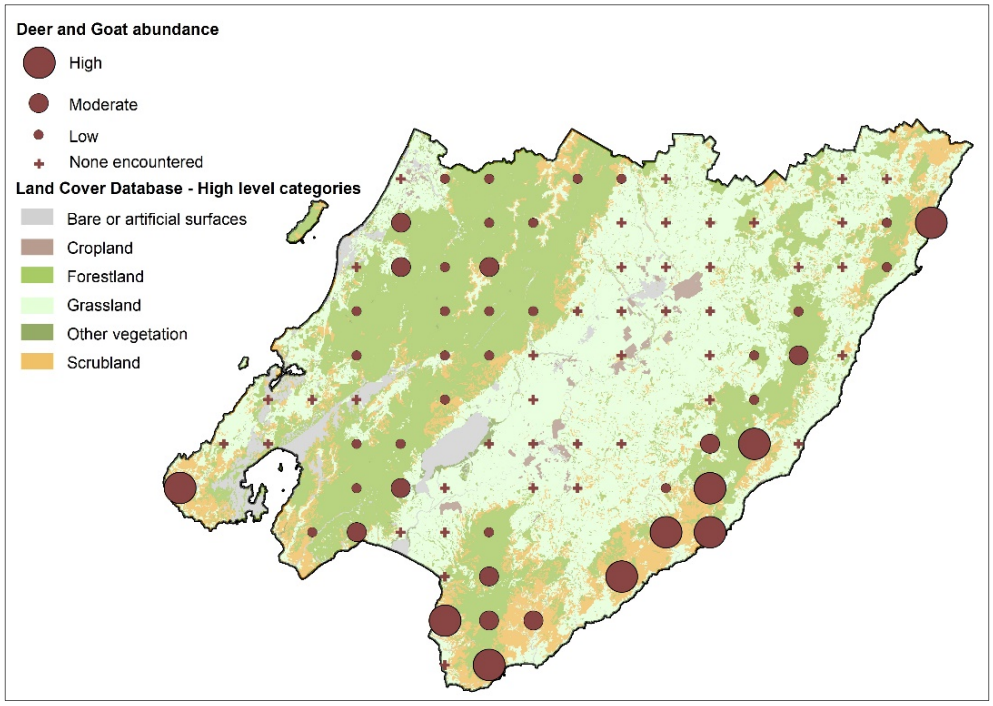

Figure 3.4: Numbers of quadrats with deer and goat pellets out of the 120 quadrats monitored at each site in the spring/summers of 2014/2015 to 2017/2018 (High = ≥20%; Moderate = 10%-19%; Low = <10%)

Acknowledgements

The field team who collected this data included:

Season 1 (2014/2015) - Grant Redvers (Team leader and Pest animals), Jacqui Bond (Botanist), Jenny Dolton (Botanist), Luke Crouch (GIS support and Pest animals) and Robin Toy (Ornithologist).

Season 2 (2015/2016) - Grant Redvers (Team leader and Pest animals), Finn Michalak (Botanist), Yong Tang (Botanist), Luke Crouch (GIS support and Pest animals) and Robin Toy (Ornithologist).

Season 3 (2016/2017) - Barrett Pistoll (Team leader 2nd half and Botanist), Grant Redvers (Team leader 1st half and Pest animals), Luke Crouch (GIS support and Pest animals), Robin Toy (Ornithologist) and Yong Tang (Botanist).

Season 4 (2017/2018) - Barrett Pistoll (Team leader and Botanist), Faline Drummond (GIS support and Pest animals), Rachel Innes (Pest animals), Rob Craven (Pest animals), Robin Toy (Ornithologist) and Yong Tang (Botanist).

Please note that although their main role is listed, most of the field team staff were involved in all measures.

Nikki McArthur advised on the establishment of the programme. Owen Spearpoint provided guidance on the vegetation sampling method at the start of the programme. Sara Moylan helped with wax tag and chew card identification in the first and second season.

Vegetation surveys were audited by Owen Spearpoint in the first season and Ian Payton in the subsequent seasons. Chew card bite mark identification was audited by Peter Sweetapple from Landcare Research in the fourth season. The programme was overseen in GWRC by Philippa Crisp.

This work includes the Department of Conservation's information which is licensed by the Department of Conservation for re-use under a Creative Commons Attribution 4.0 International License. Information on the sites sampled by the Department of Conservation was supplied by Meredith McKay and Benno Kappers. Information from the Ministry for the Environment's LUCAS team was supplied by Joanna Buswell and Asher Cook. Downloads from the National Vegetation Survey Database were provided by Elise Arnst.

References

Department of Conservation. 2016a: Field protocols for DOC Tier 1 Inventory & Monitoring and LUCAS plots, Version 11. Department of Conservation, Wellington.

Department of Conservation. 2016b: Field protocols for pest mammal, bird, RECCE surveys, Version 11. Department of Conservation, Wellington.

Forsyth DM, Perry M, Moloney P, McKay M, Gormley AM, Warburton B, Sweetapple P and Dewhurst R. (2015). Calibrating Brushtail Possum (*Trichosurus vulpecula*) abundance estimates in DOC's Biodiversity and Monitoring Reporting System: wax tags, chew cards and leg-hold traps. Arthur Rylah Institute for Environmental Research Unpublished Client Report. Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Lee W and Allen R. 2011. Recommended monitoring framework for regional councils for assessing biodiversity outcomes in terrestrial ecosystems. Report prepared for the Regional Council Biodiversity Forum. Lincoln, Landcare Research. 213p.

Lee W, McGlone M and Wright E 2005. Biodiversity Inventory and Monitoring: a review of national and international systems and a proposed framework for future biodiversity monitoring by the Department of Conservation. Lincoln, Landcare Research. 213 p.

Appendix A: Sampling methods

A1. Vegetation

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

A2. Birds

Bird counts were conducted at five stations at each site, one at Point P (south western corner) of the 20m x 20m vegetation plot and the other four 20m off the ends of each of the possum monitoring transects as shown in Figure 2.2. This is a slight deviation from the DoC protocol where the count station at the plot is monitored from the centre of the plot, not the corner. This deviation was instituted to reduce disturbance to the plot and represents a difference of ~14m. This difference was not considered to be influencing the count given that birds are being recorded from a radius of ~200m. Bird counts were conducted as two sets of five minute counts at each count station, the distance to the bird being recorded in the second set of counts (Department of Conservation 2016b). Sets of counts were repeated twice at each station to record 10 five minute bird counts and 10 five minute distance bird counts at each site.

A3. Possums

Possum monitoring transects (each 200m long) were laid out at 45^o angles from each of the corners of the 20m x 20m vegetation plot (Figure A2). Ten chew cards were placed on trees or 5mm aluminium rods 20cm-30cm above the ground, starting 20m from the corner of the plot and spaced at 20m intervals along each of these four possum monitoring transects (i.e. 40 cards per site). The chew cards were constructed from a 9cm x 18cm rectangle made of 3mm white plastic coreflute, loaded with aniseed flavoured possum dough. In accordance with the DoC protocol, cards were left out for one dry night and the bite marks on cards identified to determine the relative abundance of pests (Department of Conservation 2016b).

Initially, DoC used leg-hold traps for possum monitoring. These were however not an option in production landscapes where livestock may be injured. DoC converted to chew cards at all sites in the 2016/2017 season as these were 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 discontinued using wax tags and continue with chew cards in its third season (2016/2017). 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 in which to establish all four lines. The chew cards were used in all habitats. Although used primarily to monitor possums, the chew cards also recorded the presence of rats and mice.

Ungulates

Ungulate pellet density transects (each 150m long) were established parallel to the pest species transects off the corners of the vegetation plot, spaced 3.5m apart. These transects started 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 had a 1m radius ($3m^2$) in which all ungulate dung pellets were recorded. Nested within this quadrat was an inner sub-quadrat with a 0.18m radius ($0.1m^2$) in which all hare and rabbit pellets were 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 were recorded with the intention of revisiting sites on a five year rotation.

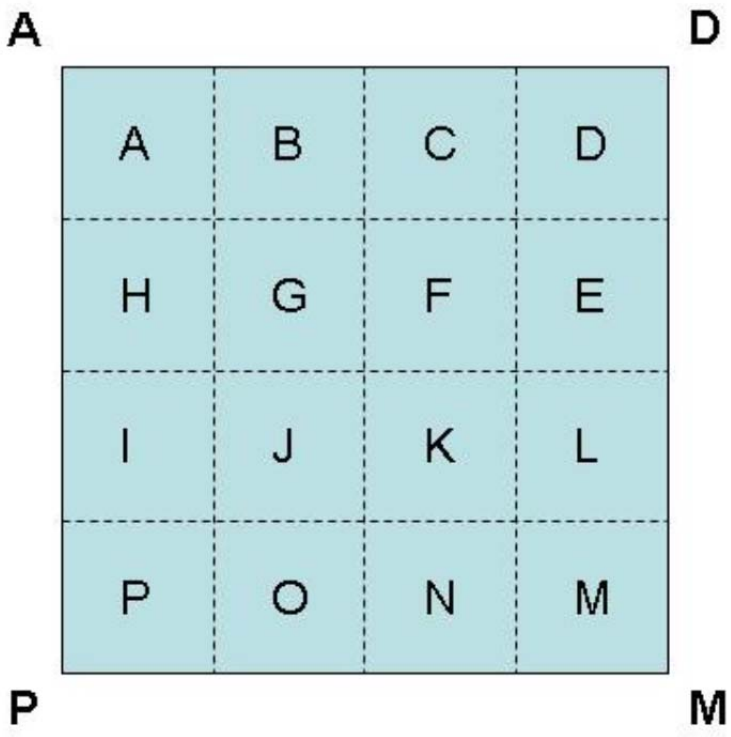

Figure A1: Outline of 20m × 20 m vegetation plot, illustrating the labelling system used to identify each corner of the plot and each of the 16 (5m × 5 m) subplots within it

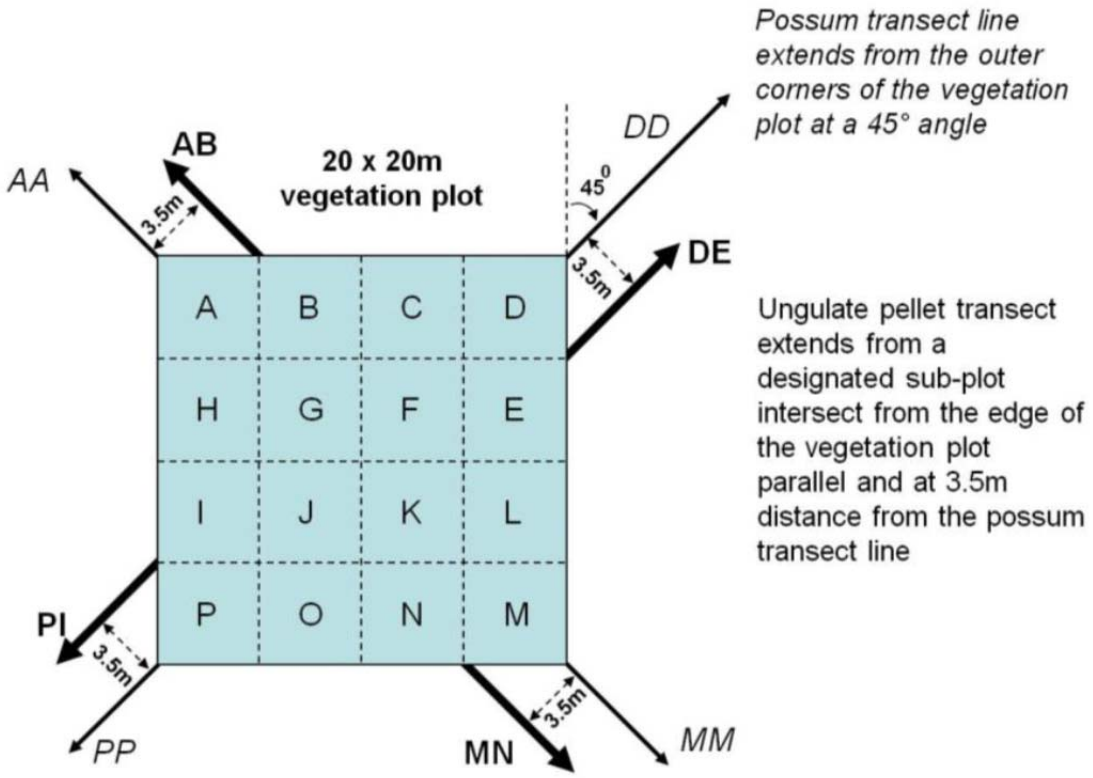

Figure A2: Location of possum transect lines in relation to pellet transects and the vegetation plot layout

Appendix B: Data tables

1. Vegetation

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

Plot ID	Indigenous species	Exotic species	Unknown species	Total species
CG101	15	35	0	50
CH100	0	20	0	20
CI99	5	41	0	46
CI100	38	14	0	52
CJ99	0	27	1	28
CJ102	73	2	0	75
CK96	24	26	0	50
CK97	65	1	0	66
CK98	55	8	1	64
CK99	18	10	0	28
CK100	42	32	0	74
CK101	66	0	0	66
CK102	89	2	0	91
CL94	2	20	1	23
CL95	44	8	0	52
CL96	70	0	0	70
CL100	60	0	0	60
CL101	66	0	0	66
CL102	19	27	2	48
CM94	36	3	0	39
CM96	58	0	0	58
CM97	43	0	0	43
CM98	34	20	0	54
CM99	61	0	0	61
CM101	3	21	0	24
CM102	0	21	0	21
CM103	20	23	0	43
CM104	66	1	1	68
CM105	6	32	1	39
CN94	53	0	0	53
CN95	77	1	0	78
CN96	72	0	0	72
CN97	38	0	0	38
CN98	66	0	0	66
CN100	0	18	0	18
CN102	50	0	0	50

Plot ID	Indigenous species	Exotic species	Unknown species	Total species
CN103	50	3	0	53
CN104	103	16	2	121
CN105	55	3	0	58
CO95	45	0	0	45
CO97	56	0	0	56
CO98	1	23	0	24
CO99	1	17	0	18
CO100	2	34	0	36
CO101	1	14	0	15
CO104	53	32	0	85
CP94	69	0	0	69
CP97	1	19	0	20
CP100	0	19	0	19
CP101	2	26	0	28
CQ94	33	27	1	61
CQ95	8	23	0	31
CQ96	2	23	0	25
CQ97	1	28	0	29
CQ98	0	26	0	26
CQ100	2	28	0	30
CQ103	51	3	0	54
CR94	19	49	0	68
CR95	2	24	0	26
CR96	0	26	0	26
CR97	2	24	0	26
CR101	67	23	0	90
CR102	60	25	1	86
CS95	0	22	0	22
CS96	5	26	1	32
CS97	1	19	0	20
CS98	2	21	0	23
CS99	7	28	0	35
CS100	38	31	1	70
CS101	50	26	1	77
CS102	45	33	0	78
CT95	2	21	1	24
CT98	20	9	0	29
CT99	27	21	0	48
CT100	42	0	0	42
CU96	2	26	0	28
CU97	37	24	0	61

Plot ID	Indigenous species	Exotic species	Unknown species	Total species
CU98	30	14	0	44
CU100	2	35	0	37
CV94	67	15	0	82
CV95	2	18	0	20
CV96	3	19	0	22
CV98	8	32	0	40
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 monitored in five minute bird counts at each site

Site	Indigenous species	Exotic species	Total species
CG101	1	7	8
CH100	9	2	11
CI99	8	6	14
CI100	6	10	16
CJ99	5	8	13
CJ102	6	3	9
CK96	11	4	15
CK97	7	5	12
CK98	5	10	15
CK99	10	11	21
CK100	7	11	18
CK101	10	3	13
CK102	6	3	9
CL94	6	12	18
CL95	8	8	16
CL96	4	8	12
CL100	7	0	7
CL101	8	4	12
CL102	11	8	19
CM94	6	9	15
CM96	8	1	9
CM97	1	8	9
CM98	10	9	19
CM99	6	3	9
CM101	8	3	11
CM102	7	9	16
CM103	13	12	25
CM104	4	9	13
CM105	9	10	19
CN94	0	7	7
CN96	4	1	5
CN95	3	8	11
CN97	1	8	9
CN98	1	5	6
CN100	9	14	23
CN102	6	1	7
CN103	10	3	13
CN104	8	2	10
CN105	8	3	11

Site	Indigenous species	Exotic species	Total species
CO95	8	0	8
CO97	6	2	8
CO98	11	8	19
CO99	6	8	14
CO100	12	12	24
CO101	8	6	14
CO104	6	10	16
CP94	5	2	7
CP97	12	9	21
CP100	7	7	14
CP101	8	11	19
CQ94	7	7	14
CQ95	13	6	19
CQ96	9	11	20
CQ97	10	3	13
CQ98	3	15	18
CQ100	6	10	16
CQ103	8	4	12
CR94	7	7	14
CR95	12	9	21
CR96	5	11	16
CR97	10	11	21
CR101	7	6	13
CR102	9	10	19
CS95	10	9	19
CS96	5	9	14
CS97	5	13	18
CS98	8	3	11
CS99	8	12	20
CS100	8	6	14
CS101	7	6	13
CS102	5	11	16
CT95	5	9	14
CT98	10	6	16
CT99	7	9	16
CT100	9	4	13
CU96	8	6	14
CU97	5	4	9
CU98	12	9	21
CU100	11	14	25
CV94	12	13	25
CV95	12	10	22

Site	Indigenous species	Exotic species	Total species
CV96	7	5	12
CV98	6	11	17
CW94	8	9	17
CW95	8	12	20
CW96	4	7	11
CX95	6	6	12

3. Possums

Table B3: Number of devices that monitored possums, rats and mice from one night of trapping ("-" indicates that the site was not monitored 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
CG101	-	-	-	-	-	-	13	2	2	40
CH100	1	40	-	-	-	-	-	-	-	-
CI99	-	-	14	0	1	40	-	-	-	-
CI100	-	-	-	-	-	-	0	0	0	40
CJ99	-	-	-	-	-	-	0	0	0	40
CJ102	-	-	-	-	-	-	6	1	0	40
CK96	-	-	21	4	1	40	-	-	-	-
CK97	-	-	-	-	-	-	1	2	0	40
CK98	-	-	-	-	-	-	-	-	-	-
CK99	-	-	4	1	0	39	0	0	0	40
CK100	-	-	-	-	-	-	0	0	0	40
CK101	-	-	-	-	-	-	1	4	0	40
CK102	-	-	-	-	-	-	4	0	0	40
CL94	-	-	-	-	-	-	0	0	0	40
CL95	-	-	-	-	-	-	2	4	0	40
CL96	11	39	-	-	-	-	-	-	-	-
CL100	-	-	-	-	-	-	0	0	0	40
CL101	-	-	-	-	-	-	1	4	0	40
CL102	-	-	-	-	-	-	0	0	0	35
CM94	-	-	-	-	-	-	2	9	0	40
CM97	-	-	-	-	-	-	0	0	5	40
CM96	-	-	-	-	-	-	8	0	0	40
CM98	-	-	4	2	1	40	1	1	2	40
CM99	-	-	-	-	-	-	0	0	0	40
CM101	-	-	1	0	0	20	-	-	-	-
CM102	-	-	-	-	-	-	3	0	0	40
CM103	-	-	8	8	8	40	2	0	2	40
CM104	1	40	-	-	-	-	-	-	-	-
CM105	-	-	-	-	-	-	0	0	0	40
CN94	-	-	-	-	-	-	1	0	0	40
CN96	-	-	-	-	-	-	0	0	0	31
CN95	1	31	-	-	-	-	-	-	-	-
CN97	-	-	-	-	-	-	1	1	3	40
CN98	-	-	-	-	-	-	3	0	0	40
CN100	-	-	-	-	-	-	1	0	0	40
CN102	-	-	-	-	-	-	0	0	0	40
CN103	-	-	-	-	-	-	1	5	3	39

Site	Leg-hold trap catch		Wax tag records				Chew card records			
	Possum	No. traps	Possum	Rat	Mouse	No. tags	Possum	Rat	Mouse	No. cards
CN104	-	-	-	-	-	-	2	0	1	40
CN105	-	-	-	-	-	-	0	0	0	40
CO95	-	-	-	-	-	-	1	0	0	40
CO97	-	-	-	-	-	-	0	1	0	40
CO98	-	-	0	1	3	40	0	2	0	40
CO99	-	-	-	-	-	-	0	0	0	40
CO100	-	-	-	-	-	-	1	0	0	40
CO101	-	-	3	0	0	20	-	-	-	-
CO104	-	-	-	-	-	-	0	0	0	40
CP94	-	-	-	-	-	-	2	0	0	40
CP97	-	-	1	1	3	38	0	0	0	40
CP100	-	-	-	-	-	-	-	-	-	-
CP101	-	-	-	-	-	-	0	0	0	40
CQ94	-	-	-	-	-	-	0	0	0	40
CQ95	-	-	0	1	3	30	0	0	0	40
CQ96	-	-	-	-	-	-	1	1	1	40
CQ97	-	-	0	0	2	30	1	0	0	40
CQ98	-	-	-	-	-	-	0	0	0	40
CQ100	-	-	-	-	-	-	0	0	0	40
CQ103	-	-	-	-	-	-	24	0	0	40
CR94	-	-	-	-	-	-	0	0	0	40
CR95	-	-	2	1	1	40	-	-	-	-
CR96	-	-	-	-	-	-	0	0	0	40
CR97	-	-	0	0	6	30	0	0	0	40
CR101	-	-	-	-	-	-	4	1	0	40
CR102	-	-	7	0	1	40	-	-	-	-
CS95	-	-	-	-	-	-	0	0	0	40
CS96	-	-	-	-	-	-	0	0	0	40
CS97	-	-	-	-	-	-	0	0	0	40
CS98	-	-	-	-	-	-	-	-	-	-
CS99	-	-	-	-	-	-	1	0	0	40
CS100	-	-	-	-	-	-	10	0	0	40
CS101	-	-	-	-	-	-	1	0	0	40
CS102	-	-	6	1	0	40	-	-	-	-
CT95	-	-	-	-	-	-	0	0	0	40
CT98	-	-	0	1	7	40	0	0	1	40
CT99	-	-	3	0	0	40	0	0	0	40
CT100	-	-	-	-	-	-	1	0	0	40
CU96	-	-	1	0	0	20	0	0	0	40
CU97	-	-	-	-	-	-	1	0	0	40

Site	Leg-hold trap catch		Wax tag records				Chew card records			
	Possum	No. traps	Possum	Rat	Mouse	No. tags	Possum	Rat	Mouse	No. cards
CU98	-	-	-	-	-	-	1	0	1	40
CU100	-	-	-	-	-	-	0	0	0	40
CV94	-	-	-	-	-	-	1	0	2	40
CV95	-	-	0	4	7	30	1	1	2	40
CV96	-	-	1	0	4	40	-	-	-	-
CV98	-	-	-	-	-	-	0	0	0	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	-	-	-	-

Note: The number of traps, tags or cards monitored has been highlighted where the planned number (i.e. 40 quadrats) could not be sampled.

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
CG101	60	1	1	0	1	17	120
CH100	0	26	10	0	106	0	120
CI99	0	0	0	0	0	0	120
CI100	0	3	0	0	0	0	120
CJ99	0	4	11	1	49	0	120
CJ102	4	0	0	0	0	0	109
CK96	0	0	0	6	1	0	120
CK97	1	0	0	0	0	0	120
CK98	2	2	0	0	0	2	120
CK99	0	0	0	0	0	20	120
CK100	4	15	4	2	24	0	120
CK101	6	0	0	0	0	0	120
CK102	17	0	0	0	0	4	120
CL94	0	2	0	34	0	0	120
CL95	12	0	2	0	0	1	120
CL96	17	0	0	0	0	0	120
CL100	10	0	0	0	0	0	120
CL101	19	0	0	0	0	2	120
CL102	0	1	1	0	0	0	115
CM94	4	0	0	0	0	0	120
CM96	8	0	0	0	0	0	120
CM97	9	0	0	0	0	0	120
CM98	1	8	0	33	0	3	120
CM99	10	0	0	0	0	4	120
CM101	0	0	2	36	82	0	120
CM102	0	0	0	40	71	0	120
CM103	0	0	1	15	49	0	120
CM104	42	0	0	0	0	0	120
CM105	0	8	6	2	105	0	120
CN94	4	0	0	0	0	0	120
CN95	6	0	0	0	0	0	120
CN96	10	0	0	0	0	0	98
CN97	6	0	0	0	0	0	117
CN98	9	0	0	0	0	0	120
CN100	0	0	0	49	0	0	120
CN102	3	0	0	0	0	0	120
CN103	15	0	0	0	0	11	120
CN104	21	0	0	0	0	2	120
CN105	29	0	0	0	0	5	120

Site	Deer & Goats	Rabbits	Hares	Cattle	Sheep	Pigs	Quadrats sampled
CO95	6	0	0	0	0	0	120
CO97	9	0	0	0	0	0	120
CO98	0	3	0	33	59	0	120
CO99	0	0	0	69	0	0	120
CO100	0	3	1	15	0	0	120
CO101	0	3	8	70	103	0	120
CO104	12	0	0	6	2	8	120
CP94	6	0	0	0	0	0	120
CP97	0	2	0	32	0	0	120
CP100	0	2	7	55	97	0	120
CP101	0	0	0	22	105	0	120
CQ94	3	0	9	31	13	0	120
CQ95	0	0	8	17	65	0	120
CQ96	0	7	0	0	83	0	120
CQ97	0	5	1	4	86	0	120
CQ98	0	0	0	26	32	0	120
CQ100	0	5	12	27	71	0	120
CQ103	84	0	0	0	0	9	120
CR94	0	1	2	15	10	0	120
CR95	0	2	3	85	0	0	120
CR96	0	0	0	0	0	0	120
CR97	0	19	17	36	0	0	120
CR101	1	0	1	14	41	0	120
CR102	33	1	3	0	18	2	120
CS95	0	10	7	21	102	0	120
CS96	0	1	2	0	106	0	120
CS97	0	0	0	1	83	0	120
CS98	0	0	0	45	81	0	120
CS99	0	0	0	31	6	0	120
CS100	13	11	22	22	51	5	120
CS101	40	1	3	4	0	17	120
CS102	36	0	0	5	17	3	120
CT95	0	7	28	51	87	0	120
CT98	4	0	4	0	0	0	120
CT99	6	0	3	0	0	1	120
CT100	33	0	1	0	0	20	120
CU96	0	0	2	20	8	0	120
CU97	9	0	25	0	0	6	120
CU98	12	0	13	0	0	14	120
CU100	0	0	0	0	36	0	120
CV94	0	1	0	6	45	0	120

Site	Deer & Goats	Rabbits	Hares	Cattle	Sheep	Pigs	Quadrats sampled
CV95	0	0	9	47	92	0	120
CV96	0	12	16	10	115	1	120
CV98	0	0	5	17	41	0	120
CW94	0	7	25	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	7	120

Note: The number of quadrats monitored has been highlighted where the planned number (i.e. 120 quadrats) could not be sampled.

Table B5: Total number of individual pellets counted at each site for deer and goats in 3m^2 and rabits and hares in 0.1m^2

Site	Deer & Goats	Rabbit	Hares	Quadrats sampled
CG101	1775	0	2	120
CH100	0	304	3	120
CI99	0	0	0	120
CI100	0	20	0	120
CJ99	0	5	3	120
CJ102	101	0	0	109
CK96	0	0	0	120
CK97	5	0	0	120
CK98	8	3	0	120
CK99	0	0	0	120
CK100	65	7	0	120
CK101	267	0	0	120
CK102	177	0	0	120
CL94	0	0	0	120
CL95	109	0	12	120
CL96	131	0	0	120
CL100	95	0	0	120
CL101	204	0	0	120
CL102	0	0	0	115
CM94	3	0	0	120
CM96	414	0	0	120
CM97	55	0	0	120
CM98	1	7	0	120
CM99	265	0	0	120
CM101	0	0	0	120
CM102	0	0	0	120
CM103	0	0	0	120
CM104	597	0	0	120
CM105	0	5	6	120
CN94	16	0	0	120
CN96	104	0	0	98
CN95	82	0	0	120
CN97	0	0	0	117
CN98	139	0	0	120
CN100	0	0	0	120
CN102	57	0	0	120
CN103	175	0	0	120
CN104	343	0	0	120
CN105	916	0	0	120

Site	Deer & Goats	Rabbit	Hares	Quadrats sampled
CO95	82	0	0	120
CO97	144	0	0	120
CO98	0	9	0	120
CO99	0	0	0	120
CO100	0	0	0	120
CO101	0	2	1	120
CO104	138	0	0	120
CP94	89	0	0	120
CP97	0	1	0	120
CP100	0	1	0	120
CP101	0	0	0	120
CQ94	5	0	5	120
CQ95	0	0	8	120
CQ96	0	0	0	120
CQ97	0	65	0	120
CQ98	0	0	0	120
CQ100	0	2	17	120
CQ103	1806	0	0	120
CR94	0	0	0	120
CR95	0	0	0	120
CR96	0	0	0	120
CR97	0	8	12	120
CR101	1	0	1	120
CR102	622	2	59	120
CS95	0	4	2	120
CS96	0	0	6	120
CS97	0	0	0	120
CS98	0	0	0	120
CS99	0	0	0	120
CS100	24	7	20	120
CS101	510	14	0	120
CS102	1059	0	0	120
CT95	0	24	12	120
CT98	264	0	21	120
CT99	269	0	10	120
CT100	259	0	1	120
CU96	0	0	37	120
CU97	7	0	11	120
CU98	160	0	9	120
CU100	0	0	0	120
CV94	0	2	0	120

Site	Deer & Goats	Rabbit	Hares	Quadrats sampled
CV95	0	0	35	120
CV96	0	50	2	120
CV98	0	0	2	120
CW94	0	3	43	120
CW95	20	0	0	120
CW96	174	0	0	120
CX95	552	0	2	120

Note: The number of quadrats monitored has been highlighted where the planned number (i.e. 120 quadrats) could not be sampled.