HAWKE'S BAY
REGIONAL COUNCIL
TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

Analysis of Benefits and Cost Allocation Process

Relevant biology

Attribute	Description
Form	Small marsupial similar in size to a cat with large eyes, oval ears, cat-like whiskers and a pointed snout. Has thick bushy tail and can be grey, brown or black in colour.
Habitat	Native and exotic forest, shrubland, farmland, orchards and urban areas. Has favoured food species, but will feed on wide range of species.
Regional distribution	Throughout the region.
Competitive ability	Has the ability to cause local extinctions of palatable plant species and cause major forest structure modifications. Eats invertebrates and will also take fledging birds and eggs from nests. Significant silvicultural and horticultural pests and also compete with stock for pasture.
Reproductive ability	Females breed from age one. In ideal conditions can produce two offspring per year.
Resistance to control	Controlled by poisoning, trapping and shooting. Can become 'shy' to any one method if the same method is used constantly.
Benefits	Valuable fur trade (according to the fur buying company Basically Bush, in one year the Taranaki region produced 4800 kg of possum pelts worth $95/kg = $465,000).

Land use/habitats occupied in Hawke's Bay

Land Use Type	Current Infestation	Potential Infestation
Dairy	High	High
Sheep and beef	High	High
Forestry	Low	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	High	High
Coastal land	Low	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = Most infested/preferred land use(s), Low = Less infested/preferred land use(s), - = Unsuitable land use

Qualitative impact assessment

Category	Current	Potential	Comment	Source
Production				
Dairy	M	H	Competes with stock for pasture, and is the main vector for bovine Tb spread.	
Sheep and beef	M	H	See Dairy.	
Forestry	L	M	Significant silvicultural pest.	1, 2
Horticulture	M	H	Major horticultural pest.	
Aquaculture	-	-		
Other	-	-		
International trade	M	H	Vector for bovine Tb in cattle. The presence of bovine Tb in cattle herds is a risk to dairy and meat exports.	2, 3
Environment				

Category	Current	Potential	Comment	Source
Soil resources	L	M	Removal of vegetation and forest collapse can lead to soil erosion.	2
Water quality	L	M	Erosion of soil can lead to increased sedimentation in waterways.	2
Species diversity	H	H	Has major impacts on native forest and shrubland. Can suppress or eliminate preferred (palatable) plant species by selective browsing, which alters vegetation composition. Excessive browse can also lead to collapse of palatable canopy species e.g. Northern rata. Competes with native bird species for food, and eats chicks and eggs.	1, 2
Threatened species	M	M	Can eliminate or suppress threatened plant species e.g. mistletoes. Predator of eggs of North Is kokako. Can compete for nest sites with hole-nesting birds such as kiwi, parakeets and saddlebacks.	2
Social/Cultural				
Human health	L	M	Could transmit Tb to humans.	2
Recreation	M	H	Damage and eliminate palatable native plant species and alter structure of native forests, which can affect recreational experiences.	2
Māori culture	M	H	Destroys native forests and eats culturally important plants (e.g. koromiko).	

L = low, M = moderate, H = high
Source: 1 - Auckland Regional Council (2004), 2 - King (2005), 3 - TBfree New Zealand (2013)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: Economic value per land use/habitat type × Impact level

Impact level
Low = 1–4% reduction in annual economic value per hectare
Moderate = 5–9% reduction in annual economic value per hectare
High = 10–50% reduction in annual economic value per hectare

Reduction in annual economic value ($) per hectare

Land Use/Habitat Type	Current Impact per Ha	Potential Impact per Ha
Production		
Dairy	273.15–600.93	546.30–3,338.50
Sheep and beef	36.95–81.27	73.90–451.50
Forestry	17.47–85.40	87.35–192.15
Horticulture	525.55–1,778.40	1,051.10–9,880.00
Aquaculture	0	0

Land Use/Habitat Type Environment/Social/Cultural	Current Impact per Ha	Potential Impact per Ha
Urban	5.33–56.05	26.64–126.11
Native terrestrial	55.60–340.00	55.60–340.00
Coastal	124.70–762.50	124.70–762.50
Freshwater	0	0
Estuarine	0	0
Marine	0	0

Cost-benefit analysis results

Proposed management: **Sustained control**
Area of Programme: **974,126 ha**
Proposed annual expenditure by Council: **$3,500,000**

Assumptions

Assumptions	Values	Assumptions	Values
Current area infested	7,890.417 ha	Time to reach maximum extent†	25 yrs
Current impacts★	$68.98/ha	Potential extent in the region°	418,743 ha
	$38.19–99.76/ha		278,121.8–559,364 ha
Current benefits	$5/ha	Discount rate	4%

★ Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

† The time a pest is predicted to take between first going wild in the region and reaching its maximum extent.

10-year assessment

The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

Scenario	Pest Impacts★	Pest Values°	Benefit	Council Costs†	Landowners Compliance Costs‡	Agency Compliance Costs‡	Net Benefit
No intervention	$59,399,252	$2,953,074		$0	$0	$0	
	min: 29,409,602	min: 2,552,564					
	max: 105,517,774	max: 3,601,177					
Sustained control	$5,371,407	$329,316	$51,404,087	$29,523,661	$0	$0	$21,880,426
	min: 3,100,081	min: 325,841	min: 23,041,135				min: -6,482,526
	max: 7,694,606	max: 332,791	max: 95,596,445				max: 66,072,784

★ Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50-year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

Scenario	Pest Impacts*	Pest Values°	Benefit	Council Costs†	Landowners Compliance Costs‡	Agency Compliance Costs‡	Net Benefit
No intervention	$219,399,294	$27,548,153		$0	$0	$0	
	min: 99,848,926	min: 21,071,554					
	max: 386,772,403	max: 40,297,659					
Sustained control	$12,805,497	$844,371	$179,890,015	$78,195,152	$0	$0	$101,694,863
	min: 7,145,721	min: 807,325	min: 53,286,964				min: -24,908,188
	max: 18,937,965	max: 881,418	max: 347,570,209				max: 269,375,057

CBA statement and risks to success

The CBA indicates that it is likely that the proposed Council-led large-scale possum control will be cost beneficial to the region, both within ten years and over 50 years. The ten-year CBA estimates that the programme is likely to save the region about $15 million dollars over the next decade. The 50-year projection suggests a benefit of $77 million, which is both considerable and is likely to be an underestimate as it is likely that possum control technologies will become much more effective and less costly over this period. This is a possibility that we conservatively omit from our modelling, instead projecting forward the costings and effectiveness of current possum control.

As with all pests that impact on the natural environment, there is a considerable range of uncertainties around these CBA estimates. In the great majority of scenarios, the proposed possum control is cost beneficial. The low estimates in the CBA results will only occur if impacts of possums on Hawkes Bay's primary industries and natural environments all end up being unexpectedly low over the next decade, across all industries, and if possum numbers would have increased unexpectedly slowly in the absence of Council-led control. This scenario is highly unlikely.

We are already purposefully modelling a slow estimate of possum spread, and we have also been purposefully conservative in our impact estimates. If anything, we expect that our CBA will underestimate the true value of the programme to the region. However, it must be recognised that, in the event that these unlikely scenarios all did occur, our model would then conclude that Council-led possum control would then not be cost beneficial.

It is therefore important that possum densities and impacts continue to be monitored in the region, so that the programme can be regularly reviewed and, if necessary, reassessed. With the current information available, we conclude that Council-led control of possums is prudent and justified.

Risk	Level of Risk	Explanation
Technical risk	Low to medium	HBRC has demonstrated this is technically feasable through its Possum Control Area (PCA) programme, initiated in 2000. It is a proven flagship biosecurity programme with a current average RTC rate of 2.3% across all PCAs.
Operational risk	Low	See above
Legal risk	Low to medium	
Socio-political risk	Low	
Other risks	Low	

Who should pay?

Beneficiaries and exacerbators

Group	Beneficiary	Exacerbator	Change Behaviour	Assess Costs & Benefits	Control Cost Effectively
Land occupiers (Crown and private)	Major	Major	Yes	Yes	Yes
Dairy/sheep and beef sector	Major		No	Yes	Yes
Regional community	Major		No	Yes	Yes

Who should pay for the proposed management approach?

Possums are a major threat to production and conservation values in Hawke's Bay. In farming areas, they spread bovine tuberculosis to beef and dairy cattle and to farmed deer, damage crops and orchards, kill poplars and willows planted to control hill-country erosion and stabilise riverbanks, and eat pasture. In exotic forest plantations possums kill young trees and stunt the growth of older trees by ring-barking them or breaking the uppermost branches.

In native vegetated areas, possums cause severe damage by altering habitats important to native animals and birds. Tree species that are palatable to possums (e.g. rata, kamahi and pohutukawa) become much reduced or locally extinct, and are replaced by plants that are less palatable such as tree ferns and pepperwood. As well as altering the composition of native forests and competing with native fauna, possums also prey directly on native insects and birds.

The existing funding split for this programme is 70% targeted rate, 30% general rate. Given the primary driver of this programme is biodiversity, it is proposed that the funding split is substantially changed to account for this. It is proposed that the programme be primarily funded by a general rate with a smaller percentage of targeted rate to reflect the greater proportion of biodiversity benefits than production benefits. No Council decisions on new PCA budgets or any revised allocation of costs have been made. These issues will be considered and discussed with the community as part of the 2024 Long-Term Plan (LTP). The changes envisioned in this proposal are enabling, but would not be enacted until the LTP and the Revenue and Financing Policy have been reviewed. Until any changes to the PCA programme are implemented, revenue sources and the allocation of costs will remain unchanged from the current RPMP.

When determining the appropriate cost allocation for this programme, the Council must consider how the costs will be shared amongst:

- Those people who have an interest in the plan
- Those who benefit from the plan (including collective benefits), and
- Those who contribute to the pest problem and who pose a risk of spreading a pest through their activities.

These factors have been considered as part of the development of this Proposal and will continue to be considered under section 100T of the Act when the funding split is confirmed as part of the review of the Revenue and Finance Policy. Consultation on the Revenue and Finance Policy review is due to commence in 2023.

Cost-benefit analysis for proposed Council-led possum control

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8 November 2021

Introduction

This document estimates the costs and benefits of the Hawke's Bay Regional Council's (HBRC) proposed investment in possum control in the region. Specifically, we model the benefits of Council-led control in the non-Department of Conservation portion of the HBRC's 974,126 hectare Possum Control Area, which includes all of the higher priority farmland and urban land in lowland Hawke's Bay plus some higher elevation areas. The Department of Conservation (DOC) manages 16,081 hectares of this area (1.6%) and is leading the possum control on this land.

Based on information provided by HBRC staff, it is expected that possum numbers will continue to increase across this area unless there is coordinated large-scale control, which the Council is well-placed to provide. Here, we estimate the benefits to the region of this proposed programme. We do this by:

1. estimating possum impacts at the low densities that would be sustained by such a programme and comparing these with the much larger possum impacts that the area would eventually experience if possum densities continued to rise
2. comparing these benefits with the anticipated cost of the possum control programme.

We use the same Cost-Benefit Analysis (CBA) methods that we used for the recent Hawke's Bay Regional Pest Management Plan (RPMP), which is a method that has been used now in five regional councils' RPMP assessments. It is based on methods originally developed for the Bay of Plenty Regional Council by economist Simon Harris, for the 2003–2008 Bay of Plenty Regional Pest Management Strategy.

The parameters we use here for estimating possum impacts are the same as we used for the recent Hawke's Bay RPMP, with the following two exceptions.

After consultation with HBRC staff, it was decided that the current impact value for Dairy and SheepBeef should be shifted from low to moderate, based in part on the increased threat to Hawke's Bay of possum-vectored bovine tuberculosis (Tb). As in the RPMP CBAs, our CBA here includes a population growth curve for possums, using a logistic (S-shaped) curve that has slow initial population growth, followed by a period of rapid increase, followed by slower growth when densities get close to the maximum. The total duration of this population growth was set conservatively at 50 years in the RPMP, since it historically took possums many decades from the establishment of the fur trade to reach problematic densities throughout New Zealand. New Zealand landscapes have changed considerably since then, and possums in low density across a large area can increase much faster than a population starting from one or a few locations. After consultation with HBRC staff and Lincoln University possum expert James Ross, we have come to the conclusion that 50 years is too conservative. We have therefore reduced this value to 25 years for this CBA. This is still a conservative growth estimate, as recent experiences with large-scale possum control have found that possum numbers can rebound to pre-control densities in as little as five years. It is likely that possums in Hawke's Bay would return to very high densities well within 25 years in the absence of sustained region-wide control. The logistic growth curve in this CBA has possum numbers reaching 70% of their maximum possible density in a decade. This emphasises the kind of risk the region faces if possum numbers are not effectively contained.

The proportional change in possum numbers is estimated based on residual trap catch (RTC) information provided by HBRC staff. Historically the possum RTC in Hawke's Bay was 30-67%, while many years of hard work by private land owners, iwi, DOC, and HBRC have brought it down to its current average of 2.3%, with RTC in recent years ranging from 2.3-6%. From these values, we estimate that possum densities are currently less than 9% of their potential densities in the absence of coordinated control in Hawke's Bay. For the calculations in the CBA, the effective "current area infested" is therefore set at 9% of the Possum Control Area excluding DOC land. Another way to think about this is if all of the current possum impacts were summed across the Possum Control Area, this would be the equivalent total area if possums were at maximum density.

To estimate possum impacts, each major land type in the region (e.g. Dairy, SheepBeef, Horticulture, Forestry, Urban, Native, Coastal, Freshwater) is given a rating of low, moderate, or high impact, both currently and if possums reached their maximum density. A low impact is set at a 1-4% reduction in annual economic value per hectare, moderate is a 5-9% reduction in annual economic value per hectare, and high is 10-50% reduction in annual economic value per hectare. The appropriate values for each land type and each pest, including possums, have been fine-tuned with regional council staff over the development of several RPMPs across the North Island. With the exceptions of Dairy and SheepBeef (see above), we otherwise use the established values in this CBA.

Impacts of possums are offset by benefits of possums, which for possums is the small possum fur industry. In this CBA we include this value as $5 per hectare, based on estimates from Taranaki Regional Council staff, corroborated by HBRC staff. While the exact value may vary a little around $5, note that it is a very small value relative to the cost of possum impacts.

The cost of HBRC-led region-wide possum control is estimated to be $35 million over the next ten years, which we have used as exactly $3.5 million annually (in reality, the exact annual expenditure may end up varying from year to year). Our understanding, from our discussions with HBRC staff, is that this is considered the most cost-effective option to large-scale possum control that will effectively and sustainably keep possum numbers suppressed across the region. As always, our hope is that the current nationwide investment in pest control technologies, as part of the Predator-free 2050 initiative, will produce a step-change in the cost and efficacy of possum control. That seems entirely possible, in which case our CBA will be overestimating the ongoing costs to HBRC necessary to suppress possums.

Note, as with our RPMP CBAs, that there is a substantial amount of uncertainty surrounding some of the values. This is unavoidable when estimating the costs and benefits of the control of pests that impact on the natural environment, as putting a dollar value on these estimates is inherently difficult and open to debate. Even estimates of the per hectare impacts of a certain density of possums on a major industry, like horticulture, can vary substantially across different crops and landscapes. Our solution in both cases is to include the range of reliable values available from industry and the environmental economics literature. We then track minimum and maximum values of these estimates, as well as their mid-points, throughout our calculations. This then provides a broad range of (un)certainty in the final CBA values. The middle value of this range is what we consider the most likely, and is the one that we encourage you to focus on. However, the range indicates what the outcome would be in the unlikely situation that, for example, all impact values were underestimated and possum growth rate was underestimated.

Parameters used in the cost-benefit analyses

Note that these parameters are all well-established values that have been used in the CBAs of recent regional council RPMPs and for the possum CBAs in the CBA supporting the latest Hawke's Bay RPMP.

Discount rate: 4%

Extent Parameters

Even abundant and widespread pests do not typically occupy every hectare of available habitat in a region. Each land use/habitat type is categorised as being a primary habitat (most infested/preferred), secondary habitat (less infested/preferred), or unsuitable for the pest. The model uses the following proportions when it estimates the number of hectares of each land use/habitat type that a pest will potentially occupy if it is not managed under the RPMP.

- Primary habitat for a pest (minimum proportion of area impacted): 0.3
- Primary habitat for a pest (maximum proportion of area impacted): 0.6
- Secondary habitat for a pest (minimum proportion of area impacted): 0.01
- Secondary habitat for a pest (maximum proportion of area impacted): 0.1

Impact Parameters

Each pest is assessed as having a low, moderate, or high impact on each land use/habitat type. The model interprets these categories as meaning that the pest reduces the annual economic value of that land use/habitat type per hectare (e.g. annual net production of dairy farms) by the following amounts.

Low impact on a land use/habitat type

- Minimum proportion of value removed: 0.01
- Maximum proportion of value removed: 0.04

Moderate impact on a land use/habitat type

- Minimum proportion of value removed: 0.05
- Maximum proportion of value removed: 0.09

High impact on a land use/habitat type

- Minimum reduction in economic value by the pest: 0.1
- Maximum reduction in economic value by the pest: 0.5

Possum (Trichosurus vulpecula)

Relevant biology

Attribute	Description
Form	Small marsupial similar in size to a cat with large eyes, oval ears, cat-like whiskers and a pointed snout. Has thick bushy tail and can be grey, brown or black in colour.
Habitat	Native and exotic forest, shrubland, farmland, orchards and urban areas. Has favoured food species, but will feed on wide range of species.
Regional distribution	Throughout the region.
Competitive ability	Has the ability to cause local extinctions of palatable plant species and cause major forest structure modifications. Eats invertebrates and will also take fledging birds and eggs from nests. Significant silvicultural and horticultural pests and also compete with stock for pasture.
Reproductive ability	Females breed from age one. In ideal conditions can produce two offspring per year.
Resistance to control	Controlled by poisoning, trapping and shooting. Can become 'shy' to any one method if the same method is used constantly.
Benefits	Valuable fur trade (according to the fur buying company Basically Bush, in one year the Taranaki region produced 4800 kg of possum pelts worth $95/kg = $465,000).

Land use/habitats occupied in Hawke's Bay

Land use type	Current infestation	Potential infestation
Dairy	High	High
Sheep and beef	High	High
Forestry	Low	High
Horticulture	Low	Low
Aquaculture	-	-
Urban	Low	Low
Native terrestrial	High	High
Coastal land	Low	High
Freshwater	-	-
Estuarine	-	-
Marine	-	-

High = most infested/preferred land use(s); Low = less infested/preferred land use(s); - = unsuitable land use(s)

Qualitative impact assessment

Category	Current	Potential	Comment	Source
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Dairy	M	H	Competes with stock for pasture, and is the main vector for bovine Tb spread.	
Sheep and beef	M	H	See Dairy.	
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Soil resources	L	M	Removal of vegetation and forest collapse can lead to soil erosion.	2
Water quality	L	M	Erosion of soil can lead to increased sedimentation in waterways.	2
Species diversity	H	H	Has major impacts on native forest and shrubland. Can suppress or eliminate preferred (palatable) plant species by	1, 2

Category	Current	Potential	Comment	Source
			selective browsing, which alters vegetation composition. Excessive browse can also lead to collapse of palatable canopy species e.g. Northern rata. Competes with native bird species for food, and eats chicks and eggs.	
Threatened species	M	M	Can eliminate or suppress threatened plant species e.g. mistletoes. Predator of eggs of North Is kokako. Can compete for nest sites with hole-nesting birds such as kiwi, parakeets and saddlebacks.	2
Social/Cultural				
Human health	L	M	Could transmit Tb to humans.	2
Recreation	M	H	Damage and eliminate palatable native plant species and alter structure of native forests, which can affect recreational experiences.	2
Māori culture	M	H	Destroys native forests and eats culturally important plants (e.g. koromiko).	

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source 1: Auckland Regional Council (2004), 2: King (2005), 3: TBfree New Zealand (2013)

Estimated quantitative impacts

Quantitative annual impacts per hectare are calculated as the current or anticipated proportional impact on land value across the region. All amounts are in net present value (NPV, $).

Calculation: Economic value per land use/habitat type × Impact level

Impact level
Low = 1–4% reduction in annual economic value per hectare
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Reduction in annual economic value ($) per hectare

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- Coastal	124.70–762.50	124.70–762.50
- Freshwater	0	0
- Estuarine	0	0
- Marine	0	0

Cost-benefit analysis results

Proposed management: **Sustained control**
Area of Programme: **974,126 ha**
Proposed annual expenditure by Council: **$3,500,000**

Assumptions

Assumptions	Values	Assumptions	Values
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Current benefits	$5/ha	Discount rate	4%

★ Current annual impact of the pest averaged across all land uses currently occupied.

° The potential extent the pest is predicted to achieve in the absence of regional management.

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The cost-benefit analysis indicates that the benefits of the proposed management programme over the next 10 years will be of net benefit to the region.

Scenario	Pest impacts★	Pest values°	Benefit	Council costs†	Landowner compliance costs‡	Agency compliance costs‡	Net benefit
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★ Includes economic, environmental and social costs.

° The estimated economic benefit provided by the pest.

† Administration and implementation costs incurred by the Council through the programme.

‡ Costs of control imposed on landowners through the programme, over and above the costs already being paid by landowners, as estimated by the Council. They are applied for the 10 years of the Plan.

50 year assessment

The longer-term cost-benefit analysis indicates that the monetised benefits over the next 50 years of the proposed management programme will be of net benefit to the region. Additional non-monetised benefits associated with the protection of biodiversity values are also anticipated.

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Conclusions

The Cost Benefit Analysis indicates that is likely that the proposed Council-led large-scale possum control will be cost beneficial to the region, both within ten years and over 50 years. The ten-year CBA estimates that the programme is likely to save the region about $15 million dollars over the next decade. The 50-year projection suggests a benefit of $77 million, which is both considerable and is likely to be an underestimate as it is likely that possum control technologies will become much more effective and less costly over this period. This is a possibility that we conservatively omit from our modelling, instead projecting forward the costings and effectiveness of current possum control.

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It is therefore important that possum densities and impacts continue to be monitored in the region, so that the programme can be regularly reviewed and, if necessary, reassessed. With the current information available, we conclude that Council-led control of possums is prudent and justified.

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