How Many Possums Are Now in New Zealand Following Control and How Many Would There Be Without It?

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Summary

Project and Client

The number of possums in New Zealand, with and without control, has not been reviewed and updated since the mid-1980s. In 2009 Northland Regional Council through Envirolink funding (NLRC104) and the Animal Health Board requested Landcare Research to re-estimate possum numbers taking into account the impact of control operations.

Objectives

To estimate the number of possums in New Zealand taking into account the control carried out by the Animal Health Board (AHB), Department of Conservation (DOC), and regional councils.

Methods

The approach taken had five steps:

1. The number of possums in New Zealand was estimated given there was no control undertaken, and assuming all habitats (i.e. vegetation classes) held possums at carrying capacity. The vegetation classes and their areas were based on the Land Cover Database (LCDB2), along with the EcoSat indigenous forest layer to provide a finer differentiation of forest classes.
2. The shapefiles (geospatial files describing the extent of an area) of control operations carried out by the AHB, DOC, and regional councils (independent of AHB operations) were obtained for the 2008/09 year.
3. A common post-control RTC value of 2% was applied to all AHB operations, 5% to regional council operations, and 10% to DOC ones.
4. Post-control RTCI values were converted to possum density using the relationship developed by Ramsey et al. (2005):

   $$\text{Estimated density} = (\text{RTCI} - 0.55)/4.86.$$

5. A new estimate of possum numbers was calculated by adding the number of possums remaining in each of the control operation shapefiles to the number of possums in the areas outside the control operation shapefiles (i.e. those areas that were assumed to still be at K).

Results

The estimated number of possums in New Zealand in the absence of control (i.e. if possums were at carrying capacity) is 47.6 million. About 28.5 million (60%) occur in indigenous forest classes other than beech, with about equal numbers (6.5 million) occurring in beech forest and scrub.

Possum control in 2008/09 was carried out over a total area of about 13.3 million ha, about half of the total vegetated area. About 9.8 million ha had control related to managing bovine TB for the AHB, 2 million ha by DOC for conservation purposes, and 1.5 million ha by councils for production and conservation purposes. About 8.3 million ha (62%) of the total area controlled were in the South Island.

When possum control is taken into account, the number of possums present in 2008/09 is estimated to be 30 million, which is an overall reduction of about 36%. Reductions in

possum numbers due to control were highest (42%) for scrub and indigenous forest classes.

On a regional basis Wellington had the greatest percentage reduction (87%), but Hawke's Bay, Manawatu/Wanganui and West Coast also had reductions of greater than 50%.

Discussion

The new estimate for the number of possums at carry capacity (48 million) is considerably less than the 70 million that has been the widely quoted figure for the past two decades. There are two main reasons for this discrepancy. Firstly, the area of each of the land cover classes used in the various estimates has varied, and for some classes such as scrub, the area ranged from 9.3 million ha as used by Brockie (1986) to 2.6 million ha used in this review. Secondly, the K value assigned to scrub by Brockie (1986) and Keber (1985) was 4.6 (and is one average high for this cover class) and this K value times the area of scrub resulted in this vegetation category making a very large contribution to total numbers (i.e. 9.3 million ha × 4.6 possums/ha = 42.8 million).

Until better estimates of K are obtained for the range of major vegetation classes, the estimate of total possum numbers will always be speculative, and the evidence from Hawke's Bay farmland suggests that at least some farmlands hold more possums than are indicated by the K values currently assigned to these vegetation classes.

Possum control is carried out for specific reasons (i.e. either to manage bovine TB or to protect conservation values) and not for the purpose of reducing possum numbers per se, and it is critical that the focus of possum control remains on achieving a desired outcome (i.e. reduction in TB or increase in conservation value) and that numbers killed or overall percentage reduction is not used to measure control success. Such general metrics have no relevance to effective management of pests unless eradication is the goal.

The value or benefits obtained from the funding spent on possum control in New Zealand should be measured against the outcomes to be achieved., This review does, however, indicate current expenditure is having a significant impact on possum numbers both locally at those sites where it is important to do so, and nationally.

1. Introduction

How many possums there are in New Zealand has held a fascination for many New Zealanders since the estimates of 60–70 million were generated in the 1980s. At the time, that number was similar to the number of sheep in New Zealand, with the national flock peaking at 70.3 million in 1982 (http://www.sheepworld.co.nz/SheepFarming.htm, accessed 31 Aug 2009).

Apart from the general fascination that the public at large and politicians have with facts and figures, the distribution and numbers of possums in New Zealand are not of any strategic or practical importance for managing this pest species. There are three reasons for this. First, neither the number of possums nor possum distribution is used to monitor progress with possum management. This is because the Department of Conservation (DOC), Animal Health Board (AHB), and regional councils currently do not have possum eradication programmes at a national or regional scale as a current strategic goal. Second, possums are not controlled because they are possums but because of the threats they pose to native biodiversity and the economic losses they cause to agricultural production. What is important, therefore, is not the number of possums or the changes in possum numbers as a result of control, but the change in the resources on which they impact; for example, the statistics of primary interest for the National Bovine TB strategy are numbers of TB-infected livestock herds, not numbers of possums killed. Third, while DOC formerly used a National Possum Control Plan to prioritise its possum control and all regional pest management strategies identify possums as regional pests, the focus of pest management for biodiversity protection is shifting from mainly single-species control to control of key pest threats at high-value conservation sites. This change in strategy recognises that possums are not always the key threat at a particular site or for a particular native species or ecosystem. In addition, control of possums alone may not always have net benefits for native biodiversity because, for example, of the increase in rodent numbers, and hence predation on native animals, that can occur when possum numbers are reduced (Ruscoe et al. 2008).

Nevertheless because of the widely held belief that there are 70 million possums in New Zealand, sectors of the public, particularly those opposed to possum control, question why there are still about 70 million possums if the country is spending $80+ million per year killing them. Clearly with the extensive control effort being applied, total possum numbers will have been reduced, and this report provides a reassessment of what the current numbers might be.

2. Background

2.1 Previous population estimates

All published estimates of the number of possums in New Zealand have been derived by much the same method – possum densities in various habitats (= vegetation classes) estimated by a variety of methods (including 'expert' knowledge) were multiplied by estimates of the area of the North and South islands of New Zealand covered by those habitats.

Pracy (in Bell 1981) referred to an estimate made sometime before 1975 of 46 million based on his national survey of possums, a conversion of trap catch to density based on a single total-removal operation (Batcheler et al. 1967), and what Pracy referred to as several 'good reference populations'.

Keber (1985) used a set of five land cover classes (exotic, beech, and other native forest, scrublands, farmland) and published estimates of possum density at habitat carrying capacity (K) to calculate the rate at which possums could be harvested sustainably; using that data we derived an estimate of the total number of possums in New Zealand of 72.4 million. Brockie (1986), using land resource inventory estimates (Blaschke et al. 1981) for the same set of five land cover classes and somewhat different estimates of K (which he noted as 'conservative'), derived an estimate of 63.6 million. Differences between Keber's and Brockie's estimates reflect differences in both estimates of habitat areas and in values of K for different habitats, and these differences have a significant effect on the estimate of total population. Using Keber's values of habitat area and Brockie's K values gives an estimate of 41 million possums, with the reverse situation giving an estimate of 94.5 million possums.

Batcheler and Cowan (1988) – using a more extensive set of 37 possum density estimates, 232 vegetation cover classes from Blaschke et al.'s (1981) inventory, and collective knowledge of faecal pellet count densities and 'quality of the habitat for possums' – derived an estimate of 68.8 million and concluded that 'the present possum population is between 60 and 70 million of which about 40 million are in scrubland habitats'. Two-thirds (66%) of the estimated possum population was in the North Island, roughly the same as the proportion of livestock units for 1985.

Keber's (1985) total habitat area (26.7 million ha) roughly matches that (26.4 million ha) used by Batcheler and Cowan (1988), but the area used by Brockie (1986) was significantly less (23.3 million ha), accounting for some, but not all of the differences between the national possum population estimates.

Potential inaccuracies in all the above estimates stem from a number of factors. None of the estimates were adjusted for reductions in possum numbers from possum control or fur harvesting. Both Keber (1985) and Batcheler and Cowan (1988) appeared to have included in their calculation the one million hectares of land classed as 'no vegetation' by Blaschke et al. (1981), although some of it, particularly the urban areas, probably had some possums.

Neither of these factors, however, would have made a significant difference to the calculations. At the time of all three estimates in the mid-1980s, only about 1.5–2.5 million possum skins were exported annually, although this underestimates the number of possums actually killed during harvesting (Warburton et al. 2000). Possum control at the time was undertaken mainly by the AHB and the New Zealand Forest Service (NZFS). In the mid- to late 1980s about 200 000 ha was under possum control for bovine TB management (P. Livingstone pers. comm.), and a further 70 000 ha was controlled for native forest protection by DOC (Parkes et al. 1997). The reduction in possum numbers over those areas is unlikely to have exceeded 2 million. Assuming half the area of land classed as 'no vegetation' was treated like grassland, the adjustment would, at the most, have been about one million possums.

The major influence on the calculated size of New Zealand's possum population is the density assumed in different habitats and the classification of habitats and their area (Appendix 1). Efford's (2000) review of possum population dynamics emphasises that for each of the main habitat types there is a wide range of recorded densities. This presumably reflects local site-specific factors such as suitable vegetation for feeding and nesting at the site or nearby (as possums will forage considerable distances out onto pasture). This complexity in density–habitat relationships highlights the basic difficulty in attempting a national census of possum numbers. Any precise recalculation of this estimate to the present day would require a much more extensive database on possum density in relation to fine-scale habitat classification and an estimate of the current reduction in possum numbers from possum control and harvesting, or the use of alternative approaches such as predictive modelling (Fraser et al. 2004).

2.2 Carrying capacity

Animal populations are never static, but vary with time, and possum populations are no exception. Carrying capacity refers to the average population density or population size of a species below which its numbers tend to increase and above which its numbers tend to decrease because of shortages of resources. The various estimates of the number of possums in New Zealand use values for possum density in different habitats that are assumed to be density at the carrying capacity of those particular habitats. Because density at carrying capacity is an average, the estimates of the numbers of possums in New Zealand are also an average, and thus do not represent the true population numbers at any particular point in time. The extent of natural fluctuations in possum numbers, at least in native podocarp–hardwood forest, can be seen from the long-term mark-recapture study of possums in the Orongorongo Valley, southern Rimutaka Range (Brockie 1992; Efford 2000; Efford & Cowan 2004). Over a 35-year period (1967–2002), this undisturbed population varied from a low of 6.5 to a high of 13.7 possum/ha, with an average of 9.8 possums/ha (i.e. ± 35%) (Fig. 1). The data from 1979 onwards also suggest a 4-yearly cycle in possum numbers. There is, thus, significant potential for any estimate of national possum numbers at a particular time to vary significantly from one based on long-term averages and/or carrying capacity.

The carrying capacity of a habitat may also change with time as a result of natural or animal-induced change (e.g. browsing impacts), with implications for national estimates of possum numbers. Efford and Cowan (2004) hypothesised that vegetation changes seen in the forests of the Orongorongo Valley (particularly the loss of plant species highly preferred by possums) were causing possum carrying capacity to decline. In fact, a small but significant upward trend in density was observed from 1980 to 2001. Efford and Cowan (2004)

attributed this to an increase in carrying capacity due to an increase in fast-growing and resilient palatable plant species that buffered possum carrying capacity against the loss of less resilient palatable species. Whether such change has occurred in other habitats, and to what extent change may reflect long-term climatic effects, are not known.

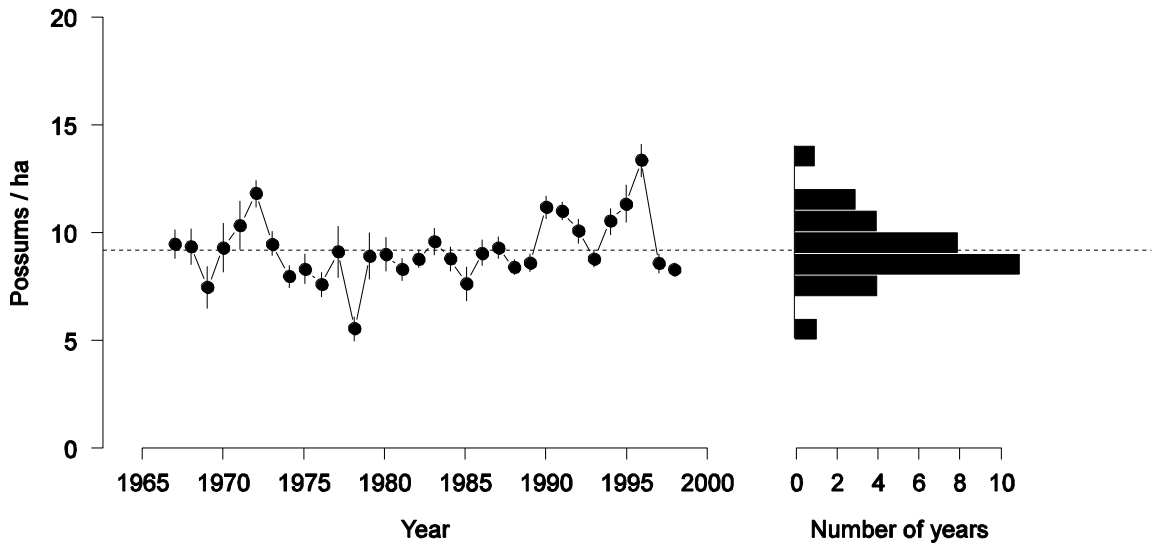

Fig. 1 Annual estimates of possum density in the Orongorongo Valley from 1967 to 1998, and the frequency of densities over the same period (from Efford 2000).

3. Objectives

To estimate the number of possums in New Zealand taking into account the control carried out by the Animal Health Board, Department of Conservation, and regional councils.

4. Methods

Because numbers of possums vary from year to year as a result of the combined effect of natural fluctuations, reductions as a result of control operations, and increases due to population recovery following control, the estimates provided here are based on a 'cross-sectional' estimate in 2008/09 and do not attempt to incorporate the dynamics of populations over time.

The approach taken had five steps:

1. The number of possums in New Zealand was estimated given there was no control undertaken, and assuming all habitats (i.e. vegetation classes) held possums at carrying capacity, K (see above). The vegetation classes and their areas were based on the Land Cover Database (LCDB2), with the EcoSat indigenous forest layer used to provide a finer differentiation of forest classes. This resulted in 36 vegetation classes

(from a total of 52 cover classes) that had a carrying capacity value assigned (Appendix 1). The K values were obtained from Efford (2000) and from discussion with a range of 'experts'.

2. The control operations carried out by the AHB, DOC, and regional councils (independent of AHB operations) are now recorded in spatial databases, and we obtained the shapefiles (geospatial files describing the extent of an area) for control operations undertaken in the 2008/09 year from each of the agencies. There are also various private control initiatives being carried out either as fenced sanctuaries or continuous control programmes, but because these areas are generally small and at most total about 100 000 ha the reduction in possum numbers is unlikely to exceed 0.5 million. Additionally, private fur hunters have been removing about 1 to 1.5 million possums per year, but again have little impact on total numbers.

3. We also obtained post-control trap-catch indices (RTCI values) for the shapefiles, where available. These indices varied but many were less than 1%. Because not all shapefiles had corresponding RTCI values and because some control areas would have had some time to recover from control, we elected to apply a common post-control RTC value of 2% to all AHB operations, 5% to regional council operations, and 10% to DOC ones. The higher value of 10% was applied to DOC operations because some of the DOC areas are controlled at fixed frequencies of 3–7 years (Parkes et al. 2006) and would therefore show some recovery to higher levels between operations. It is now common practice for most control operations to have an initial 'knockdown' operation and then maintenance control to maintain possums at low densities. Consequently, for most operations, it is safe to assume possum numbers remain low for extended periods.

4. Post-control RTCI values were converted to possum density using the relationship developed by Ramsey et al. (2005):

$$\text{Estimated density} = (\text{RTCI} - 0.55)/4.86.$$

5. A new estimate of possum numbers was calculated by adding the number of possums remaining in each of the control operation shapefiles to the number of possums in the areas outside the control operation shapefiles (i.e. those areas that were assumed to still be at K).

5. Results

The estimated number of possums in New Zealand in the absence of control (i.e. if possums were at carrying capacity) is 47.6 million (reported as 48 million from here on). About 28.5 million (60%) occur in indigenous forest classes other than beech, with about equal numbers (6.5 million) occurring in beech forest and scrub (Table 1).

Table 1 Estimated possum numbers with and without control in each of the major vegetation classes in 2008/09. 'No control' represents possum numbers at carrying capacity. See Appendix 1 for how cover classes were grouped into the seven classes shown here.

Vegetation class	Area (ha)	No control	Control	% reduction
Other	1 769 253	0	0	0
Grassland	11 333 721	2 196 809	2 196 809	0
Tussock	2 645 194	528 988	528 988	0
Scrub	2 653 869	6 435 345	3 749 686	42
Exotic Forest	2 053 523	3 689 556	2 279 741	38
Other Indigenous Forest	4 245 037	28 404 024	16 607 506	42
Beech Forest	2 120 634	6 361 323	4 912 510	23
Total	26 821 231	47 616 046	30 275 241	36

Possum control in 2008/09 was carried out over a total area of about 13.3 million ha, about half of the total vegetated area. About 9.8 million ha had control related to managing bovine TB, 2 million ha by DOC for conservation purposes, and 1.5 by councils for production and conservation purposes (Table 2). About 8.3 million ha (62%) of the total area controlled were in the South Island.

When possum control is taken into account, the number of possums present in 2008/09 is estimated to be 30.3 million which is an overall reduction of about 36%. Reductions in possum numbers due to control were highest (42%) for scrub and indigenous forest habitats (Table 1). Both grassland and tussock had no reductions in numbers because the estimated carrying capacity for these habitats (0.2 possums/ha) was below the post-control residual RTC value assigned to these vegetation classes (i.e. a 2% RTC value equates to 0.29 possums/ha). However, within a general area of grass or tussock lands, habitat such as patches of scrub, shelter belts, and remnant forest larger than 1 ha, are included in their respective vegetation classes and these areas have higher densities of possums than their surrounding low-density grasslands. Nevertheless, intensive trapping of some ‘grasslands’ in the Hawke’s Bay suggests this vegetation class has subclasses of vegetation that can support higher numbers of possums than the average assigned to this class (Table 3). The reasons for this difference are being investigated independently, but one possible reason is that the imaging used to identify habitat is not differentiating some habitats (e.g. patches of tussock or fern) from surrounding pasture.

Table 2 Areas under possum control by the Animal Health Board (AHB), Department of Conservation (DOC) and regional councils (Reg Council) in 2008/09

	Area under control (ha)
North Island	
AHB	3 085 894
DOC	639 716
Reg Council	1 330 748
Total North Island	5 056 358
South Island	
AHB	6 813 036
DOC	1 366 819
Reg Council	96 881
Total South Island	8 276 736
New Zealand	
AHB	9 898 930
DOC	2 006 535
Reg Council	1 427 630
Total	13 333 094

Table 3 Number of possums estimated using LCDB2 vegetation classes >1 ha and assigned K values, and the actual number of possums killed in 22 control blocks of farmland in the Hawke's Bay in 2008/09

Area (ha)	Estimated number of possums using LCDB2	Actual number of possums killed	Possums killed/ha
9	11	0	0
327	195	262	0.8
547	314	504	0.92
2287	1346	3396	1.49
303	69	67	0.22
589	469	841	1.43
419	935	445	1.06
728	1095	2296	3.15
548	328	676	1.23
823	216	1216	1.48
75	29	42	0.56
10	23	0	0
332	75	315	0.95
65	14	76	1.17
61	20	43	0.71
116	179	4	0.03
295	103	237	0.8
26	53	0	0
1470	3022	2612	1.78
523	481	669	1.28
331	635	99	0.3
8	6	0	0
Total	9618	13800	

On a regional basis Wellington had the greatest percentage reduction in the number of possums (87%), and Hawke's Bay, Manawatu/Wanganui and West Coast also had reduction of greater than 50% (Table 4).

Table 4 Estimated possum numbers with and without control for each region in 2008/09. No control represents possum numbers at carrying capacity

Region	No control	With control	% reduction
Northland	2 807 053	2 413 521	14
Auckland	668 856	602 459	10
Waikato	4 639 958	2 618 799	44
Bay of Plenty	4 438 812	4 057 336	9
Gisborne	1 481 770	1 473 636	1
Hawke's Bay	2 144 640	961 094	55
Manawatu-Wanganui	4 125 088	1 995 920	52
Taranaki	1 988 377	1 356 539	32
Wellington	1 482 782	192 159	87
Tasman	2 601 994	1 393 564	46
Nelson	103 510	103 510	0
Marlborough	1 580 787	1 219 007	23
West Coast	8 276 286	3 654 091	56
Canterbury	2 862 752	1 993 020	30
Otago	2 109 603	1 113 939	47
Southland	6 303 777	5 126 645	19
Total	47,616,046	30,275,241	36

6. Discussion

The new estimate for the number of possums at carry capacity (48 million) is considerably less than the 70 million that has been the widely quoted figure for the past two decades. There are two main reasons for this discrepancy:

Firstly, the area of each of the land cover/vegetation classes used in the various estimates has varied, and for some classes such as scrub, the area ranged from 9.3 million ha as used by Brockie (1986) to 2.6 million ha used in this review (Table 5). Secondly, the K value assigned to scrub by Brockie (1986) and Keber (1985) was 4.6 and this K value times the area of scrub resulted in this vegetation category making a very large contribution to total numbers (i.e. 9.3 million ha × 4.6 possums/ha = 42.8 million). For the other vegetation classes, K values also differed between Brockie (1986) and Keber (1985) with both varying from what was used in this review (Table 6).

Table 5 Total areas of habitat classes used in previous estimates and in this report

Vegetation class	This report	Brockie	Keber
Other	1 356 632		
Grassland	11 333 721	8 100 000	13 530 000
Tussock	2 645 194		
Scrub	2 653 869	9 300 000	6 090 000
Exotic Forest	2 053 523	200 000	850 000
Other Indigenous Forest	4 245 037	3 700 000	1 700 000
Beech Forest	2 120 634	2 000 000	4 500 000
Total	26 408 610	23 300 000	26 670 000

Consequently, the variations in both area of each vegetation class and K result in a wide range of estimates of total possum numbers. For example, using the areas of each vegetation cover class applied in this review and the K values used by Brockie (1986) and Keber (1985), results in estimates of total numbers of 41 million and 84 million possums, respectively.

Until better estimates of K are obtained for the range of major vegetation classes, the estimate of total possum numbers will always be speculative, and the evidence from Hawke's Bay farmland suggests that at least some farmlands hold more possums than are indicated by the K values assigned to these vegetation classes.

Nevertheless, the possum control applied over about 13 million ha in 2008/09 has clearly reduced total possum numbers by at least 36%. This reduction is conservative because it excludes off take by commercial fur hunters, possum control in sanctuaries, and other private conservation initiatives. Additionally, if the K value for some farmland is significantly under-estimated, as suggested by the Hawke's Bay data, then the difference between total possum numbers and numbers after possum control will be greater than currently estimated.

The percentage reduction in possum numbers in some regions has not been high even though intensive possum control has been carried out in some of the regions. For example, Southland has had a very effective possum control programme targeting bovine TB, yet the overall percentage reduction (19%) is not that large. This is because Fiordland National Park, which makes a significant contribution to the total area of Southland, does not have any significant areas of possum control. Northland and the Bay of Plenty also did not have large percentage reductions, mainly because these areas do not have extensive AHB possum control operations.

Possum control is carried out for specific reasons (i.e. either to manage bovine TB or to protect conservation values) and not for the purpose of reducing possum numbers per se, and it is critical that the focus of possum control remains on achieving a desired outcome (i.e. reduction in TB or increase in conservation value) and that numbers killed or overall percentage reduction are not used to measure control success. Such general metrics have no relevance to effective management of pests unless eradication is the goal.

Table 6 Variation in possum numbers depending on the K values and areas of the different vegetation classes used. Neither Keber nor Brockie treated tussock as a separate class, so for these calculations it has been treated as grass

Vegetation class	Area (ha) as used in this report (A)	K values used by Brockie (B)	N possums (A × B)	K values used by Keber (C)	N possums (A × C)	N Possums (B × Brockie's vegetation areas)	N Possums (C × Keber's vegetation areas)
Grass	11 333 720	0.1	1 133 372	1.5	17 000 581	810 000	1 353 000
Tussock	2 645 194	0.1	264 519	1.5	3 967 791	*	*
Scrub	2 653 869	4.6	12 207 797	4.6	12 207 797	42 780 000	28 010 000
Exotic	2 053 523	2.5	5 133 807	3.0	6 160 569	500 000	2 550 000
Other indigenous forest	4 245 037	5	21 225 185	10.0	42 450 370	18 500 000	17 000 000
Beech	2 120 634	0.5	1 060 317	1.0	2 120 634	1 000 000	4 500 000
Total			41 024 997		83 907 742	63 590 000	72 360 000

Table 6 cont.

Vegetation class	Area (ha) as used by Brockie (D)	K values used by Keber (E)	N possums (D × E)	Area (ha) as used by Keber (F)	K values used by Brockie (G)	N Possums (F ×G)
Grass	8 100 000	1.5	12 150 000	13 530 000	0.1	1 353 000
Tussock						
Scrub	9 300 000	4.6	42 780 000	6 090 000	4.6	28 014 000
Exotic	200 000	3.0	600 000	850 000	2.5	2 125 000
Other indigenous forest	3 700 000	10.0	3 700 000	1 700 000	5.0	8 500 000
Beech	2 000 000	1.0	2 000 000	4 500 000	0.5	2 250 000
Total			94 530 000			42 242 000

The value or benefits obtained from the funding spent on possum control in New Zealand should be measured against the outcomes to be achieved. This review does, however, indicate current expenditure is having a significant impact on possum numbers both locally at those sites where it is important to do so, and nationally.

7. Acknowledgements

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Appendix 1 Possum carrying capacity (K) per hectare allocated to land cover classes. Of the 52 cover classes listed 36 are vegetation classes

Cover class	Vegetation Class	K	Area (ha)
Built-up Area	Other	0	163 452
Urban Parkland / Open Space	Grassland	0.2	40 148
Surface Mine	Other	0	9 769
Dump	Other	0	568
Transport Infrastructure	Other	0	6 515
Coastal Sand and Gravel	Other	0	51 226
River and Lakeshore Gravel and Rock	Other	0	179 721
Landslide	Other	0	16 959
Alpine Gravel and Rock	Other	0	698 108
Permanent Snow and Ice	Other	0	110 963
Alpine Grass-/Herbfield	Grassland	0	224 371
Lake and Pond	Other	0	357 492
River	Other	0	81 970
Estuarine Open Water	Other	0	92 510
Short-rotation Cropland	Grassland	0.2	333 717
Vineyard	Grassland	0.2	25 399
Orchard and Other Perennial Crops	Grassland	0.2	58 304
High Producing Exotic Grassland	Grassland	0.2	8 891 606
Low Producing Grassland	Grassland	0.2	1 652 309
Tall Tussock Grassland	Tussock	0.2	2 394 736
Depleted Tussock Grassland	Tussock	0.2	250 458
Herbaceous Freshwater Vegetation	Grassland	0	88 656
Herbaceous Saline Vegetation	Grassland	0	19 210
Flaxland	Scrub	3	6 446
Fernland	Scrub	3	51 718
Gorse and Broom	Scrub	3	203 016
Manuka and or Kanuka	Scrub	3	1 186 013
Matagouri	Scrub	3	29 520
Broadleaved Indigenous Hardwoods	Scrub	3	539 206
Sub Alpine Shrubland	Scrub	0.2	385 265
Mixed Exotic Shrubland	Scrub	3	63 213
Grey Scrub	Scrub	3	72 382
Major Shelterbelts	Exotic Forest	2	12 718
Afforestation (not imaged)	Exotic Forest	2	49 504
Afforestation (imaged post LCDB 1)	Exotic Forest	2	85 049
Forest Harvested	Exotic Forest	0.2	229 907

Pine Forest – Open Canopy	Exotic Forest	2	482 691
Pine Forest – Closed Canopy	Exotic Forest	2	977 294
Other Exotic Forest	Exotic Forest	2	132 236
Deciduous Hardwoods	Exotic Forest	2	84 125
Indigenous Forest	Other Indig. Forest	5.5	580 839
Mangroves	Scrub	0	26 030
Subalpine Scrub	Scrub	0.2	91 062
Coastal Forest	Other Indig. Forest	5	5 199
Kauri Forest	Other Indig. Forest	8	91 645
Podocarp Forest	Other Indig. Forest	8	65 181
Podocarp–Broadleaved Forest	Other Indig. Forest	9	1 239 670
Beech Forest	Beech Forest	3	2 120 634
Broadleaved Forest	Other Indig. Forest	5	341 731
Podocarp–Broadleaved– Beech Forest	Other Indig. Forest	7	842 547
Beech– Broadleaved Forest	Other Indig. Forest	4	97 027
Beech–Podocarp–Broadleaved Forest	Other Indig. Forest	5	981 197
Total (ha)			26 821 231