

Predator-Free Rakiura

An Economic Appraisal

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Summary

This report estimates the benefits of making Rakiura and surrounding islands predator free. The proposal is to do this in two phases, starting with the Halfmoon Bay area (denoted in this report as “HMB”) before progressing to the rest of the island (denoted in this report as “full”). We have tried to include, where possible, the full scope of benefits that may arise from the eradication, whether they could be valued or not. The costs have already been estimated elsewhere.

In this paper the benefits of predator eradication have been split into three parts:

- Part One: The financial and social benefits for Stewart Island/Rakiura;
- Part Two: The wider, non-financial benefits (including environmental);
- Part Three: An estimate of the return on investment (comparing the financial and non-financial benefits to the costs) of the project to New Zealand.

The focus in Part One of this report is on the *financial and social* benefits of predator eradication to Stewart Island/Rakiura. Making Rakiura and surrounding islands predator free would require a large eradication workforce, and would attract tourists to view the unique native wildlife. Both of these groups would spend money in the local economy. We know that tourism to Stewart Island/Rakiura has dropped by at least 25% since the global financial crisis. The existing predator free sanctuary of Ulva Island is now central to the tourism offer of Stewart Island/Rakiura, and attracts a steady stream of high spending visitors.

Based on experience of predator eradication elsewhere, we estimate tourism spending would increase by between 80-140% following a predator eradication just in the Halfmoon Bay area. Throughout this paper we have used the figures at the lower end of the range to ensure we are conservative. Yet even using these lower estimates we estimate that tourism, spending by the eradication workforce and the associated flow-on effects on the local economy would create 88 new permanent jobs and inject over \$10m new spending each year into the Stewart Island/Rakiura economy. These figures could be (temporarily) higher during the full eradication process itself due to the increased eradication workforce on the island. We estimate that Oban’s population would grow by 116 people, including at least 13 children which would boost the school roll by at least 9 pupils.

This higher level of economic activity on Stewart Island/Rakiura would provide significant opportunities to the local community. However, case studies indicate that the degree to which local people benefit depends on whether they seize those opportunities, or leave them to be picked up by outsiders. In similar locations, the impacts of a tourism on rates, house prices and electricity have been variable. In the case of Stewart Island/Rakiura we would expect an increase in tourism to raise house prices and reduce electricity prices (thanks to the larger population). The likely impact on rates is unclear, due in part to the increased revenue from the levy on visitors to Stewart Island/Rakiura.

In Part Two we look at other benefits from making Rakiura and surrounding islands predator free. These are known as ‘ecosystem services’ – useful things we get from the environment without having to pay for it. These benefits don’t always result in cash changing hands, but they are nevertheless valuable, so where possible we include an estimate of their value to people (e.g. from

surveys). Please note that these non-financial benefits have not been included in the numbers above, as they are of more interest to the people of New Zealand as a whole.

Following predator eradication our native wildlife - plants, trees, birds and insects - would regenerate and flourish. This could create many benefits for the people of New Zealand, most notably saving our native species, storing carbon and improving our international reputation. Given the sheer size of Rakiura and surrounding islands, eradicating predators could remove the threat of extinction from many of our endangered species, including iconic birds such as the kiwi, kakapo and kokako. Healthier native forests would store more carbon dioxide, reducing the impact of climate change. There may also be benefits from improving our international reputation, which could lead to increased immigration of skilled people and attract a larger premium for our exports. However, this reputation improvement is very difficult to measure.

In Part Three we estimate the return on investment to New Zealand as a whole from making Rakiura and surrounding islands predator free. We conclude that the costs of the smaller Halfmoon Bay project could be easily justified on direct economic benefits alone, particularly as a result of increased international tourism. The business case for the full eradication stacks up too, however it relies on other, more difficult to measure, ecosystem services to justify the significantly higher cost. The two most valuable services (that we can currently estimate) are saving many of our rarest native species, and the carbon dioxide stored in the regenerating forests. These and other ecosystem services need further research to improve the estimates of the improvements brought about by predator eradication.

Introduction & Method

A Governance Group has been established to examine the possibility of making Rakiura and surrounding islands predator-free. We are in the process of establishing a charitable trust with trustees being the members of the Governance Group. Methods of eradication are under consideration by the Governance Group, however the proposal is for a two-stage process. The project would initially begin with an eradication around the populated Halfmoon Bay area, followed by a full eradication on the rest of the islands.

The costs of a Predator-Free Rakiura have previously been assessed. From past experience, depending on the eradication method, the range of cost has been placed at \$35-55m.¹ The smaller Halfmoon Bay project is estimated at \$3.5-5m, but this will be particularly sensitive to eradication methods given the area is populated. There are also considerable risks associated with any eradication, such as missing some animals or from significant predator reinvasion.

However, all these issues are better understood than the benefits of eradicating pests from Rakiura and surrounding islands. Gaining a better understanding of the economic, social and environmental benefits is the purpose of this paper. In Part One we start with the tangible benefits to the economy of Stewart Island/Rakiura from increased tourism and the eradication process. Estimating the tourist impact was most difficult, but this was done by looking at case studies from overseas.

In Part Two we then go on to look at the intangible benefits. Working with Department of Conservation (DOC) and other national experts and drawing on an internationally recognised “ecosystem services” framework, we have compiled a preliminary list of the benefits that could arise from a Predator Free Rakiura. This analysis found that the majority of recognised ecosystem services would be improved by removing predators from Rakiura and surrounding islands. The only real question is to what degree those services would be improved. This raises the question about how measurable the improvements are, and whether they can be transferred into a common unit that allows them to be compared with the costs, such as money.

In some areas we have made some estimates of the impact, however the simple answer is that in many cases we don't know how big the improvements would be. The research into ecosystem services is in its infancy internationally, and even more so in New Zealand. Eradicating predators has been done in the past solely to secure the future of endangered species, and the wider ecosystem benefits have not been measured. Given this lack of data, any assessment of any improvement in ecosystem services will necessarily be of limited accuracy. However, the eradication on Rakiura and surrounding islands could serve as a natural experiment which allows all these benefits to be tested and better quantified for the future.

In Part Three we conclude by estimating (as best we can, given the caveats above) the return on investment to New Zealand of the small scale eradication around Halfmoon Bay (Stage One) and the whole island (Stage Two).

Where possible we have estimated the benefits in dollar terms as a way of quantifying the true value of the project in a way that can be compared with the costs. Ideally all of the ecosystem services would be estimated in the same detail, however this in itself would be a massive undertaking in terms of surveys and gathering data about the Stewart Island/Rakiura environment. As a result some estimates have been based on data from previous New Zealand studies. These are indicated where

appropriate. In some cases we have found no previous studies, so the benefits have remained unmeasured – again these instances are indicated in the text.

By measuring some benefits in monetary terms we are not attempting to value some benefits more highly, nor put a price on nature. Our intention is simply to give an indication of the value of making an investment to improve the Stewart Island/Rakiura ecosystem. As with any appraisal there is considerable uncertainty in the numbers, however care has been taken to be conservative with all estimates.

This report has been produced with the input of many independent experts including TRC Tourism, Department of Conservation, Landcare Research, Lincoln University and University of Waikato.

Part One: Financial & Social Benefits of Predator Eradication on Stewart Island/Rakiura

In this section focus on the direct benefits to Stewart Island/Rakiura. The main issue here is any likely increase in tourism. We also need to consider the spending by the labour force employed for the eradication and on-going monitoring of Predator-Free Rakiura. Both of these factors will create knock on impacts for the Stewart Island/Rakiura economy. We will conclude this section by looking at the social impact of these changes.

Eradicating predators from Rakiura and surrounding islands would almost certainly contribute to increased tourism; the only question is by how much. Native plants and wildlife would return, as has happened with previous eradications, and this is likely to attract more visitors, staying for longer.

The unique nature of a Predator-Free Rakiura is twofold; the sheer size of the project, including a large quantity of primary habitat, and the fact that the predator-free territory will include a permanent resident population. At 1,746km² an eradication project on this island would be the largest in the world – and would therefore create the largest predator-free sanctuary in the world. The extent of primary forest on the island (which has never been disturbed by human development) is also unique in terms of providing near-pristine habitat for native wildlife – and there are some signature species that could potentially return to the island – e.g. Kakapo. We also need to be mindful that there are a number of other islands around the world competing for predator eradication funding.

The combination of these factors would almost certainly capture international attention and make Stewart Island/Rakiura a candidate for World Heritage Status. If achieved this would in turn further raise the profile of the island. Current New Zealand World Heritage sites include the Tongariro National Park, Te Wahipounamu (South West New Zealand) and the subantarctic islands. Predator eradication is part of the UNESCO management plan for the subantarctic islands so that they can be returned to their natural state, and some of these eradications have already been completed (such as Campbell Island). Stewart Island/Rakiura has already been placed on the tentative list by the New Zealand Government but would need to go through a formal nomination and selection process to achieve World Heritage Status². The appropriate criteria used by the subantarctic islands to gain UNESCO status are also relevant to Predator Free Rakiura. These are set out below:

- to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;
- to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

We will begin by looking at the current tourism situation on Stewart Island/Rakiura, and then look at other examples of the impact of predator eradications on tourism to get some idea of the likely impact on Stewart Island/Rakiura.

Existing Tourism in New Zealand and on Stewart Island/Rakiura

First, a caveat. There are no public, reliable sources of data on tourism for Stewart Island/Rakiura. The closest tourist data in existence is for the Southland District Council and Southland Region, and this is not recognised as completely reliable. There have been studies of tourism on Stewart Island/Rakiura undertaken by DOC in 2002 as part of the creation of the National Park, and Southland Tourism as part of a Stewart Island Tourism Strategy. To supplement the shortage of public data, we have also accessed confidential data from local tourism providers. This data cannot be presented in this paper as it is commercially sensitive, but has instead been used behind the scenes to ensure that our estimates are robust.

There are two main ways that a Predator-Free Rakiura could contribute to increased tourism revenue on the islands: firstly it could attract new visitors, and secondly encourage existing visitors to spend more, particularly by staying longer. Both these outcomes are of interest as they would increase tourist spending.

Let's begin with the national numbers.³ New Zealand tourist numbers have been growing relatively slowly since a long period of rapid growth that ended in 2004. There were 2.56m international arrivals in 2012, some 22% higher than in 2003 but slightly down on 2011. However, this stable total glosses over huge changes in our tourist market. Since the start of the Global Financial Crisis, visitor numbers from the United Kingdom, United States, Japan and South Korea have fallen sharply. These falls have been supplemented by growth from Australia and China, which are now our top two tourist markets. Visitors from Germany have also grown, reflective of that country's strong economic performance.

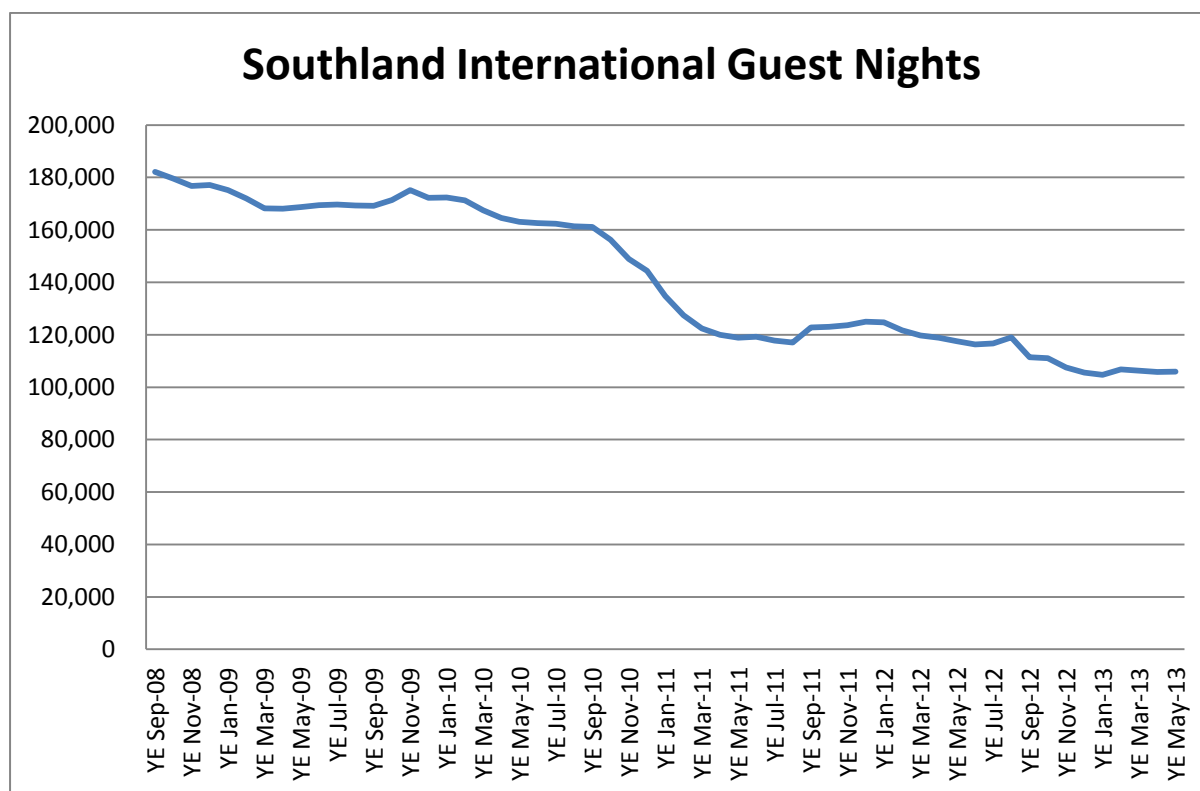
This shift in the origin of visitors to New Zealand is driving trends that are relevant to Stewart Island/Rakiura tourism. Visitors from Australia and China don't stay in the country as long, perhaps because they travel less far to visit New Zealand. This is driving an overall downward trend in the number of visitor nights spent in the country. Despite this, the Chinese still spend as much money as longer staying tourists, although the Aussies are far more frugal. Germans on the other hand have the longest length of stay in the country (twice as long as other countries), and despite being fairly frugal on a daily spend, end up with one of the highest total spends per visitor.

There are also changes in the activities that are being demanded by tourists which are relevant to Stewart Island/Rakiura. Australian and Chinese tourists are less likely to tramp or visit national parks than tourists from the UK or US. So while tramping is still the predominant activity among tourists, it is starting to decline. As a result, many regions that rely on natural tourism (such as Stewart Island/Rakiura) are facing declining international visits. That said, there is significant latent demand for outdoor activities like tramping amongst Australians and Chinese, so it may be possible to attract them into these markets. Germans are the only nationality that has very high participation in nature-based outdoor activities where visitor numbers are growing.

The trends on domestic tourism (Kiwis travelling around New Zealand) are not quite so clear. According to most measures domestic tourism has been fairly static over the last few years. Guest nights seem to be growing slowly, with spending growing slightly faster.

These national trends are also evident on a regional level. Tourism New Zealand's Visitor Experience Monitor⁴ surveys international visitors and found that 13% of their sample visited the Southland

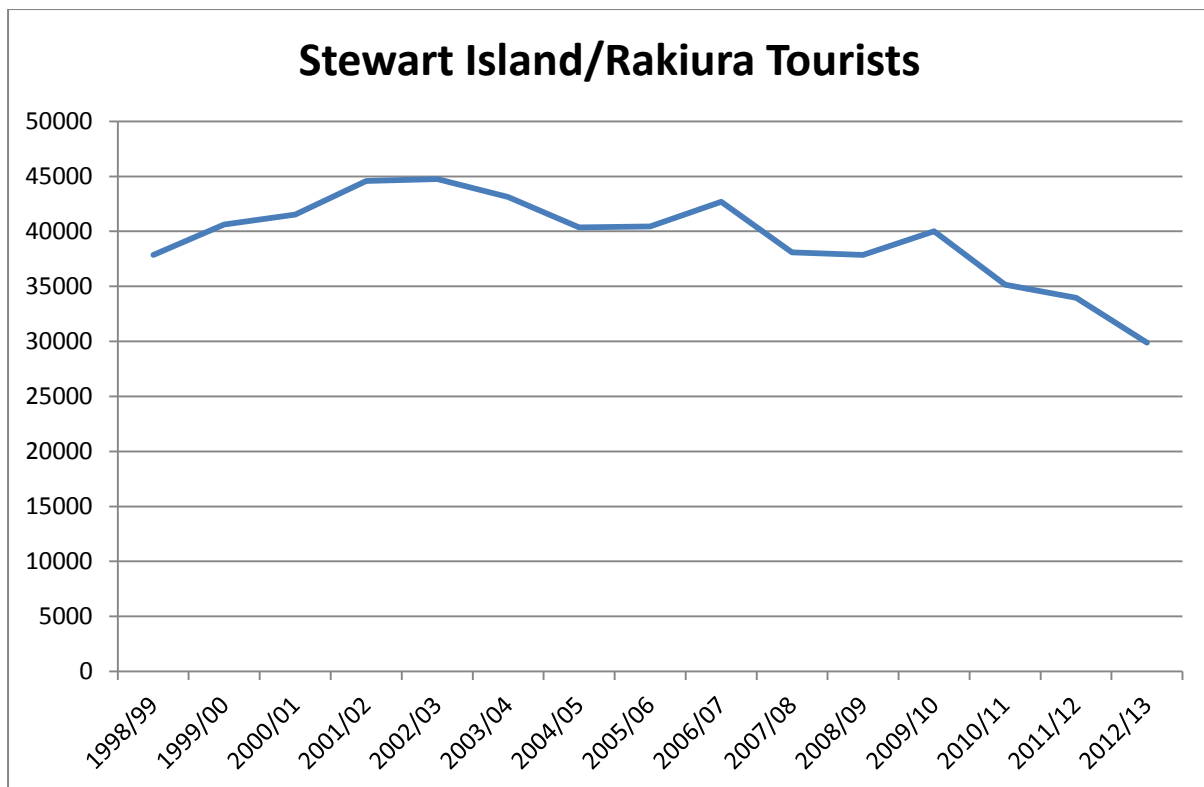
region in 2011/12 - down from 18% the previous year. The Visitor Experience Monitor survey reinforced that Germans and British tourists are the most likely to visit the Southland region. The fall-off in British tourists has had an impact region wide - international visitor guest nights have fallen around 40% since their peak in 2009, as shown by the figure below. In contrast domestic guest nights have remained relatively static, so overall guest nights are down around 20% from their 2009 peak.



Source: Statistics New Zealand Accommodation Survey

Based on these national trends, we would expect tourism on Stewart Island/Rakiura to be declining in recent years. What data we have from Stewart Island/Rakiura confirms this.

The only long term data we have for tourism on the island is from counting traffic at the DOC Stewart Island/Rakiura Visitor Centre. There are a couple of problems with this data. Firstly, the same tourist can be counted more than once by simply returning to the Centre. Secondly, the Visitor Centre stopped operating as the official information point in 2006, which altered the number of visitors passing through the Centre. We have done our best to calibrate this data set based on other tourist information from the island to get an estimate of Stewart Island/Rakiura visitors over time. See the graph below.



Source: DOC & author's calibrations

A 2008 study estimated that there were around 40,000 tourists visiting Stewart Island/Rakiura each year.⁵ A 2002 study estimated that the number of tourists prior to the National Park opening was 32,000 per year, which is some way from our calibrated data set. This difference may either be because the estimate was wrong (one of the sources used to estimate the number was the 1997 tourism strategy), or that the blip in Visitor Centre counts occurred around 2001/02 due to the opening of the National Park. Regardless, most available information suggests tourist numbers have been falling since 2008/09, and we estimate they now stand at around 30,000 per annum. We'll take a quick look at some of the detailed information that makes up this estimate.

In 2002 the majority of the tourists to Stewart Island/Rakiura were from New Zealand. However, the proportion of international tourists has been steadily rising and by 2010 a survey suggested that international tourists outnumbered New Zealanders. This trend appears to have reversed again during the global financial crisis as international tourism has fallen away faster than domestic tourism. In recent years we estimate about 40% of tourists (12,000 people) were from overseas.

This is substantially less than the number of international tourists visiting the Southland region more broadly. As mentioned above around 13% of international tourists visit Southland, whereas based on our estimate here Stewart Island/Rakiura attracts around 0.5% of New Zealand's international tourists. This means that only 1 in 26 international tourists that visit Southland make the trip across the Foveaux Strait. Clearly there is considerable scope for attracting more international visitors.

International tourists to Stewart Island/Rakiura have traditionally been mostly from the United Kingdom and Germany. As a result, Stewart Island/Rakiura has suffered substantially from the drop off in British tourists that we have seen at a national and regional levels. Visits from the United

States have also fallen, and Europe has been flat. Unlike the country more broadly, this drop in tourist numbers appears not to have been offset by an increase in tourism from Australia and China. Domestic visitors (mostly from Canterbury and Otago) have also fallen slightly in recent years, though not by nearly as much as international tourists. This is a concerning trend given that domestic tourism has been stable around the rest of the country. Overall this explains our estimate of a 25% fall in tourist numbers since 2008 (40,000 to 30,000).

In 2002 the average length of stay of tourists was estimated at 3 nights and 4 days.⁶ By 2010 this had fallen to 2.5 days⁷. This is still substantially longer than the average for the Southland Region more broadly (1.7 days)⁸. This makes sense given that people are paying to travel across Foveaux Strait. We have no reason to suspect this figure has changed since 2010.

The 2002 and 2010 studies also sets out the average spend per day for both overnight and day tourists, both of which we have updated to 2013 prices. This covers food, gifts and accommodation (hence the different figures for day tourists and overnights). Again, we have no reason to suspect this figure has changed, so we have extrapolated tourist spending to 2013 based on our estimate of tourist numbers.

Key Tourism Statistics	2002 Survey	2010 Survey	2013 Estimate
Inflation multiplier to 2013 prices	1.32	1.07	1
Estimated Number of Tourists	32,000	40,000	30,000
Percentage Day Tourists	8.6%	14%	14%
Average Length of Stay	4 days	2.5 days	2.5 days
Average Spend per Day (overnight)	\$47.52	\$125.73	\$125.73
Average Spend per Day (day)	\$36.96	\$129.47	\$129.47
Travel to and from island	Not included	Not included	Not included
Annual Estimated Spend Total	\$5.7 m	\$11.54m	\$8.65m

Sources: Booth & Leppens (2002), Tourism Resource Consultants (2010) and authors estimates (for 2013)

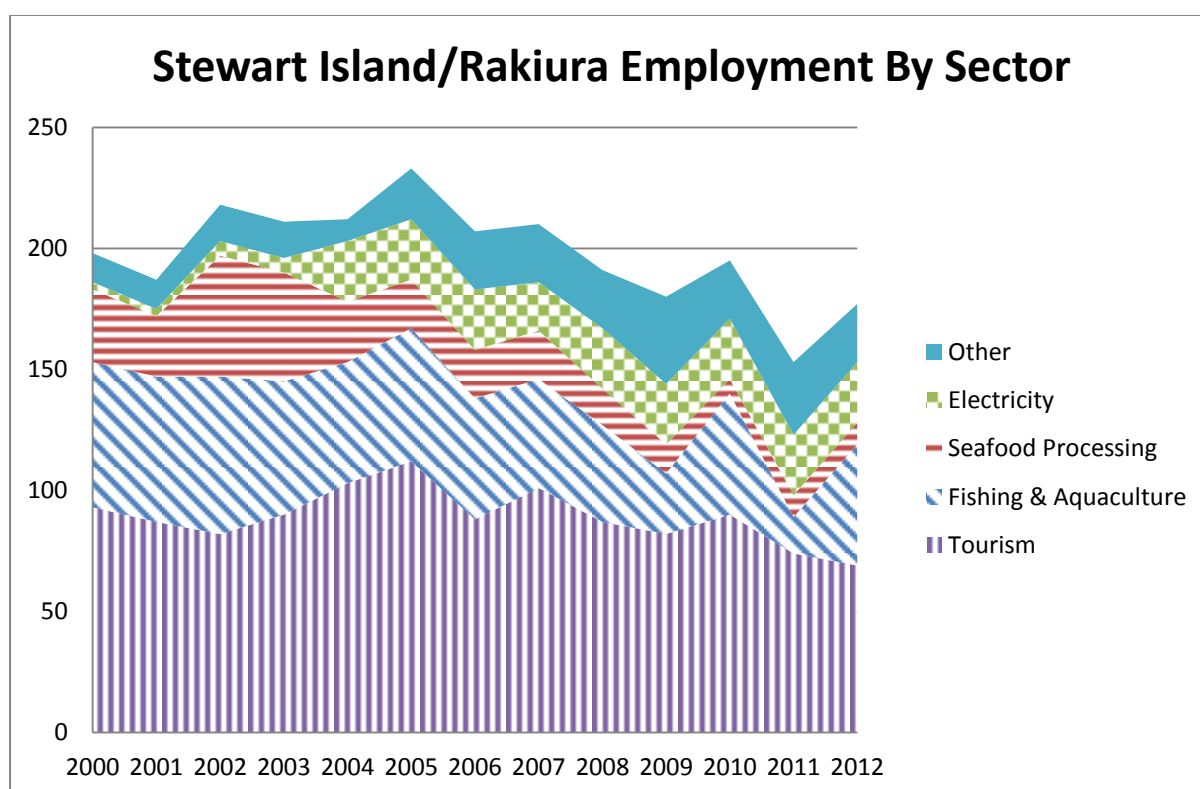
Tourism spending on the island has grown over the last decade, driven by a higher average spend per tourist. The daily spend per tourist on Stewart Island/Rakiura is in line with the national average, although it is slightly unusual in having higher spending on day trips rather than overnight stays. Overall this growth in average daily spend means that even accounting for lower visitor numbers and a shorter length of stay in recent years, the total visitor spend on the island is higher than it was in 2002 in real dollar terms. It is worth noting that domestic tourists stay longer on the island and spend more than international tourists (probably due to high numbers of international backpackers).

What do we know about visitors to Stewart Island/Rakiura? In 2002, the average tourist to Stewart Island/Rakiura was fairly young (in their twenties) and highly educated. This is still the case, but since then there has been a large growth in the 50+ age groups visiting the island. Visitors tend to travel to Stewart Island/Rakiura with their friends, family or by themselves, rather than in large tour groups. The island experiences a relatively low repeat visit rate among visitors. This is partly to be expected due to the distance, but surveys also suggest relatively low levels of satisfaction with visits compared to other New Zealand tourism experiences – in particular with the information provided, facilities & services and standard of food & beverages.

Of the Stewart Island/Rakiura tourists surveyed in 2010, the two most popular activities were day walks (76%) followed by wildlife viewing (56%), especially kiwi. Boat cruises (28%) and overnight walks (21%) are also popular. In 2010 the most common responses from tourists when asked what they liked best about their visit to the island was the environment (30% - which includes conservation, scenery, bush and nature), followed by wildlife (17% - mostly birdlife, bird watching and dolphins).

The data on hunting and fishing tourism is poor, as these visitors tend to avoid the more popular tourist routes. However, DOC permit data suggests that roughly 500 hunting parties have visited the island every year since 1997. According to hunting sources the average party size is around four people, with an average length of stay of 7 days. These are clearly substantial numbers, however figures on spending by hunters is more difficult to come by. Some of these parties go directly from Bluff, so it is difficult to know exactly what impact they have on the Stewart Island/ Rakiura economy.

Tourism is now the leading employer in the local economy, as can be seen from the graph of employment below. From 2004-2010 tourism consistently employed around 100 people on the island. However tourism employment has also clearly struggled with the drop off in tourist numbers in recent years. By 2012 tourism employment had fallen to 69 full time equivalent employees (FTEs). This compares with 50 FTEs in the next largest sector, fishing & aquaculture, with another 9 employed in processing seafood. Employment in the fishing & fish processing industry has been steadily declining.



Source: Statistics NZ

It is also worth noting that just under 30% of visitors to Stewart Island/Rakiura spend a night in Invercargill before *and* after visiting Stewart Island/Rakiura. That suggests that Stewart Island/Rakiura tourism could be worth in the region of \$2.3m to the Invercargill economy (based on the recent lower estimates of tourist numbers used in this report).

This section has given an overview of the current situation facing the tourism industry on Stewart Island/Rakiura. We now turn to the impact of predator eradication projects on tourism in other parts of the world, to get some idea of what change predator eradication would cause.

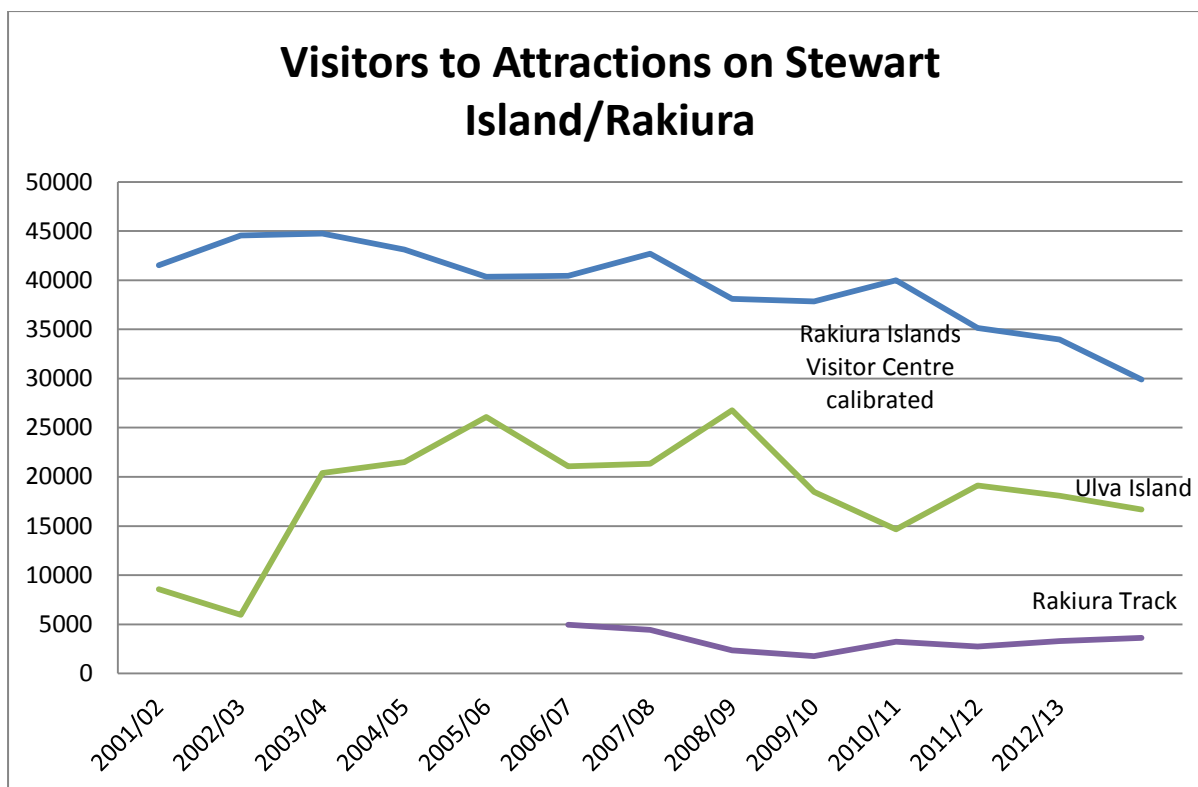
Evidence of Eradication Impact on Tourism

The fact is that New Zealand is a world leader on predator eradication, so many of the best examples are from our own country. Unfortunately in many cases where predator eradication has been carried out, the tourism benefits have not been captured or assessed. Also tourism is often strictly controlled, even prohibited on many predator-free islands in New Zealand, so it can be difficult to get a true picture of the impact. That said, where tourism benefits have been recorded, the results have been impressive.

Ulva Island

This island is located in Stewart Island/Rakiura's Paterson Inlet. It is 266 hectares in size and is only a short water taxi ride from Oban. There has never been a population of possums on the island, and by 1997 the rat population was eradicated. The Ulva Island Charitable Trust was set up in 1999 by a group of people from Stewart Island/Rakiura to raise money to upgrade walking tracks and facilities on Ulva Island. Over the following years multiple species translocations occurred. In April 2000 the tracks on Ulva Island were upgraded and opened, which finally allowed the increased demand from predator eradication to be realised, and visitor numbers climbed substantially.

Tourism to Ulva Island has been consistently 2-3 times the levels prior to predator eradication. It appears that Ulva Island is now central to the tourism package offered by Stewart Island/Rakiura more broadly. The graph below adds visitor numbers for Ulva Island and the Rakiura Track to our estimate of tourism on Stewart Island/Rakiura. Visits to Ulva Island have been reasonably steady despite the fall off in tourism generally, and it has consistently attracted far more visitors than the Rakiura Track and National Park. Without Ulva Island, the National Park and Great Walk the recent downward trend in visits to Stewart Island/Rakiura may have been even sharper.



Source: DOC & author's calibration calculations

The demographics of visitors to Ulva Island are also interesting. Compared to Stewart Island/Rakiura itself, Ulva Island attracts a higher proportion of international tourists. Visitors from the United Kingdom, Germany and Australia that visit Stewart Island/Rakiura are particularly likely to visit Ulva Island. This does not prove that Ulva Island is their motivation for visiting Stewart Island/Rakiura, but it is an interesting correlation. New Zealanders only made up 40% of the visitors to Ulva, whereas they make up a larger proportion of the visitors to Stewart Island/Rakiura more broadly. Ulva Island also attracts a far older (and presumably more affluent) patronage than the rest of Stewart Island/Rakiura – some 66% of visitors are over 50 years of age. Ulva's clientele is also older than DOC's other walks, including the Rakiura Track which attracts in the realm of 3,000 trampers each year (of which 28% are New Zealanders⁹). Ulva Island may therefore help explain the rise in tourism among the elderly we have witnessed on Stewart Island/Rakiura over the past decade, as well as the increase in average spend per visitor.

Ulva island is also notable in that some 40% of visitors are guided, giving a higher return to the local economy. This is a far higher rate of guided tours than that recorded for any other DOC walk, a promising sign for the local economy if Predator Free Rakiura became a reality.

*Tiritiri Matangi*¹⁰

Tiritiri Matangi is a small island (220ha) just off Whangaparaoa Peninsula near Auckland. It has been predator-free since 1993 and now has both a local and international reputation which attracts many visitors. The big advantages for this island are that it is near Auckland, and the eradication was simpler because kiore rats were the only invasive predator on the island.

Tiri's history goes back to the early seventies (part of the island was designated a recreation reserve in 1970). Tree planting began in 1983 and continued until 1994. The first animal translocations were kakariki in 1974, saddleback in 1984 and brown teal in 1987. The 'Supporters of Tiritiri Matangi' was formed in 1988. The first guiding track was completed in 1989. All of this work was completed long before it became predator-free after a poison drop in 1993. It is difficult to know how big an impact kiore had on bird life, but anecdotally there were high densities of rats on the island.

Becoming predator-free allowed the re-introduction and management of more species (NI Robin, hihi, tuatara, Duvaucel's gecko, shore skink, whitehead, little-spotted kiwi, rifleman, wetapunga, takahe, fern bird, kokako) and for already resident species to thrive. As a consequence, Tiritiri Matangi attracted more visitors.

In 1995 visitor numbers to Tiri were reported to be around 13,000 per annum.¹¹ Over the past four years it has received up to 29,000 per year visits on the scheduled ferry service and around 8,000 per year on their own boats (it's a while since those arriving on their own boats were counted, so we don't know the numbers for sure). It is also worth pointing out that visitor numbers are limited by the DOC concession and, in peak periods, the ferry company is turning away potential visitors.

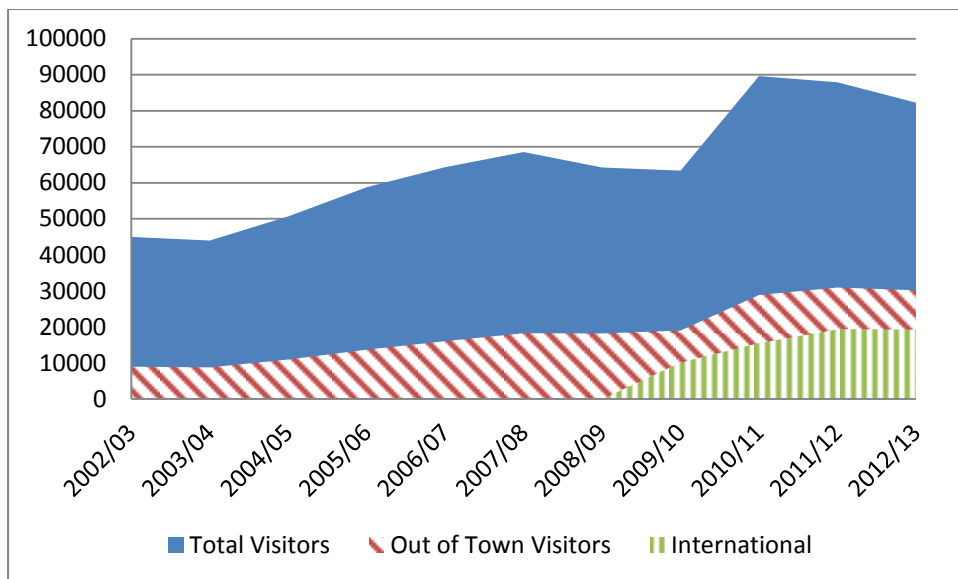
More than half of these visitors are resident in New Zealand, with most of those living in Auckland. The United States and United Kingdom were the next largest source of visitors. Most visitors are elderly; roughly 40% of visitors are over the age of 60. Three quarters of visitors say they enjoyed the bird life on the island.¹²

In summary, visitor numbers have roughly trebled since Tiritiri Matangi became predator-free (13,000 to 37,000), but as with Ulva it would be simplistic to claim that all this is due to predator eradication. Many other factors have worked in tandem with this and have also contributed to the rise including track upgrades, tree planting, school visits from Auckland and animal relocations. However, these other factors may not have occurred without the predator eradication.

Zealandia

In 1998 a fence was built around a valley in Karori, Wellington, and in 1999 the predators in the valley were eliminated. Over time new species have been introduced, so that there is now double the number of bird species (32) in the valley than there was when the sanctuary was created. Numbers of certain bird species in and around the sanctuary, particularly tui and kaka, are also up substantially.

Since opening, Zealandia (formerly known as the Karori Wildlife Sanctuary) has steadily attracted more visitors. Since data collection started in 2002 numbers have roughly doubled to over 80,000 per year. Around 30,000 of these are New Zealanders from outside Wellington, and 19,000 are international. International visitors are the fastest growing segment, although we only have data for them back to 2009.



Visitor numbers have been very resilient to recent rises in admission prices, which occurred in 2010. The international market in particular has grown strongly at a time when prices have risen sharply, so they are clearly prepared to pay for a unique interaction with New Zealand wildlife.

Unfortunately there have been no studies of the impact of Zealandia on Wellington's tourism market overall.

Maungatutari

Maungatutari is a forested mountain in the Waikato just south of Cambridge. It is the largest predator-free enclosure on mainland New Zealand with 47kms of predator proof fence enclosing 3,400 hectares.

The full fence was completed in 2006, followed by predator eradication and the release of many native species over the following years. Governance of the project is shared between partners (landowners, iwi, and the community), which has at times made progress slow. In 2012 they opened a visitor centre, and are now gearing up to act as a tourist attraction. Their aim is to tap into the international tourist traffic that flows from the Waitomo Caves in the west to Rotorua in the east. The Auckland market is also less than a 2 hour car drive away.

It is still too soon to understand what the full impact of Maungatutari will be on local tourism. At the moment, even without much advertising, the mountain is attracting some 30,000 visitors per year. Most of these are local or from the Waikato region. The trust managing Maungatutari expect that number to grow rapidly once advertising begins, and soon reach 50,000. The initial projection of 100,000 visitors is considered to be a long term goal dependent on tapping into the bus tourism traffic that passes by the mountain en route from Waitomo to Rotorua. Partners are aiming to drive revenue growth by offering guided tours. As an indication of this possible growth, when Sirocco the kakapo was resident at Maungatutari they attracted some 5,000 visitors over 6 weeks.

We don't know how many tourists Maungatutari attracted prior to being predator free, probably very few since the access was across private land. However it is reasonable to contrast visitor numbers with Mt Pirongia, another forested mountain walking area to the west of Hamilton. This attracts 20,000 visitors per year. Pirongia is far more established as a walking destination than

Maungatautari, and is more accessible to Hamilton and the tourist destination of Raglan. So already without advertising Maungatautari is attracting 50% more visitors than Pirongia, and it is expected to quickly grow to 2 ½ times as many visitors.

Elsewhere in the world

While predator eradications elsewhere in the world are rare, there is clearly a growing demand for predator-free tourist destinations. Tourism in predator-free environments is part of a growing demand for unique eco-tourist experiences more generally. Since the 1990s, ecotourism has been growing at 20%-34% per year. It is growing far faster than tourism generally; in 2004, ecotourism/nature tourism was growing globally 3 times faster than the tourism industry as a whole.¹³

Evidence from eradications around the world indicates that removing predators improves the lot of native fauna and flora, and this often provides a boon for the tourism industry. The importance of predator eradication to tourism has been recognised in the Seychelles, which is a global biodiversity hotspot. Tourism operators on privately owned islands have even funded eradications with the primary goal of facilitating the reintroduction of endangered bird species that would enhance their existing tourism operations. Despite a reinvasion on one island, private tourist operators on other islands have continued to embrace the eradication concept. Providing pristine tropical island getaways with endangered birdlife allows the Seychelles to target the exclusive top-end tourist market. A survey of islands that have undertaken rat eradications showed that ecotourism was the (or one of the) primary motivation(s) behind the activity along with philanthropy and direct commercial issues. Resort owners noted that 'exclusive 5 star tourism and rats don't mix'.¹⁴

Eco tourism is also crucial for the Galapagos. A total of 108,600 people visited the Galapagos Islands in 2005, compared with 66,071 in 1999 and 17,500 in 1980. That is an increase of 500% in 25 years – much faster than New Zealand's average rate of tourism growth (roughly doubling every ten years). The majority of these tourists, 76,000, were foreign.¹⁵ However, studies of the Galapagos have noted that tourist ships reduce the amount of money circulated in the local economy. Over the same time period that that tourism has increased five-fold, the Galapagos population has also increased five-fold.¹⁶ This indicates a strong association between tourism and local population growth. This population growth has led to mixed impacts on local residents, as discussed in the Appendix.

Potential of International Bird watching Market

Of ecotourism activities, bird watching has been growing fast and is now one of the dominant sectors in the world.¹⁷ The international bird watching market is large and growing, and New Zealand has a strong position in that marketplace. We do not have the sheer numbers of species that can be found in South and Central America, but what we do have is unique species that can only be found here. This position as a bird watching destination would only be strengthened by a Predator-Free Rakiura.

New Zealand is unique in that our natural history resulted in many of our native ecosystem niches being occupied by birds. As a result, New Zealand has 256 species of birds that can be found nowhere else. However, 58 of these are now extinct (or functionally extinct), another 77 are threatened and 92 are at risk. We have another 208 species that are found elsewhere in the world.¹⁸ Of the bird species that remain in New Zealand, we have the fourth highest level of endemism - the percentage of all our bird species that can only be found here.¹⁹

Where New Zealand particularly stands out is in populations of seabirds. We have over 100 species of seabirds, more than one quarter of all the seabirds in the world. Only five other countries have more species of seabirds, but none of them can match New Zealand for high levels of endemism – birds that are found nowhere else. Sadly they also cannot match our numbers of endangered species – we have over 40 seabird species that are a conservation concern.²⁰

Of the 2.56m international visitors in New Zealand each year, around 86% walk & trek and 11% bird watch. That is almost 300,000 international tourists engaging in bird watching activities in New Zealand. Of the domestic population around 8.6%, or 138,629 people, engage in this activity on an annual basis.²¹

Between 1982 and 2002 the numbers of birdwatchers in the United States increased by 225%²², and now some 20-35% of Americans bird watch.²³ Around 20 million of them travel away from their home town to bird watch,²⁴ and more than half of the US birdwatcher recreation budget is devoted to travel (\$1850). In any year American birders spend \$32 billion in retail sales, contribute \$13 billion in federal and state income taxes and create 863,406 jobs.²⁵ Internationally there are an estimated three million trips that happen solely for bird watching every year.²⁶ Bird watchers also tend to be older, more educated, high value individuals.

Around half of bird watchers keep life-long bird spotting lists. These bird watchers want to see endemic wildlife that they wouldn't see anywhere else, and they prefer to see birds in the wild rather than in captivity.²⁷ A key factor in deciding where to visit is how easy it is to view new species. This is often expressed as the cost per species viewed. Cost per species viewed in the United States is US\$75, for Costa Rica US\$8-10, and in Australia A\$22-26.²⁸ In theory if visitors from the US to Ulva Island saw every species that exists (or can exist) there, they could receive similar value as those to Australia. This would be a total of 95 unique species, which when compared to the cost of the travel would come at a cost of NZ\$28 per species.²⁹ However, seeing 95 species is an unlikely proposition for a day trip to Ulva Island. Seeing all these birds (and more) would be a far more realistic proposition for tourists if they were staying on a Predator Free Rakiura. Also, the larger area of the mainland would allow for an even larger variety of species. Therefore a larger predator free area would make a competitive offer for international birdwatching tourists.

Bird tourism is a crucial factor for many parks around the world, generating significant revenue. In Australia they have calculated that the absence of birds at Lamington National Park would reduce visits to it by more than 40 per cent (around \$15m of a total revenue of \$35m).³⁰ Birdwatching creates \$30m and 283 jobs in six sites around Lake Erie.³¹ The Scottish Seabird Centre in North Berwick, Scotland generates an annual income of £2 million and is directly responsible for 50 jobs in the community and indirectly created another 25 positions.³² Some of America's top birding locations and the expenditure they generate are set out below.³³ As can be seen there is huge variation in expenditure, which often depends on proximity to cities and how accessible a destination is. Accessible locations can be visited in a day trip, which means they get more visitors with a reduced average expenditure per visitor. So there is some advantage in being a remote, unique birdwatching location; fewer visitors, spending more.

Location	Visitors	Expenditure
Cape May, New Jersey	100,000	\$10m
Hawk Mountain, Penn	53,000	\$2.4m

High Island, Texas	6,000 or more	\$2.5m
Grand Isle, Nebraska	80,000	\$40m
Point Pelee, Ontario	56,000	\$3.2m

Source: Jones & Buckley (2001)

Survey

To complement this data from overseas eradications, we have conducted an online survey to test whether Predator Free status would alter their likelihood of visiting Stewart Island/Rakiura. The survey was passed through the local and international birding community and Stewart Island/Rakiura tourism networks. It asked local and international people whether they had previously visited or planned to visit Stewart Island/Rakiura. It then explained the predator free status, and asked whether that would change their likelihood of visiting. The purpose of the questions was to estimate the proportionate increase in tourism that predator free status would generate.

The results are remarkably consistent with what we have found in other eradications; that predator free status would roughly double or triple the likelihood of visiting, and would increase the average length of stay by 1 day. These results are available in the table below.

166 responses	Now	Predator Free	Change
Do you intend to visit Stewart Island/ Rakiura?	36%	87%	+140%
Intended Length of Stay? (median)	3 days	4 days	+33%

Source: Morgan Foundation survey

Estimate of Tourism Increase under Predator-Free scenario

Based on the impact of other eradications elsewhere, it seems reasonable to expect tourism to Stewart Island/Rakiura to double or even triple once it attains predator free status. However, the fact that up to half of those visiting Stewart Island/Rakiura may already be doing so in order to visit the Ulva Island bird sanctuary complicates matters. While the results of the survey indicate that this may not be an issue, in the interests of making a conservative estimate we will assume that it is.

Given that up to half of all current visitors may already be coming to see birdlife, the increase in tourism numbers overall may not be as large as double or triple. In order to be conservative, the 2-3 fold increase in tourist numbers will be applied only to the other half of Stewart Island/Rakiura's tourists – those that currently don't visit Ulva Island. For those that do visit Ulva Island, a Predator-Free Rakiura is likely induce these tourists to stay longer. The survey suggests 2 days longer, but to be conservative again we will use 1-2 days.

Are there any possible negative tourism impacts from predator eradication? Conceivably some eradication methods could require temporary suspension of hunting and fishing tourism (or commercial fishing) in certain areas. The impact of the Halfmoon Bay eradication on hunting and fishing tourism is expected to be negligible due to the likely methods, so we can be sure that there would be no negative impact on hunting and fishing until well after the benefits of increased tourism have been felt. The full eradication could cause greater disruption but this is impossible to estimate, given that the method of eradication is yet to be chosen, and there is limited data on hunting and fishing tourism spend. However, any loss from reduced hunting and fishing is likely to be less than the spike in extra spending generated by the full eradication process itself (see the next section below).

In fact, the research on marine protection indicates that ³⁴ temporary exclusions from hunting and fishing are unlikely to reduce hunting and fishing activity overall, simply displace it to other times or nearby areas. Given that one possible approach is to progressively eradicate predators from zones on the island, hunting and fishing activity could well be temporarily displaced to elsewhere on Stewart Island/Rakiura, without any overall reduction in activity.

Therefore overall we can expect to see a 50-75% rise in tourism numbers, and an increase of between ½ a day and a full day in the average length of stay of all visitors. The table below shows how those increases would flow through the local economy.

Key Tourism Statistics	2013 Estimate	Predator Free Estimate - Low	Predator Free Estimate - High
Estimated Number of Tourists	30,000	45,000	52,500
Percentage Day Tourists	14%	14%	14%
Average Length of Stay	2.5 days	3 days	3.5 days
Average Spend per Day (overnight)	\$125.73	\$125.73	\$125.73
Average Spend per Day (day)	\$129.47	\$129.47	\$129.47
Travel to and from island	Not included	Not included	Not included
Annual Estimated Spend Total	\$8.7m	\$15.4m	\$20.8m

Sources: Tourism Resource Consultants (2010) and authors estimates (for 2013)

In total this equates to an extra \$6.7m-\$12.1m per annum in tourism spending, an increase of 80-140%. In order to be conservative we are using the lower end estimate (\$6.7m) for the rest of this paper. This (conservative) increase in tourism spending would equate to around 54 full time jobs in the tourism industry.

There are likely to be further benefits across all of New Zealand, and particularly Southland. As noted above, roughly 30% of visitors to Stewart Island/Rakiura spend a night in Invercargill before and after their visit, which is worth around \$2.3m in direct spending to the local economy each year. The increase in tourist numbers estimated here would bring this figure closer to \$3.5m, an increase of 50%.

Some are concerned about the effects on infrastructure of this increase in tourism on the island. However, this is unlikely to be an issue, this change would not increase tourism far beyond levels that the island has seen in the past. As an example while the Rakiura track huts are near capacity during the summer season there is plenty of scope for bookings at other times during the year. In addition there is now a tourist levy on visitors to the island of \$5 which would help maintain infrastructure and fund additional if needed. We estimate that charge would currently raise over \$150,000 per annum, and based on the figures above would rise by \$75,000 after Predator Free status is achieved.

It is worth noting that, depending on the eradication method there may also be potential for volunteer tourism (also known as *voluntourism*) during the eradication. Normally we would expect tourism to pick up in the years following the eradication, but this has the potential to bring tourists to the island earlier – during the eradication process itself. Conservation Volunteers have demonstrated that there is considerable demand among the international ‘gap year’ community to visit the country and take part in a conservation programme. This is not only a potential source of labour but also a potential source of tourism income for the island.

Tourism is likely to be the largest and most tangible ecosystem service to benefit from predator eradication. However, while we are looking at financial benefits for the local community, we must also consider the impact of the eradication process itself.

Financial Benefits of Eradication Process

The actual eradication workforce are likely to have a large economic impact while they are working on Rakiura and surrounding islands. While this will not necessarily provide net economic benefits to New Zealand as a whole (depending on how much of the funding is sourced overseas), it certainly will to the local Stewart Island/Rakiura economy. At this stage we don't know exact numbers, as the eradication methods are not yet clear. As a result, what follows are our best estimates.

As mentioned, the proposal is to carry out the eradication in two segments – beginning with the smaller Halfmoon Bay area, followed by the rest of the island. We will also assume that there is a fence constructed to separate the two projects (although this is undecided and still under consideration of the project Governance Board).

First up we have the fence building process. Due to weather constraints, this project would not be carried out consistently over a year. It is more likely to involve intense bursts of activity over two summers, with less work occurring in winter. On average over an entire year, experienced fence builders estimate that this is work for around 5 full time equivalent workers.

The smaller Halfmoon Bay predator eradication project would create a number of jobs, with exact numbers depending on the methodology. We estimate 15 FTE's would be needed over five years for the first eradication phase. Following this eradication there would also be a need for some on-going maintenance and predator detection on the island. We estimate this would equate to 3 full time positions.

For the larger eradication operation across the rest of the island, estimating the workforce required becomes even more difficult. Our estimate is that 35 full time positions would be needed until eradication is confirmed (5years). After this there will be an on-going workforce of at least 7 to cover biosecurity and incursion detection and response (this includes the 3 mentioned after the Halfmoon Bay project above). All these positions are in addition to the existing DOC staff currently on the island.

The average salary for DOC staff is \$45,000 each, for the fence building crew it is likely to be much higher (closer to \$70,000)³⁵. Again, to be conservative we have estimated that the local economy will receive an injection of spending of just over \$30,870 per person per annum (making the average national provision of 31.4% for saving and tax³⁶). Total projected spending is summarised in the table below:

Project	Jobs	Total Spending p.a.	Duration
Fence Building	5	\$309,000	1 year
Halfmoon Bay Eradication	15	\$463,000	5 years
Maintenance of Halfmoon Bay	3	\$93,000	Until full project finishes
Full Island Eradication	35	\$1,080,000	5 years
Full Island Eradication Maintenance	7	\$216,000	Indefinitely

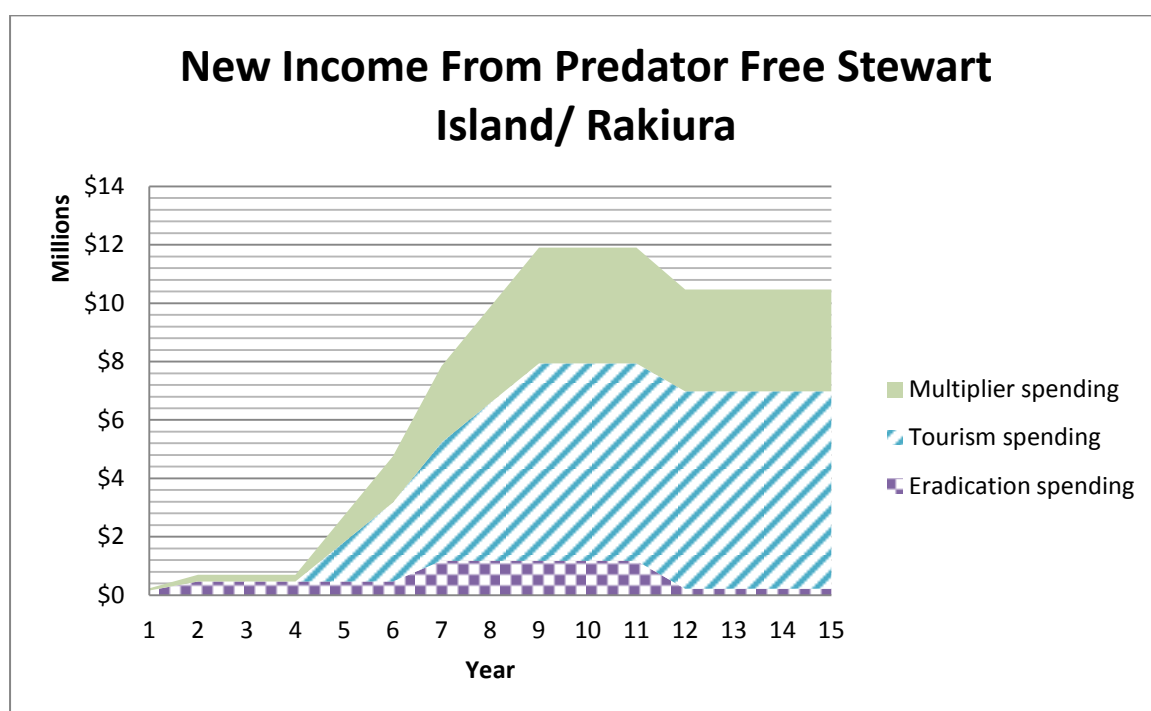
Source: DOC and Fence Building Companies

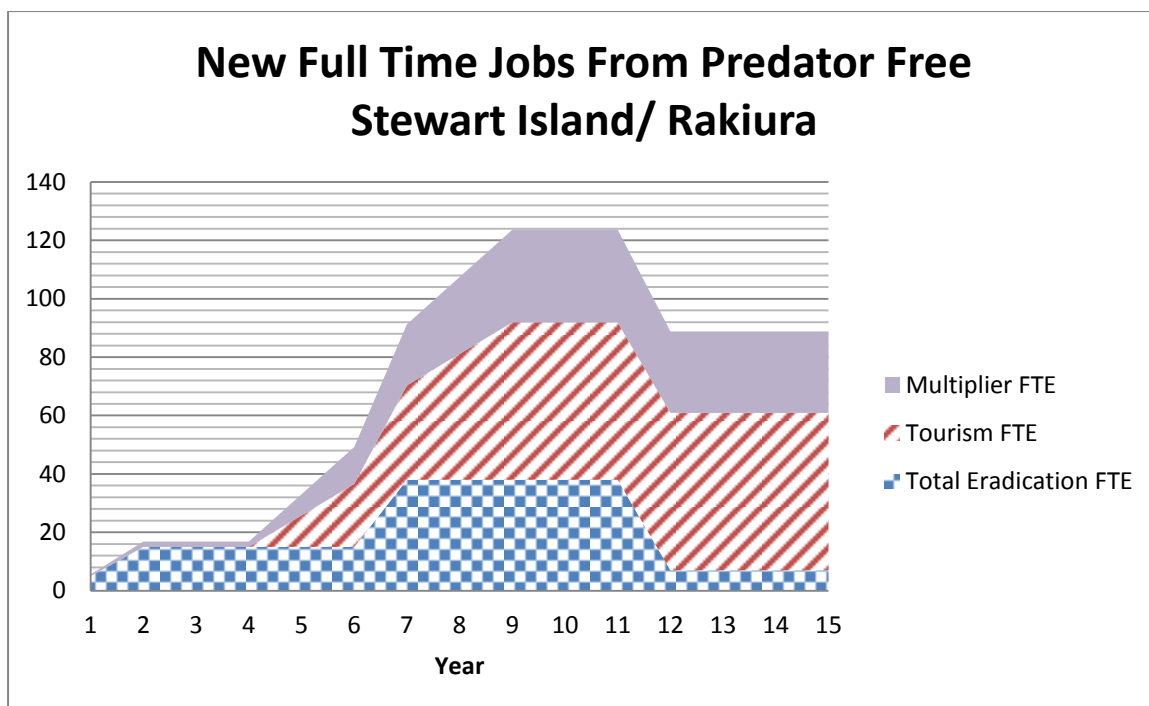
Summary of Financial Benefits to Stewart Island/Rakiura Economy

This section summarises the financial benefits we would expect to see in the Stewart Island/Rakiura economy as a result of the predator eradication. To do this it brings together the information on tourism and spending from the eradication process. The eradication process itself would generate the economic benefits initially, with the tourism benefit ramping up following the successful completion of the Halfmoon Bay project.

Of course this additional money does not simply get spent once and disappear. It becomes someone else's income, and fuels further spending, multiplying the impact through the economy and onward to the mainland. For example, extra visitors spend money on food. The owner of the café or restaurant has a higher income, which might mean more profit and/or more staff. Some of this money from profit or wages gets spent in the local economy – on food, accommodation and other things. Then some of this money is respent, and so on. In this way \$1 spent by a tourist has a bigger than \$1 impact on the local economy. In lieu of exact regional multipliers for Stewart Island/Rakiura, it is conservative to assume a multiplier of 1.5 for any new spending (\$1 spent by a tourist gets respent in Rakiura for a total value of \$1.50).³⁷

Given that these benefits occur in different years, the easiest way to see the impacts of these three benefits on income and employment is in the graphs below. It sets out the expected sources of income over a 15 year period following the beginning of the Halfmoon Bay project. The assumption is that the full eradication would begin immediately after the successful completion of the first project (five years).





Over the long term, this project is expected to generate over \$10m per annum for the local Stewart Island/Rakiura economy, and generate around 88 new jobs. This includes the 54 tourism jobs, 7 DOC jobs and the remainder as a result of the multiplier effect – in effect these jobs arise from providing basic services for the larger population that would be living on the island. We assume these jobs would be generated at the same rate as the tourism jobs (on Rakiura there appears to be one job created for every extra \$125,000 spent in the local economy). At the peak, the eradication process and tourism together would provide around 124 jobs and almost \$12m per annum in revenue to the local economy.

Social Benefits of Eradication to Stewart Island/Rakiura

The population of Stewart Island/Rakiura is currently around 420 people. Employment fluctuates around 200 jobs per annum, and currently (2012) sits at 177. The labour market on Stewart Island/Rakiura appears to have been very flexible, accommodating varying levels of employment, yet maintaining generally low unemployment (around 4.4% in 2006). This indicates that despite low official unemployment some jobs (as many as 30, based on past employment peaks) may be picked up by people on the island. The rest of the jobs would need to be filled by new immigration.

As mentioned above expect the eradication to generate around 88 permanent new jobs over the long term, although this could temporarily rise as high as 124 during the eradication itself. If 30 of these jobs are filled locally then we can expect 58 positions to be filled by permanent immigrants, with up to another 36 temporary migrants during the eradication process itself. These temporary positions are unlikely to attract people with families, however the 58 permanent positions could well attract families to the island. Based on the existing New Zealand demographic of one dependent for every employed person, we could expect these 58 jobs to raise the population by around 116 people, a rise of 28%.

The main social benefits generated by this increase in population would include an increase in the school roll, construction of new dwellings and higher rates of occupation of existing holiday homes,

potentially one more district health worker, an additional part-time or full-time teacher and increased community activity including events, sports and leisure activities. We will look at these in more detail below.

One of the greatest social benefits will be to increase the number of families living permanently on the island. The case studies provided in the Appendix illustrate that this is something that will not happen by itself. The Stewart Island/Rakiura community and lead agencies such as DOC, Southland District Council, Southland District Health Board and Department of Education as well as the tourism sector will have to exert influence to make it happen. The key will be in selecting more mature workers with families or partners, provision of affordable housing and land to build, child care and health services and a school that can cater for growth.

Stewart Island/Rakiura currently has a relatively low number of children under 15 years of age (48 residents, about 11% of the population). The proportion of children in the Stewart Island/Rakiura population is half that for Southland where about 23% are aged under 15 years, and also lower than the New Zealand average (20%). The majority of these children (27 or 61%) are attending the school, with about 10 in pre-school and approximately 11 attending school elsewhere.

This low proportion of children is no surprise given there is no secondary education on the island, and the relatively high number of single people living on the island. Single people occupy 42% of the dwellings – a much higher proportion compared with the Southland population (26%). This means that close to half of the 255 occupied dwellings on the island are families (couples or couples with children), compared with 69% for the rest of Southland.

So, we expect 58 new full time positions, attracting 116 people in total to the island. How many of these will be children, and how many of them will attend the school? If the population moving over reflects the current demographics of Stewart Island/Rakiura then we would expect 11% of them to be children, which means 13 more children on the island. If 61% of these are of the school age, the school roll should face a rise of around 9. If however the new arrivals looked like the rest of New Zealand demographics then we would expect 23 children (20%), with a rise in the school roll of 14. Given the skill mix required with the eradication project and subsequent tourism workforce appears more of an intensification of current skills on the island rather than a completely different set of skills, we would expect the number to nearer the bottom of the scale. However, a concerted effort to recruit families could push the number to the top of the scale.

In short, given the increase in full time employment and population, we estimate that Stewart Island/Rakiura would gain 13-23 more children, of which 9-14 would attend the school 10 years after the eradication project begins. In keeping with the conservative estimates made elsewhere, we will focus on the numbers at the lower end of the scale – 13 more children, including 9 of school age. We have assumed that the majority of people involved in the eradication itself will not settle on the island, so numbers would gradually reach these levels after the Halfmoon Bay eradication has been completed and tourism grows as a result.

We have used case studies of similar localities (see Appendix) to review the likely impact of tourism increases on the existing community. There were few commonalities between different areas to draw many clear lessons. However, it is clear that the extent to which a local community benefits

from the opportunities created by tourism depends on how the people in the community react, whether they seize those opportunities or allow others to take them.

In terms of the impact on rates and property values, the case studies indicate that there are no guarantees that can be applied to Stewart Island/Rakiura. Typically, as tourism increases in remote destinations, so do property values. This has been particularly true in places such as Franz Josef and Fox Glacier, the Catlins and Te Anau. However, property prices at Franz Josef and Fox Glacier have decreased significantly since the financial crisis. The impact on rates is variable, as rates are made up of fixed and variable charges. Movement in variable charges depend on how house prices in one area change relative to elsewhere in the region.

Rates at Franz Josef and Fox Glacier have been kept artificially low by a Council town development fund. The new visitor levy for Stewart Island/Rakiura should have a similar effect, countering any upward movement in rates associated with increased tourist numbers, thereby keeping rates at a more manageable level. This is a good example of Stewart Island/Rakiura and SDC getting on the front-foot to solve an infrastructure affordability issue. If the eradication proceeds, actions like this will help ensure the island community makes the most of the opportunities.

The case studies also illustrate that the cost of electricity and building is not consistent in remote destinations. On Lord Howe Island, building costs are high but electricity is similar to that in New South Wales whereas in Franz Josef it is the same as elsewhere in Westland. It depends on the local supplier and how the price of electricity is structured. In the case of Stewart Island/Rakiura, the cost of electricity is based on high fixed costs, and is likely to remain so even if alternative generation approaches are used. Given this, it is likely that an increased population base will mean that generation costs are spread over a wider base, resulting in lower prices.

Part Two: Improvements in Other Ecosystem Services from Predator Eradication

What actually are the benefits of a Predator-Free Rakiura? By removing a few species of predators (feral cats, rats and possums) we can expect a healthier ecosystem in which our native species flourish. In other words the natural biodiversity will increase. In the past this alone has been enough to justify investments in predator eradication but with a project of this size and complexity we have to ask “so what?” What difference will an increase in biodiversity make? In order to answer this question we need to track the improvements through to ecosystem services.

Ecosystem services are all the services that the environment performs for humans without charge. We tend to take these services for granted, but they are incredibly important to our economy and the health of our planet. Services we receive from nature include eco-tourism, storing carbon, providing oxygen, food, clean water and perhaps most importantly nutrient cycling (turning waste into nutrients).

Ecosystem Services & Biodiversity Explained

A healthy ecosystem performs many tasks for us without us noticing. An analogy for this is that the environment is a bit like the human body. Forests are like lungs, they cleanse the air, creating oxygen and storing carbon. Clouds are like the heart pumping the lifeblood - water - around the environment. Rivers and lakes are like veins, draining the water back to the sea, while estuaries and wetlands are like the kidneys, cleansing the water before it returns to the sea.

Biodiversity, or the variety of species present in an environment, underpins all these ecosystem services. Why is it important to have more species in an ecosystem? Apart from the species having intrinsic or iconic value, the simple answer is that biodiversity is a bit like the environment's immune system. When disaster strikes, like a virus hitting the body, a healthy immune system helps us all bounce back quicker. And so it is with the environment. A more diverse environment is more resilient to bad things happening, and recovers more quickly. This means it is more able to provide ecosystem services, and avoid collapse when hit by disasters. This makes the value of biodiversity very difficult to estimate, as it only shows its true worth in the worst circumstances. In that way it is akin to an insurance policy against all the other changes humans are causing (such as climate change).

What do we know about the ecosystem services generated by the environment of Rakiura and surrounding islands, and what is likely to happen if predators are eliminated? Rakiura and the surrounding islands have several examples of large-scale, near-pristine habitats that are unrivalled throughout New Zealand. Of the 175,000 hectares of land, the dominant habitat is podocarp forest. This forest is largely intact thanks to minimal logging, and is one of the best examples of primary forest remaining in the country. The river and wetlands have been dubbed the largest example of what freshwater ecosystems would have looked like pre-European settlement. There are also many relatively undisturbed dune systems of national significance, particularly the 12km long Mason Bay dunes.

The difficult issue with valuing ecosystem services in this instance is calculating exactly what difference predator eradication makes. We have some idea of the impact predators have on our

biodiversity, but it is difficult to know what knock on impact this has for the ecosystem services generated by the environment. Let's start with what we know about the impact of predators on biodiversity.

First up, biodiversity loss is a problem in New Zealand and worldwide. In fact a recent study in Nature magazine put global biodiversity loss at ten times the 'sustainable' rate, and 100-1000 times the pre-industrial rate.³⁸ The same study ranked accelerating biodiversity loss as a bigger concern than climate change. And New Zealand is no exception to this. Almost a quarter of the birds that were originally found only in New Zealand prior to human settlement (Maori and European) are extinct.³⁹ Of the remaining endemic species, 85% are threatened or at risk.

Predators are a major cause of the decline in native species all around the world, particularly on offshore islands. Rodent invasions of islands are one of the greatest causes of species extinction in the world. Worldwide, rats have negatively affected at least 170 taxa of plants and animals on over 40 islands or archipelagos and have caused at least 50 extinctions.⁴⁰ Ship rats alone are responsible for the severe decline or extinction of at least 60 vertebrate species, and currently endanger more than 70 species of seabird worldwide. They suppress plants and are associated with the declines or extinctions of flightless invertebrates, ground-dwelling reptiles, land birds and burrowing seabirds.⁴¹

Cats meanwhile are the second major cause of extinctions behind rodents,⁴² having a direct hand in 9 native bird extinctions in New Zealand, and a further 33 with endangered status.⁴³ There was a resident population of kakapo on Rakiura, but this was moved when it was discovered they were being preyed on by feral cats.

In New Zealand predators like possums, cats and rats all predate on native creatures, but possums and rats also eat native plants and their seeds, effectively competing with native animals for food (or sometimes eliminating the food altogether). This damages the populations of native flora and fauna, and in some cases drives local extinctions. Birds like saddleback and mohua struggle to coexist with rats at all, while possums will often eliminate certain plant species like mistletoe, tree fuchsia and rata. These trees have cultural significance and traditional medicinal value to Maori; rata trees in particular are considered to be *raakau rangatira* ("chiefly trees").

Predators can also have compounding impacts on native flora. For example possums remove the canopy species, creating clearings which attract deer, which then feed on the small plants growing to replace the canopy. Another example of this compounding effect is that mistletoe relies on bellbirds to open their flowers so that they can reproduce. When predators reduce the bellbird populations, the mistletoe (an important food source) is similarly impacted.

New Zealand birds are not adapted to dealing with mammalian predators, and many have evolved to nest on the ground or in tree cavities and respond to threats by freezing and being camouflaged. This makes them very vulnerable to predation from mammals with a good sense of smell such as mustelids, cats, possums, hedgehogs, rats and mice. Some 40% of New Zealand's land birds are already extinct as a result and many of the threatened species remaining are cavity nesters. Thankfully on Rakiura and surrounding islands only possums, rats and feral cats are problem predators. The absence of mustelids (e.g. stoats) in particular is credited with the relatively high kiwi population on Rakiura and surrounding islands.

Nevertheless, rats, cats and possums still take an immense toll on the native species, as evidenced by this paragraph from Harper (2009):⁴⁴

Brown teal, rifleman, mohua, South Island kokako, falcon, Stewart Island weka and probably yellow-crown parakeets, have gone extinct on Stewart Island/Rakiura within the past 50 years. Birds showing dramatic declines in the past 100 years include kereru, kaka, kakapo, and robin. Populations of native birds on Stewart Island/Rakiura showed similar patterns of extinctions and declines as the South Island despite fewer agents of decline.

Predator eradication leads to a marked increase in plants, birds, reptiles and insects (we look at more evidence for this in the Habitat for Species section later).⁴⁵ In the case of Rakiura and surrounding islands there are a number of species that could benefit from predator eradication. Most notable features are being the only breeding site of the southern NZ dotterel, and the large population of tokoeka, a variety of kiwi. Many of these species are endemic (only found on the island):





Threat Status	Number of species on Rakiura & surrounding islands	Number of Endemics	Examples - animals	Examples – plants
Nationally Critical	8	2	Southern NZ dotterel	<i>Gunnera hamiltonii</i>
Nationally Endangered	16	3	Short tailed bats; long tailed bats; tawaki/ Fiordland crested penguins; Australasian Bittern; mohua; mätä / Stewart Island fernbird; Stewart Island weka; South Island kākā; toutouwai/ Stewart Island robin; tīeke/ South Island saddleback;	<i>Crassula peduncularis</i>
Nationally Vulnerable	3		Stewart Island shag; hoiho/ yellow-eyed penguin	<i>Ranunculus ternatifolius</i>
Serious Decline	7			<i>Carex littorosa</i>
Gradual Decline	28	3	Southern tokoeka / kiwi; yellow-crowned kakariki; koekoeä / long-tailed cuckoo; kererū; tītī / sooty shearwater; tītipounamu /	<i>Austrofestuca littoralis</i>













			riflemen; banded dotterel; kororä / little blue penguin; harlequin gecko; jewelled gecko; green skink.	
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There are also a number of species that could be reintroduced to the island once the eradication has taken place. This includes iconic species like the kakapo – recently voted the world’s most loved species – and the kokako – the hauntingly beautiful songbird of the New Zealand forest. Following appearances on the TV show *Last Chance to See...* and the fame of Sirocco, kakapo have achieved international cult status. The prospect of encountering kakapo in their natural habitat might alone be enough to entice people to visit from all over the world.

While this data gives us a flavour of the improvements in biodiversity that we are likely to see from a Predator Free Rakiura, we don’t really have a comprehensive picture of even this basic fact. This is a critical knowledge gap that needs to be urgently overcome.

Once we understand the changes in biodiversity, the next question is what impact is that likely to have on ecosystem services more broadly? Working with DOC we have completed a preliminary assessment designed to inform a discussion about possible benefits, and help direct future research. Many of these ecosystem services cannot be measured given the current state of knowledge. We have summarised this information on likely improvements using the internationally recognised TEEB (The Economics of Ecosystems and Biodiversity) framework for ecosystem services. Thanks to the TEEB team for this framework and the loan of their symbols.

Ecosystem Service		Likely Impact of Predator Eradication	Estimable?	
Provisioning		Food	No impact on deer in the long term. Improvement for shellfish due to enhanced water quality. Possible ability to harvest titi and other traditional species following population increases.	Yes, apart from titi.
		Raw Materials	Possible exploitation of rata and manuka honey following forest recovery. Loss of potential to harvest possum fur (minimal due to low densities).	No – too speculative
		Fresh Water	Marginally improved water quality by reducing the sediment in run off (from improved forest). Also there would be no more rats in water tanks.	N/A
		Medicinal Resources	Possibility for harvesting native plants with medicinal value. Improved genetic diversity may support bio-prospecting (subject to Wai 262 claim).	No – too speculative

Regulating		Local Climate and Air Quality	Unlikely to be any material impact.	N/A
		Carbon Sequestration & Storage	The improvement in forest cover and quality is likely to store more carbon over time.	Yes.
		Moderation of Extreme Events	Improved resilience to disasters – less damage from floods and storms and more rapid recovery. Unlikely to be major impact given small settlement.	N/A
		Waste-water Treatment	Unlikely to be any material impact given small settlement.	Yes
		Soil Formation & Erosion Prevention	Improvement in forest cover and quality will boost soil formation and reduce the risk of erosion. Unlikely to be material given erosion is low currently.	Yes
		Pollination and Seed Dispersal	The return of native pollinators will improve plant biodiversity.	No
		Biological Control	Predator eradication would eliminate need for existing predator control.	Yes
Supporting		Habitats for Species	Predator eradication would provide improved habitat for many iconic species whose survival is valued by all Kiwis.	These are estimable together through surveys.
		Maintenance of Genetic Diversity	Loss of 3 common predator species from the island but in return could save many endangered species.	
Cultural		Recreation, Mental & Physical Health	Enhanced wildlife would provide an improved visitor and resident experience.	Yes (through surveys)
		Tourism	Enhanced bird life and forest would increase visitor numbers, length of stay and average spend.	Yes (financial estimate possible)
		Aesthetic Appreciation & Inspiration	A project of this scale would provide inspiration for Predator Free New Zealand, and would be an example of New Zealand as it could be.	Partly - value of on the job training and R&D

			Eradication process would provide training & innovation for eradication industry, which is an export business.	
		Spiritual Experience & Sense of Place	This project would save many symbolic species sacred to Maori and all New Zealanders. There would also be reputational benefits for NZ which could impact on exports and make the country a desirable place for talent to live. Talent, as defined here, generates more than average employment and income.	Possible to estimate impact on exports but very speculative.

So, we have scoped the likely improvements in ecosystem services likely to occur if predators are removed from Rakiura and surrounding islands. Now we will look at what information exists on their value.

Note that this is an initial assessment, in most cases more research is needed to confirm these benefits and properly estimate their size. Assigning values to many of these regulating services is extremely difficult. Accurately quantifying all of the ecosystem benefits of a Predator Free Rakiura would require a large amount of new research, which would be disproportionately expensive. However, these factors should be monitored following the predator eradication so that we have better information for future Predator Free New Zealand projects.

Unless otherwise indicated, most numbers in this section have come from Patterson and Cole (2013). This study put the value of a hectare of New Zealand forest at \$2,204/ ha, although around half of that comes from the commercial value of harvesting trees, which is clearly not relevant here.⁴⁶ This study is based on the original international studies on ecosystem services by Costanza and translated into the New Zealand context. We used studies that were more relevant to predator eradication wherever possible, as indicated below.

These average numbers for New Zealand should be treated as initial estimates at best, as the value for ecosystem services are affected by their location. Many of the services rely on nearby human populations that can benefit from factors like fresh water, erosion control, food, pollination and waste-water treatment. Therefore, given a small local population the value of the forest on Rakiura and surrounding islands is likely to be below the national average. However, not all ecosystem services are location dependent. Carbon storage is valuable regardless of where it happens, the harvesting of titi and shellfish does not require a local population to benefit, and saving our native species has some value to New Zealanders whether they get to see them or not. We have tried to focus on those ecosystem services that are not dependent on having a population nearby.

Despite the numbers being an estimate, these ecosystem services are where the true benefits of predator eradication project become evident – in removing predators from the 175,000 hectares of near pristine primary forest on the island. Much of this forest is unseen by human habitation and visitation, and so incapable of economic exploitation (a bit like fresh air's contribution to our well-being which whose value isn't revealed or valued until we find ourselves without adequate supplies). But that doesn't mean that it doesn't have value to us all.

The key question in all of this is to what degree would predator eradication improve the functioning of the forest ecosystem? The damage done by possums, rats and cats on Rakiura and surrounding islands will vary across different species. Overall the total biomass (amount of life in the environment) should rise without introduced predators, and the diversity of that biomass is likely to be far higher, particularly if our focus is on rare native species. We know that a predator-free forest ecosystem will be healthier, but the question is how much healthier? And how would that affect the services that the Rakiura and surrounding islands' forest provides? We will look at each ecosystem service in turn.

Provisioning Services



Food

A better functioning forest ecosystem creates more nutrients, which ultimately provides sustenance for a larger population of plants and animals on both land and in the ocean.

The marine ecosystem would benefit from more nutrients, less soil and lower levels of faecal coliforms (due to no rats, cats and possums) present in the water flowing off the land. It should benefit filter feeders in particular, leading to increased harvests and a reduced risk of disease for shellfish following predator eradication. However there could be benefits right up the food chain, some studies even show that Maui's dolphins feeding around estuaries in the North Island are affected by toxoplasmosis, a disease spread by cats.

There would also be major changes on land. With the removal of predators which kill the young of native birds and compete with them for food there would be a huge increase in some bird populations (see habitat for species below).

In the long run, once populations of traditionally harvested species have *fully* recovered, *partial* reinstatement of traditional harvesting rights to local Maori could conceivably be considered on the Rakiura mainland if (i) it was scientifically proven to be sustainable, (ii) the benefits outweighed the risks to conservation; (iii) appropriate quotas could be put in place; and (iv) active and effective regulation was feasible to ensure that harvesting quotas were not exceeded.

Of most interest here are the sooty shearwater, or titi, which is a burrowing bird and therefore particularly susceptible to predators.⁴⁷ These are currently harvested by Ngai Tahu on the Titi Islands off the coast of Rakiura. Small colonies still exist on the main island, and based on previous experience these birds would re-colonise Rakiura and surrounding islands rapidly after the removal of predators. Their breeding habitat would be increased exponentially, which would allow for increased levels of sustainable harvesting over than seen in the past.

There is likely to be increased potential for cultural harvest in general, although it is difficult to know in advance which bird or plant species would recover to levels that would allow this.

Estimating the value of this improvement is difficult. We do know that New Zealand's forest ecosystems recycle nutrients, which are then used by land or ocean ecosystems (which is why fisheries are more abundant in coastal areas). The value of this ecosystem service is around

\$195/ha.⁴⁸ As a conservative estimate of the increase in nutrients in the ecosystem we have chosen 12.5% - half the amount used in the climate storage section below – which gives a value of \$4m per annum. This reflects the remote location of Rakiura and surrounding islands.

We expect no long term change in the availability of deer for hunting. There may be short term reductions due to the eradication. In the long term it is likely there could be an increase in deer numbers given the improvement in habitat and less competition for food with rats and possums. However, this could be offset by having fewer possums, as their grazing of the forest canopy creates clearings, which are ideal habitat for deer.



Raw Materials

With the removal of possums we are likely to see the flourishing of the native Southern Rata and manuka forests. Along with the return of native pollinators, this could provide new opportunities for harvesting honey from the flowers in the forest. The manuka honey industry in particular is currently expanding rapidly. However, this is speculative and at this stage it is too difficult to estimate the benefits.

There is no existing commercial possum fur industry on the island, although some island residents do harvest possum fur on a small scale. A future industry looks unlikely, with previous operators having ceased due to high costs and low densities of possums. However, predator eradication would certainly remove the option for creating a possum fur harvesting industry in the longer term.



Fresh Water

The quality of fresh water would certainly improve along with a healthier forest ecosystem. Primarily there would be less erosion and sedimentation in the water due to the improved forest health. Predator eradication would also remove faecal coeliforms and the threat of rats dying in water tanks. However, given the size of the island in relation to the village, this is unlikely to have a material impact on the local's water supply. As a result we do not think this benefit is worth quantifying.



Medicinal Resources

A healthier forest on Rakiura and surrounding islands would have increased potential for harvesting traditional Maori remedies. There would also be the potential for bio-prospecting new material for the pharmaceutical industry (subject to the Wai 262 Treaty claim). At this stage any value would be purely speculative.

Regulating Services



Local Climate and Air Quality

Forests do filter particulates out of the atmosphere.⁴⁹ However, given the size of the forest in proportion to the existing community, the changes from a Predator Free Rakiura are unlikely to have a material impact on the local climate and air quality.



Carbon Sequestration & Storage

We consider this to be a potentially large impact from a Predator Free Rakiura. This is simply a case of the scale of the forest that exists on the island. The vast majority (83%) of New Zealand's carbon inventory is actually stored in native forests, rather than exotic planted forests that are the focus of Kyoto and emissions trading. The majority (two thirds) of that carbon is actually stored in the soil.⁵⁰ Storing carbon is important as it reduces the amount of carbon dioxide in the atmosphere, which reduces climate change. The question is what difference would predator eradication make?

The short answer is that we don't know for sure, yet. We do know that a possum can eat up to 40kg of carbon per year.⁵¹ Possums alone tend to chew through about 7% of the vegetation produced by our forests each day. Some of that growth is replacing old growth, so the impact of possums on overall sequestered carbon is much higher. According to DOC estimates possums alone reduce the rate of carbon sequestration in our native forests by 20%⁵², although the uncertainties around this are large. The longer term effects of this browsing are unknown, but if left unchecked predator species could eventually completely change the ecosystem. We do know that certain species are harder hit than others; in the southern rātā-kāmahi forests of Westland, many valleys lost more than 50% of canopy trees within 15–20 years of possums arriving.⁵³ The impacts of other predator species are unknown, but we know that rats consume a large amount of seed and seedlings which can prevent regeneration on the forest floor. This is why anecdotally forests without predators seem to have more intermediate plant growth – the medium level trees between the forest floor and canopy. The existence of predator species appears to simplify the habitat markedly. Modelling suggests that over time the carbon storage capacity of the forest may be reduced by up to 25-50%.⁵⁴

In all it seems a best guess to estimate that predator eradication would improve Rakiura and surrounding islands' carbon storage by around 25%. Further research into this issue is underway by DOC and Landcare Research. As the science develops, it may become possible to claim carbon credits from the additional carbon stored in predator free forests under the Emissions Trading Scheme. This would help monetise one of the major ecosystem service benefits that we would expect to see from predator eradication. However, this is only likely to be of financial benefit if the price of carbon credits recovers.

According to Patterson & Cole (2013) a hectare of native forest contributes around \$240 in climate regulation services each year.⁵⁵ For Rakiura and surrounding islands an improvement of 25% across 175,000 hectares would equate to an estimated value of \$10m per year. Given that these ecosystem

services are generated irrespective of location, there is no need to adjust this figure downwards as we have done with others.



Moderation of Extreme Events

The impact of predators on flora is chronic, subtle and difficult to measure. The experts do agree that the existence of predators reduces the resilience of our native ecosystems to deal with extreme events. When storms damage native forests, areas without predators recover more quickly. This is partly because the trees are less stressed so more resilient, and also because there is an intermediate sub-canopy in place ready to replace the larger canopy trees. This will flow through to benefits humans in several ways that are picked up under other headings, including through reduced erosion and sedimentation in the water, and improved carbon storage. In the case of Rakiura and surrounding islands there is no foreseeable direct impact on the small population from the moderation of extreme events, such as from reduced flooding or landslides. As a result there is no need to estimate the value of this ecosystem service.



Waste-water Treatment

A Predator Free Rakiura is likely to have an ecosystem that can potentially process waste more effectively. This includes natural waste from the forest, from septic tanks, ship hulls and the marine farms in the area. This is one of the major benefits created by forests in most ecosystem services assessments; in New Zealand the benefit is estimated at \$230/ ha. However given the size of the islands forest and marine ecosystem in proportion to the existing community, the changes from a Predator Free Rakiura are unlikely to have a material impact on waste water treatment. Therefore we have only counted the waste water treatment benefits for the Halfmoon Bay area (\$300k per annum), and not the rest of the island.



Soil Formation & Erosion Prevention

The improved health of the forest would make it less susceptible to damage from extreme weather events, reducing the loss of soil during storms and floods. As noted elsewhere, reduced erosion would improve the quality of water flowing from the land into the marine ecosystem. Soil formation and erosion prevention are key benefits created by forests in ecosystem service assessments; in New Zealand they are estimated to be worth around \$360/ ha.

The question is what impact would predator eradication have on soil formation and erosion on the island? Simply put we don't know. In more modified catchments, the impact of intensive farming, deforestation and extreme weather events far more important than predators, so we don't have a reliable estimate of predator impact.⁵⁶ In the relatively untouched context of Rakiura and surrounding islands, predators are likely to be the key issue in erosion and soil formation.

Regardless for Rakiura and surrounding islands erosion is not a major issue, particularly since the main cause of the problem – deer – will be remaining on the island. We consider that this ecosystem benefit will be felt most strongly in the Halfmoon Bay project, particularly since the whole area will receive increased foot traffic. Therefore we have only included erosion improvements of 25% and only for the Halfmoon Bay area (5000 ha) which is valued at just under \$450k per annum.



Pollination and Seed Dispersal

Birds play a major role in the pollination of New Zealand forests, more so than other ecosystems. Many of the native birds that act as pollinators and seed dispersers of native plants are impacted by predators. This includes bellbird, kaka and kereru, as well as several birds that are now extinct to Rakiura and surrounding islands but could return after predator eradication, including SI kokako, SI saddleback, mohua and yellow-crowned parakeet.⁵⁷ So the removal of predators will not only be good for pollinating birds like the bellbird, but also endangered plants like the mistletoe, which relies on the bellbird for pollination. We have no reliable way of estimating this benefit, other than under the Habitat for Species service below.



Biological Control

A healthy ecosystem is more effective at stopping pests and weeds from getting established in the long term. This ecosystem service is valued at \$10 per hectare. Assuming a 25% improvement in the ecosystem services following the elimination of predators, we could expect a rather modest annual benefit of around \$460,000 per annum.

However, we have a more accurate way of calculating this figure. Following eradication there will be no need to continue the existing predator control on the island, which currently costs around \$630,000 per annum. We consider this figure to be more reliable, and will use it in our estimate of the benefits of biological control.

We also know that predator-free status will result in public health benefits. Rodents create significant health risks, including a range of viruses, bacteria, internal parasites (such as intestinal worms) and external parasites (such as fleas, mites and lice), many of which can spread disease to humans. Possums carry TB, and cats toxoplasmosis.

Anecdotal reports from Oban reflect that rats have negative impacts on food stores, gardens, water pipes, electrical wiring and the odd dead rat in a water tank.⁵⁸ Controlling rats already imposes costs and risks on the local population through the use of traps and poisons. These issues would be eliminated if rodents were eradicated.⁵⁹

Supporting Services



Habitats for Species

This can be interpreted as protecting our native species. And a Predator Free Rakiura would certainly deliver that. We have much stronger evidence for the impact of predators on our native fauna than we do on our flora. Predators reduce the populations of most native birds, and can cause local extinctions of certain species. Eliminating predators dramatically alters the survival rates of many species of native birds. As an example, the nesting survival rates of robins double in predator controlled areas.⁶⁰ When populations of rats and possums were reduced below 4%, kukupa (New Zealand wood pigeon) nest success rates went from zero to 100%.⁶¹ Since becoming predator-free, the valley where Zealandia is situated now has twice as many species of birds resident there. Bird call numbers in one predator-free area are 2-3 times higher than similar control regions.⁶² For certain species in certain areas these improvements are much higher.

Under other ecosystem services we have seen the benefits that removing predators and improving biodiversity brings. However, New Zealanders also recognise the value of preserving our iconic species, regardless of whether or not they see them, simply for their innate value. This may be because we understand the value of biodiversity, we have an emotional connection or because they are part of our 'national identity'.

There have been a few studies that use surveys to understand how Kiwis value biodiversity. It is important to distinguish between the value of maintaining a species so that a person can enjoy it and the value of simply maintaining a species for its own sake. Most studies for preservation of an inaccessible area (such as Little Barrier Island off Auckland) concluded that people are willing to pay between \$12.90-\$21.11 per New Zealand household to protect biodiversity on offshore islands (an average of \$17).⁶³ The Halfmoon Bay project could be considered a substantial regional project and with just over 11,000 households in Southland this gives a value of just under \$200,000 per year. However, the full predator eradication project would be far more substantial and would be a national undertaking; putting the annual value to New Zealanders at closer to \$25 million per year. Again this is likely to be conservative as a Predator-Free Rakiura would be so much bigger than any comparable predator eradication conducted in the past, and would lift many of our species out of their endangered status.



Maintenance of Genetic Diversity

This ecosystem service recognises the role that maintaining biodiversity plays as an insurance policy, or 'option value' for the future. At some time in the future we may discover that a certain species of plant or animal plays an essential role in an ecosystem, or carries possibly useful properties for new industries like bio-prospecting (the practice of harvesting genetic material for new products, particularly pharmaceuticals). Any bio-prospecting would be subject to the Wai 262 Treaty claim.

Regardless, once a species is lost it is too late to find out these benefits. Only by maintaining our biodiversity do we keep open the 'option' of gaining these benefits in the future. There is no further evidence of the value of this service other than that given under Habitat for Species above.

Cultural Services



Recreation, Mental & Physical Health

This ecosystem service goes beyond the financial benefits afforded by increased tourism. Firstly, visitors to the island and people living on the island will receive an enhanced experience. We have already looked at the additional numbers that would be attracted to the island (or stay longer on the island) by Rakiura and surrounding islands being predator-free. We will not count those people again here. However, people that live on the island or would visit it regardless will also get a benefit from the enhanced lifestyle that additional wildlife brings to the island. This benefit would be supplied to these people at no extra cost. This is analogous to improving the facilities or infrastructure on Stewart Island/Rakiura – it may attract additional visitors but those already there would also benefit from the improved experience. This is also known as the 'Non-Market Use' benefit.

Residents would be able to benefit from the Non Market Use benefit all year round. Being surrounded by nature has positive impacts on people's health such as lower rates of depression and improved physical health – for example people recover from surgery quicker when exposed to nature.⁶⁴ Improving the amount of nature in cities and in buildings also has benefits for worker productivity.⁶⁵ Surveys have also shown that native birds are the fourth most important outdoor feature for an 'ideal property' and also the fourth most important feature looked for by residents in their nearby parks and reserves.⁶⁶ There is also anecdotal evidence of an impact on real estate prices from real estate listings and surveys from reductions in predators (such as around Zealandia in Wellington).

The question is how do we value this benefit to people living on Stewart Island/Rakiura? The closest study done to this was in the Waikato for the Maungatautari Ecological Island Trust. It found that the average household there was willing to pay \$108 per annum to live in an environment with a greater number of native birds.⁶⁷ In lieu of similar figures for Stewart Island/Rakiura, we will use this figure as the closest available estimate (such values tend to be higher in urban areas, but the Waikato is a similarly rural community). Over the 135 owned houses on the island this would be worth \$14,580 per year. Given this project would not be funded by local rates, we would expect to see this value capitalised in higher house prices as those valuing these particular circumstances move to the island. Based on these rough values above we would conservatively expect an average house price rise on the island of around \$2000.¹ This may well be higher if the island attracts people who particularly value being in a Predator Free environment.

Visitors to the island don't have the same amount of time to enjoy the birdlife as the locals have, however this is compensated by the rarity of encountering native wildlife. Visitors to the island

¹ Based on the house price increase that would create an annual mortgage payment of \$108 per annum, at current interest rates of 5.5%.

already enjoy its outstanding natural beauty, regardless of the activity they are undertaking. With the addition of predator-free status, every day on the island would effectively also become a day spent bird watching. Surveys have been done asking people to value the different activities they have undertaken in New Zealand. Averaging across New Zealand studies suggests that the non-market value of bird-watching is around \$64.41, compared to the value of a general recreation day in New Zealand at \$33.89.⁶⁸ A Predator-Free Rakiura would therefore add the difference between these values – around \$30.52 – of non-market value (i.e. money isn't changing hands, but people are getting a benefit) from each day spent by visitors on the island. Stewart Island/Rakiura currently has 30,000 visitors per year, with 86% spending 2.5 days on the island, so this would total \$2.1m per year in recreation benefits.



Tourism

This has already been covered above.



Aesthetic Appreciation & Inspiration

This project would be a cornerstone project for the wider Predator Free New Zealand initiative. Many smaller and uninhabited islands have been cleared of predators, however Stewart Island/Rakiura is unique in being populated and because of its scale. The success of this project would be a major step towards Predator Free New Zealand, and would demonstrate that the goal was actually possible. This may in turn encourage New Zealanders to undertake projects near to them, thereby hastening the pace of progress towards the ultimate end goal.

The wider inspiration provided by creating a place that was closer to “New Zealand as it is supposed to be” is far more difficult to measure. However, there are clearly many artistic and creative industries that are inspired by New Zealand flora and fauna. These benefits would only be enhanced with a Predator Free Rakiura which would almost certainly become an iconic destination.

This project would also provide inspiration to what is rapidly becoming a New Zealand export industry; predator eradication. The eradication on Rakiura and surrounding islands would keep New Zealand at the forefront of innovation in the predator control marketplace. While some of our predator control is context specific, issues like rat control are universal. As a result, predator eradication expertise and products are increasingly being used overseas. Ex-DOC staff have been employed in eradication operations on Macquarie Island, Lord Howe, the Galapagos and many other islands. This eradication would provide an opportunity to train new expertise, as set out above.

There is also considerable scope for selling the technology we develop in this eradication overseas. The self-resetting predator trapping company Goodnature now sources the majority of its orders from overseas and has recently succeeded in creating rat-free areas in a DOC trial. Achieving a Predator-Free Rakiura is likely to involve considerable innovation, and those new ideas, products and processes could have significant potential in overseas markets. The goal of a Predator Free Rakiura is

likely to stimulate an investment \$1.25m from DOC into Research & Development over the next five years to create the technology needed for success.



Spiritual Experience & Sense of Place

A Predator Free Rakiura would capture international attention and it may be eligible for World Heritage Status. It would certainly be an iconic place for New Zealanders. But could this added exposure generate any hard-nosed economic benefits?

The project could potentially drive immigration to the whole country, particularly of skilled people. This is what Sir Paul Callaghan referred to when he alluded that a Predator-Free New Zealand would become a 'place where talent wants to live'. In a globalised world people can increasingly choose where to live, and so the natural, cultural and social capital of a place becomes more important. Natural capital in particular becomes more valuable as other countries run down theirs – note for example that air pollution in parts of China now cuts life expectancy by five years.⁶⁹ Attracting skilled people creates a virtuous circle because high skilled people attract other high skilled people, a positive feedback effect known as 'agglomeration' that smart cities are renowned for.⁷⁰

Would a Predator-Free Rakiura improve the prospects of our businesses? There are reasons to think that is the case. New Zealand certainly leverages the 100% Pure brand in terms of tourism. Almost two-thirds of tourists recognise the brand, although only 11% say it impacted their decision to visit the country.⁷¹ Almost 90% of New Zealanders think this brand provides a competitive advantage in overseas markets, yet only 55% think that we actually live up to it.

There are two possible impacts on exports from enhancing biodiversity: it may create a price premium or simply become a condition of supply. Some businesses question the existence of an environmental price premium, but there is certainly evidence of environmental sustainability becoming a condition of supply. In other words, if a product is not considered 'sustainable', it won't even get sold in certain places. The Marine Stewardship Council badge for sustainable fisheries is now applied to 6% and growing of the world's fishing catch, and is now necessary to supply the world's largest retailer: Walmart. Two-thirds of New Zealanders would switch from a brand or supplier that had a negative impact on the environment, and in the past year some 23% actually have done. Meanwhile the number of companies with a focus on sustainable business practices is falling.⁷² This is probably a reaction to short term cost pressures, and is likely to change in the long term.

Recent research from Lincoln University suggests that there is also a price premium from products that are certified to enhance biodiversity. For a long time it has been felt that any price premium would be less applicable in the developing world, however this research indicates it is actually larger in markets like India and China than it is in the developed world (in this case the UK). The table below shows the price premium consumers in India, China & UK were willing to pay for dairy and lamb products that were certified to enhance biodiversity. The developing world was willing to pay 3 to 7 times the price premium of that paid by consumers in the UK.⁷³ These results suggest that a Predator-Free Rakiura could help New Zealand secure a comparative advantage for our products via

demonstrating our biodiversity credentials. Certainly this evidence would be a boost for the exports from Stewart Island/Rakiura itself, such as salmon, cod, lobster and paua.

Price Premium for Products that Enhance Biodiversity

China		India		UK	
Dairy	Lamb	Dairy	Lamb	Dairy	Lamb
22%	15%	27%	42%	6%	6%

Source: Saunders et al (2013)

The Chinese market for New Zealand dairy alone was worth \$2.2 billion in 2012. A 22% price premium in this market would therefore be worth \$484m per annum. This is a massive potential benefit, the scale of which would swamp all other benefits quantified in this report. We have not used these figures in the return on investment totals calculated below, as this research is still at an early stage and not yet reliable enough. Also, it would require a cultural change among New Zealand producers, pursuing a strategy based on achieving margins from product/ brand/ quality differentiation rather than maximising quantities of commodities. However, clearly there is huge potential here to convert our nation's brand and reputation into economic gains.

Part Three: National Return on Investment in Predator Eradication

The purpose of this final section is to total the full economic and environmental benefits to New Zealand as a whole from an investment in a Predator-Free Rakiura. This allows them to be compared to the costs of the initial investment in a 'like for like' way.

This cost of eradication projects are incurred up front, while the benefits are received over many years into the future. This is similar to most investments where money is paid up front in exchange for future benefits. To make the investment worthwhile, we expect the future benefits to be higher than the initial investment, in other words a dollar received in a year is worth less than a dollar today. That is why when businesses and Government make investment decisions they reduce the value of future benefits to compare it to the upfront investment. To ensure our calculations are conservative we have used the Government's highest possible discount rate of 10%. This means that to receive a dollar's worth of benefits next year, it is not worth investing any more than 90c this year. It is worth noting that some experts argue that lower discount rates should be used, particularly for environmental projects. Again this makes our estimates extremely conservative.

We have excluded two major benefits to ensure the figures used in these calculations are conservative. The local spending by the eradication workforce has not been included in this section as from a national perspective their wages are considered a cost rather than a benefit. The value of domestic tourism has also been excluded as this money would have been spent elsewhere in the national economy. For this purpose we have assumed that half the increase in tourism would be from domestic sources – this is consistent with the long term trend on Stewart Island/Rakiura.

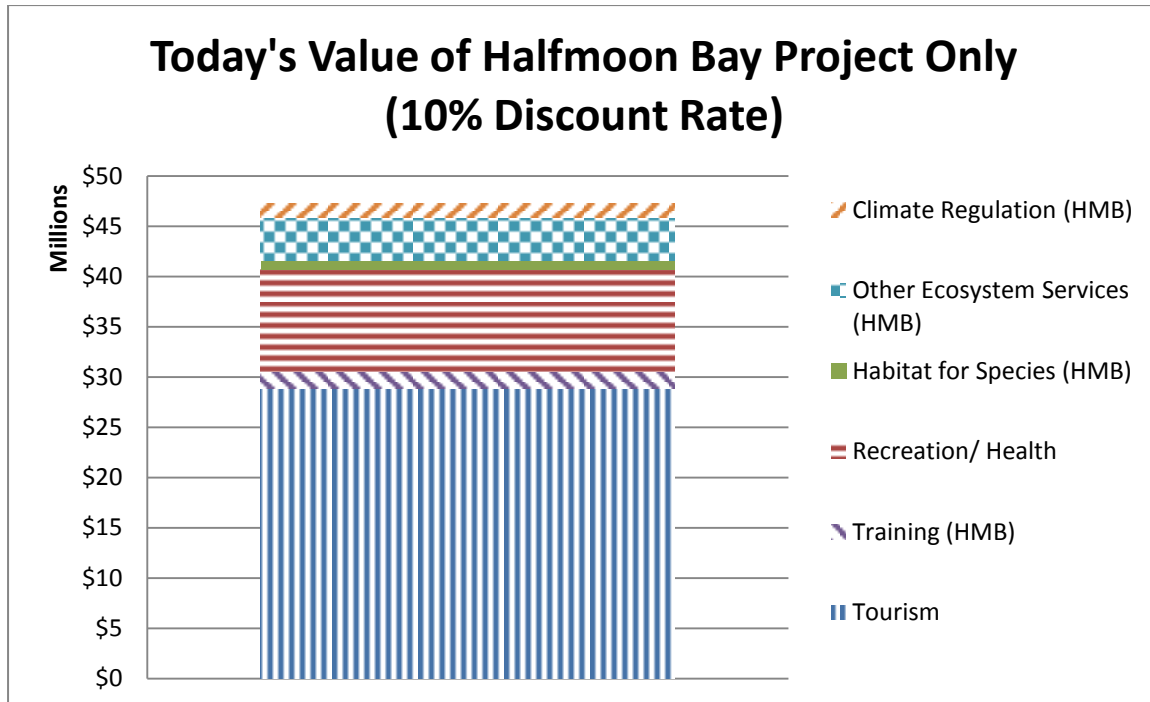
While the eradication spending is not included, we do need to include an estimate of the value of the training provided by the projects. These projects will involve substantial on the job training. Typically with these projects around half the employees involved have been trained from scratch – most of these tend to be locals (that may not be possible in this case because the operation is so large and the local population relatively small). This training equates to a permanent lift in income for around 12 people for the initial Halfmoon Bay project (including the fence), and a further 11 for the full eradication project. To be conservative we have assumed no turnover in staff between projects – this would lead to an even higher level of training. If we assume that these people would otherwise be on minimum wage, the skills they would learn on the job are worth an additional \$8 per hour, or around \$16,000 per year. We assume this training would increase their skills and therefore annual income by that amount. Taking the net present value of that annual amount, the first eradication will deliver training worth around \$1.7m to the country, growing to \$2.6m for the full eradication. This benefit would appear over time through the higher incomes of those participating in the project.

The table below shows the full value of the future benefits, stated in today's value. The two graphs following display the total benefits of the Halfmoon Bay project and full eradication in turn. We have assumed a phasing similar to that used in the Stewart Island/Rakiura economic benefits above, i.e. one year of fence building, a five year Halfmoon Bay eradication followed by a five year full eradication, with the tourism and ecological benefits gradually appearing over time.

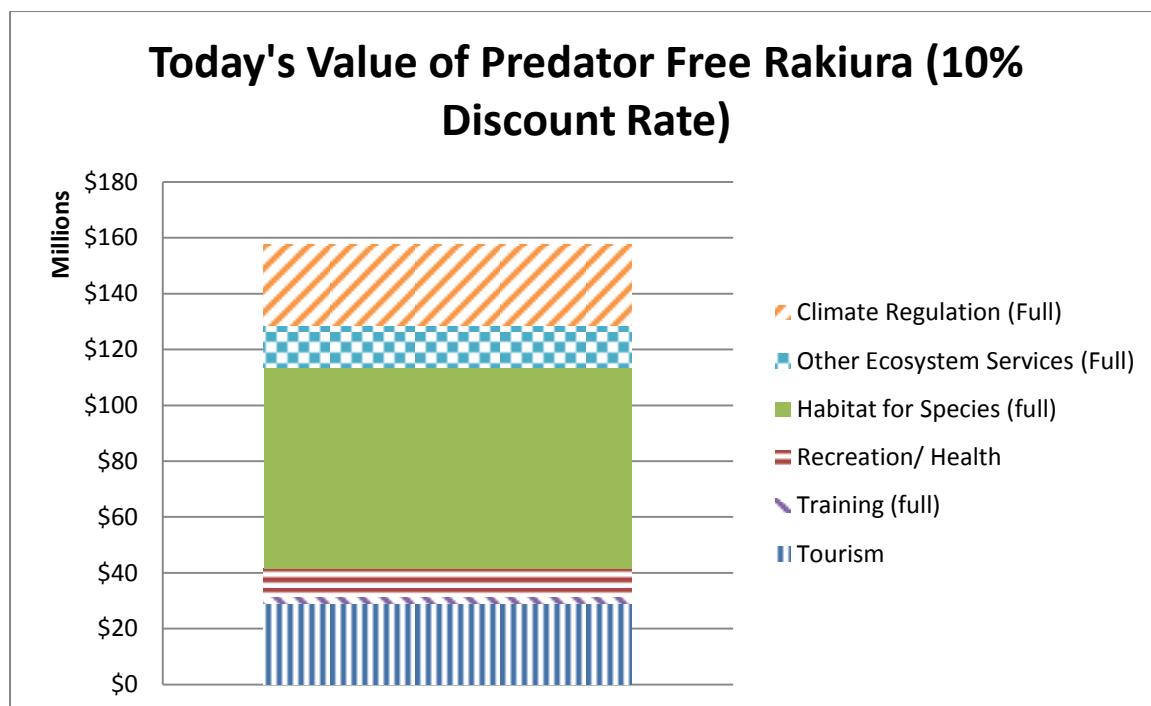
Total Benefits	HMB Project Benefits	Full Project Benefits
Other Ecosystem Services	\$4.2m	\$14.8m
Carbon Storage	\$1.4m	\$29m

Habitat for Species	\$0.9m	\$72m
Tourism	\$28.9m	\$28.9m
Recreation/ Health	\$10.1m	\$10.1m
Training	\$1.7m	\$2.6m
Total	\$47.2m	\$157.4

Our final task is to compare the total benefits from the two projects with their estimated costs, to get an idea of the return on investment we could expect.



The Halfmoon Bay project has a return on investment today of just under \$50m, which is more than ten times higher than the cost of approximately \$3.5-\$5m (including the fence at \$2.1m) plus an ongoing maintenance cost of \$250,000 per year (for biosecurity and fence maintenance). In fact the Halfmoon Bay eradication appears to be a worthwhile investment on the economic (tourism) benefits alone.



Clearly the return on investment of the full eradication is also positive, with the benefits outweighing the respective costs (\$35-55m) by a factor of 3-4 times. However, the full eradication cannot be justified on economic benefits alone, as in this instance the intangible ecosystem services are far more important. The key ecosystem services that we anticipate would be improved by predator eradication are habitat for species and climate regulation. Both these areas are worthy of further research to better quantify the benefits. In particular we have never provided habitat for our native species on this scale before – which begs the question how much do New Zealanders value our native biodiversity? Further research on these issues will be crucial to underpin the case for a Predator Free New Zealand.

Appendix: Case Studies of Social Benefits and Issues

In this appendix we have explored five examples of locations sharing similar characteristics or issues with Stewart Island/Rakiura to gain further insight into the potential social benefits of predator eradication. As we have seen elsewhere in this report there are few examples of predator eradication projects on remote, inhabited islands. In light of this, we have looked more broadly at rural and remote communities whose principle drivers are conservation and tourism. Two of the examples involve communities that have or are about to undertake major pest eradication projects.

Lord Howe Island, Australia

Lord Howe Island is located in the Tasman Sea approximately 780km east of Sydney and 900km from Norfolk Island. Listed in 1982 as a World Heritage Area, the island's economy is largely driven by conservation, the Kentia Palm Nursery and tourism. Similar to Rakiura and surrounding islands, there is a proposal for a large-scale eradication project to rid the island of rodents.

The usually resident population numbers around 360 residents (2011 census). Of these, 180 are employed full time and 122 part-time. The unemployment rate is 1.4%. Close to 37% of homes are fully owned, 21% are in the process of being purchased and 40% are rented (the median rent in Lord Howe Island is \$150 per week). Median individual income for the island is \$631 per week and the median household income \$924 per week (2011 Census).

The Lord Howe Island Board employ about 40 staff of which 10 - 15 regularly undertake duties that relate to environmental protection or conservation. Grant funds engage volunteers and contractors to assist with environmental works.

Many of the Board staff that come from the mainland bring their families which are important to bolster numbers at the school and to participate in community events (markets, sports, socializing, volunteering, church) and provide additional labour (partners of employees). The school caters for kindergarten up to Year 6 with 32 children at the time of writing.

Electricity is largely provided via diesel generator. The Lord Howe Island Board is responsible for the operation and maintenance of the island's electricity generation and transmission system with an underground electrical reticulation system servicing 275 customers. Reportedly, cost of power is not much more than the mainland where electricity costs are always on the rise. Although locals complain about the cost, new workers are surprised at how competitive it is when compared to the mainland (Hank Bower, resident conservation worker, personal communication). There is a move toward having more solar power on the island and wind energy options are also being explored. The NSW government provides some subsidies on electricity, waste, animal registration and perpetual leases to pensioners and those with medical disabilities.

Building costs are expensive, estimated to be at least 30% more than on the mainland. Food is expensive although there is some food produced on island. More food used to be produced locally but with increased tourism employment, many locals believe it is easier and more financially advantageous to work in hospitality than to grow produce for the industry.

The rodent eradication project has split the community. Most people want the rodents gone but the community has not been sufficiently involved in the process so there is a good deal of mistrust.

By contrast, the Lord Howe weed eradication project is reported to be working well as has the eradication project to remove pigs and cats to save the native Woodhen. Although not entirely embraced by the local community, visitors apparently agree with these projects and think it adds to their experience if taken on a tour and shown the detail (Hank Bower, personal communication).

Pamilacan Island, Central Philippines

Located in the Visayas Region, central Philippines, Pamilacan Island lies a few kilometres off the main island of Bohol with the nearest city of Cebu only 1.5hrs ferry ride away. Pamilacan was a small fishing village of about 600 – 1,000 residents living subsistence lifestyles. Illegal fishing was rampant until the introduction of whale and dolphin watching in the late 1990s and early 2000s.

The social welfare of the island has generally improved since the dolphin and whale-watching sector was initiated. Illegal fishing has reduced and some fishermen have changed to running whale and dolphin watching. There is now a high school on the island, where before there was only an elementary school. The high-school aged children previously travelled to the mainland. There is now also a brand new water desalination plant on the island with no other potable water resources previously being available. There is still the separation between the island community in terms of those who would like to be a part of the tourism industry, and the fishermen who are very much against it.

There is quite a visible difference in the standard of housing between the two as a result. The side of the island that is participating in tourism is definitely more developed than the side that continues with illegal fishing. Those involved in tourism have concrete houses of a decent size, rather than very small and often dilapidated nipa (grass-roof) huts that are predominant on the fishing village side. Some people also live in these nipa huts on the 'tourist side', but they are bigger and better maintained.

There could be far greater improvements in the social welfare of the community if there was greater cohesion and coordination in the tourism program on the island to boost tourism numbers. A problem has been that much of the economic benefits of protecting the dolphins and whales are going to neighbouring Panglao Island, not Pamilacan, where the tourism operators are severely undercutting the standardized pricing of Pamilacan's tour operators.

In summary, the social environment of Pamilacan has improved with the introduction of whale watching and reduction in illegal fishing, but possibly not as much as it could have due to competition from nearby resorts and some of the community shunning change (Source: Emily Pederson, Baclayon Municipal Tourism Officer, personal communication).

Phillip Island, Victoria

Phillip Island Nature Parks is one of few organisations in the world that generates a financial surplus from operating wildlife attractions. This includes Penguin Parade, Koala Conservation Centre, Churchill Island and the Nobbie's Centre. A long-term program of habitat restoration and predator eradication program has enabled a fully integrated conservation, eco-tourism and recreation focussed master plan to be prepared and approved in 2012. An active predator management programme over the last 20 years involving the control of foxes has contributed to the success of the wildlife tourism operation.

Total visitation to Phillip Island natural attractions is just over 3.7 million per year. The pest eradication programmes and associated increase in tourism over the last 30 years has contributed significant social and economic benefits to the region.⁷⁴ In 2011-12, Nature Parks spent \$4 million on environment, scientific research and education initiatives. It also has an annual economic contribution to the State of Victoria of \$125 million including \$64 million directly into the Bass Coast Shire economy.⁷⁵

By 2012, the achievements have included:

- the buyback and initial habitat restoration had been completed;
- total average crossings of penguins at the beach on Penguin Parade was 1016 compared with 582 in 1977;
- less than 3 penguins per year killed by cars compared to 40 in 1992;
- incidence of foxes and dogs killing penguins had been reduced to random killings only;
- weed invasion reduced by 80%; and
- positive social, economic and cultural benefits.

The ecotourism operation at the Penguin Parade and other Phillip Island Nature Parks are one of Victoria's most significant ecotourism operations and depend on the health of the Little Blue Penguins on the Summerland Peninsula. Income generated supports Phillip Island Nature Parks that cares for approximately 20% of Phillip Island's natural environments.

Galapagos

Two research papers indicate how in some situations, the partnership between conservation and tourism does not always benefit local communities in ways that are expected.

The Galapagos Islands experienced an economic boom between 1999 and 2005. Total income increased by an estimated 78%, or 9.6% annually placing the Galapagos among the fastest growing economies in the world.

However, as tourism grew on the Galapagos there was a high migration response from the mainland. As a result the rapid income growth did not significantly improve living standards on the islands. Per-capita income increased by only 1.8% annually, due to migration-induced population growth. In real terms, income per capita almost certainly declined. As a result the benefits of growth were acquired by the poorer workers and their families immigrating from the mainland, rather than by the usually resident population. The inequitable income distribution of the region also created disincentives for those with the lowest income to conserve the environment.⁷⁶

Franz Josef Glacier

The tourism and conservation industries associated with Franz Josef Glacier – Westland National Park helps to sustain a usually resident population of 320 to 340 residents. Over summer this increases to about 400 - 450 with seasonal workers. Approximately 450,000 – 500,000 visitors make day or overnight trips to Franz Josef per annum. While Franz Josef has a smaller usually resident population than Stewart Island/Rakiura its visitor industry is considerably bigger.

In terms of social services being derived from Westland National Park, these include:

- a school for up to Year 8 students with a current roll of 22 children (up from 16 in 2008);
- playgrounds, community centre and medical centre with one rural nurse and a doctor;
- one ambulance with voluntary crew;
- children's play group twice per week but apart from that parents share child care responsibilities between each other; and
- upgraded water and sewerage systems.

Unemployment was rated 0% in the 2006 census. The majority of those in the workforce work in tourism with the remainder in conservation and retail. Approximately 42% of the population are families with children and 57% couples without children. There is a low level of property ownership with 30% of those in private dwellings owning their properties. This compares with 62% property ownership for the West Coast region as a whole.

Growth in tourism between 2001 and 2009 led to an increase in average house prices (at the peak many were selling in the \$350,000 - \$450,000 range) but these values have since slumped with many of the same properties selling now for around \$200,000 - \$250,000. Average room rental for workers averaged \$120/ room/ week up until 2008/09 whereas now the same rooms rent for \$80 / week. The cost of electricity is reported to be the same as elsewhere in the South Island. Rates have been kept at relatively low levels for the last decade and not considered a barrier for living there. Food however is more expensive than in most larger towns and cities in New Zealand due to transport surcharges and lack of any local produce.

Despite the cycle of growth and decline over the last decade, new businesses have been established leading to a slight increase in families living at Franz Josef and children going to school. The Stony Creek subdivision just north of the township has enabled more workers and families to own their own homes and thereby stay in Franz Josef for longer. This has led to a slightly more stable permanent workforce.⁷⁷ New businesses established over the last five years include a construction company, new resort by Ngai Tahu, a wildlife centre at Okarito (Operation Nest Egg for the brown kiwi), a glacier shuttle service, one more restaurant and a new motel (The Oasis).

The ability to attract families to Franz Josef continues to be a challenge due to the seasonal nature of the work, remote location and limited opportunities for children once they reach secondary school age.

Lessons Learned

These case studies throw up three key lessons that have relevance to Stewart Island/Rakiura:

- There is evidence to suggest that pest eradication projects aimed at strengthening the appeal of wildlife or other nature-based tourism can be associated or possibly lead to an increase in visitation. However, there are a lot of other factors that can influence the outcome such as; the investment in marketing, development and management of the core wildlife/ natural attractions, access to the destination and availability of a skilled workforce.
- There are no guarantees that economic and social benefits would come as a result of the eradication project. There would be opportunities for the local economy to benefit through the process of eradication and afterwards with increased tourism. However, whether the

local community makes the most of those opportunities is up to the people, businesses and agencies involved.

- It is likely that population on Stewart Island/Rakiura will increase in size as a result of the eradication project. However, the impact of this on the cost of housing, rates, rentals and electricity is unclear from other case studies. In the case of Lord Howe Island, the cost of housing and building is considered very expensive (not surprising given its location) whereas at Franz Josef, the cost of buying and renting houses has reduced as a result of the recent economic downturn. There is simply too much variance between locations similar to Stewart Island/Rakiura to conclude what would happen from these case studies. However, there is in principle more leverage to be gained in terms of social benefits by having a larger population. Therefore we would logically expect house prices to rise, relative rates to rise slightly (house prices are only a part of the formula) and electricity prices to fall (as there is a high fixed cost element and this would be spread over a larger population).

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