Pomona Island, Lake Manapouri
20 m x 20 m Permanent Forest Plots
Re-measurement Report
2005 – 2016

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The 2016 field team
From left: George Ledgard, Fay Edwards, Sharon Lake, David Fortune, Sue Marwick.

1 Introduction:

Five permanent forest vegetation plots were established on Pomona Island in 2005 and re-measured in 2016. During this time there has been a significant change in deer and possum density so comparing these permanent plots, which detail any forest changes, make it a very valuable data set.

Pomona Island, with an area of 260 ha, is the largest island in Lake Manapouri and rises to just over 332 metres above lake level (511 metres asl).
It is a steep sided round topped dome – a typical *roche moutonee.*
The forest cover is mixed tall mountain beech (*Fuscospora cliffortiodes*) – silver beech (*Lophozonia menziesii*) forest with other broadleaf species (including southern rata and kamahi) and podocarps (including miro, Hall's totara and rimu).
In the subcanopy treeferns (*Dicksonia squarrosa* and *Cyathea smithii*) are quite common along with other species including lancewood (*Pseudopanax crassifolius*), stinkwood (*Coprosma foetidissima*), other *Coprosma spp* and supplejack (R*ipongonum scandens*).

2 Background

Red deer (*Cervus elahus scoticus*), possums (*Trichosurus vulpecula*), stoats (*Mustela erminea*), rats (*Rattus sp*) and mice (*Mus musculus*) all existed on Pomona Island when Pomona Island Charitable Trust was set up in 2005. The vegetation had been highly modified by these animals (Porter and McTavish 2006).

The Trust decided to eradicate all mammalian pests from Pomona Island.
This eradication was completed in 2007, including the removal of five red deer and at least four hundred and thirty possums. Red deer and possums have never been sighted on Pomona Island, nor has there been any evidence of their return since that eradication.

Since the 2007 mammal eradication rats, stoats and mice have reinvaded Pomona Island.
They are now controlled with extensive traplines and bait stations on the island and with trap lines on the mainland opposite Pomona island.

3 Aim

Volunteers, who regularly visit the island checking the network of traps, have observed forest changes since 2007 with the removal of browsing animals. When those volunteers visit the adjacent mainland the differences are obvious.

The aim of this report is to analyse the forest structural and compositional changes in Pomona forest plots between 2005 and 2016.

Studies of the impact of browsing animals have shown that deer and possums have altered the vegetation in both the canopy and subcanopy. Pomona Island gives us an opportunity to further study the effects of removing browsing mammals (deer and possums) on the ecosystem of our forests.

In 2005 five permanent 20m x 20m plots were laid out and a vegetation study was completed.

In 2016, after a time interval of 11 years since establishment, and about 9 years with no browsing mammals, the same plots were re-measured to give a scientific data set to measure against the Trust's ecological goals. A team of five people camped on the island from 28th November to 30th November 2016 to facilitate this measurement.

4 Field methods

In 2005 five 20m x 20m plots were established in the forest, on a transect line beginning 100 m from the lake, at 200m intervals, to near the summit on a north western aspect as shown in Appendix 1.

The monitoring method follows the Hurst & Allen protocol (2007).
In summary: the main deviation from Hurst and Allen(2007) is that in 2005 trees were tagged at ≥ 3cm dbh (diameter at breast height – 135 cm). In 2016 we measured tagged trees at ≥ 2.5cm dbh to be more consistent, and following best practice protocol, with the current method of other permanent plots around the country.

In each plot sampling recognised the categories:

- **trees** (> 2.5 cm diameter at breast height (dbh) in 2016, > 3.0 cm diameter at dbh in 2005)
- **saplings** (< 2.5 cm dbh and greater than 1.35 m in height)
- **seedlings** (between 15 cm and 1.35 m in height)
- **understorey** (all plants < 15 cm in height - recorded by presence (not numbers))

These definitions are used in all following graphs and tables.

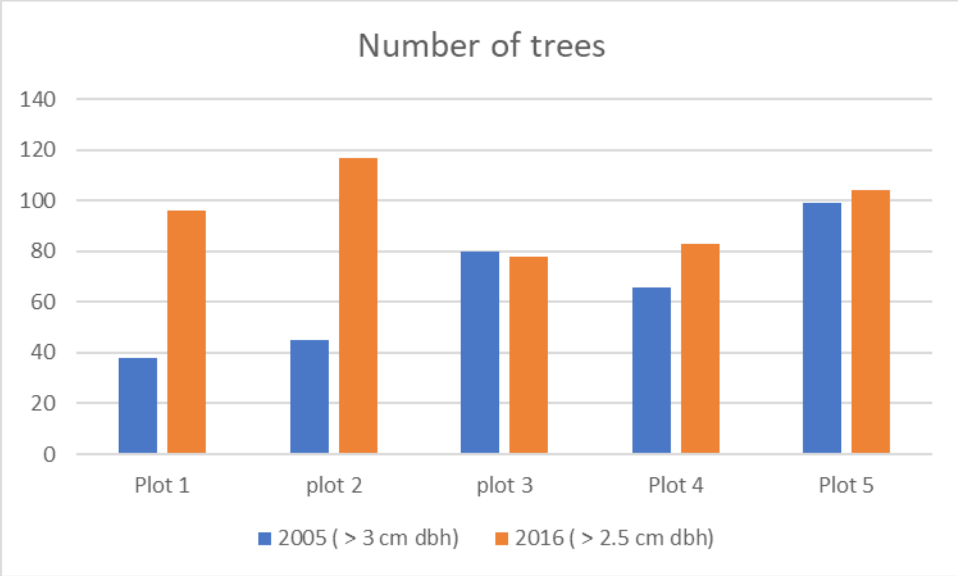
The number and species of each tree and each sapling were recorded in each subplot (5m x 5m square).
All plants between 15 cm and 135 cm in height were counted and identified and for plants less than 15 cm their presence noted, in twenty four systematically located circular understorey subplots.
All other standard 20m x 20m plot measurements were carried out in each plot including full RECCE descriptions.

Photographs were taken along the perimeter of each plot from each corner, with the tape in place, towards each adjacent corner. For some comparative examples see Appendix 2.

5 Results and discussion

❖ 1 Amount of vegetation present in 2016 compared with that in 2005.

The graph below compares the number of trees for each of the five plots in the two different years.



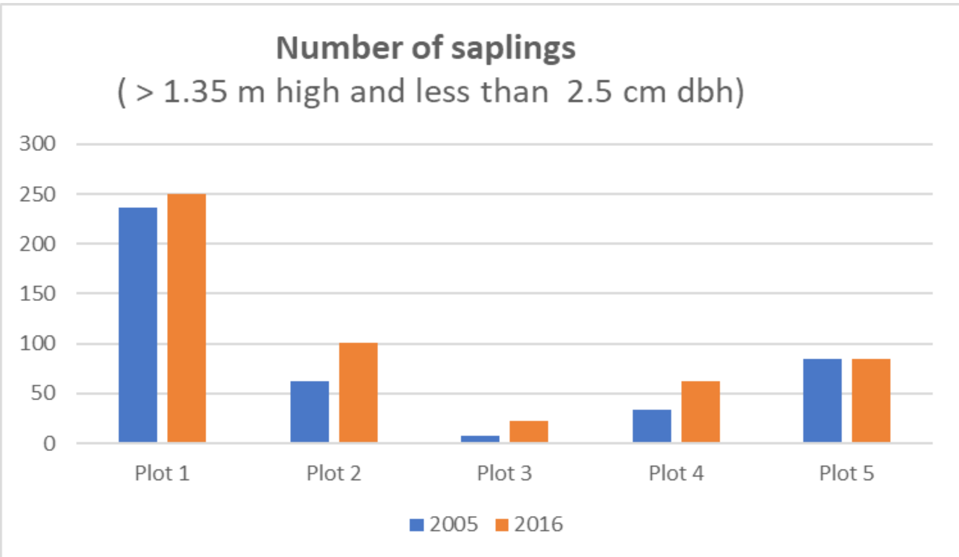
The two plots nearest the lake (plots 1 and 2) had a very significant increase in the number of trees present - in each case more than doubling. The number of trees increased in plot 4 and was similar in plots 3 and 5. The photos in Appendix 2 give an indication of this vegetation change for plot 1.

The table below shows the change in the number of trees for each subplot within Plot 1

Subplot	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
2005	1	1	1	0	0	0	3	2	0	4	4	1	3	1	11	6
2016	8	8	4	4	5	5	7	10	3	6	6	6	5	2	10	4

The number of trees increases in each subplot within Plot 1 (except in O and P where there was a treefall). Subplot O is all one species, *Fucospora cliffortioides* (mountain beech).
The table shows it is not an open canopy.

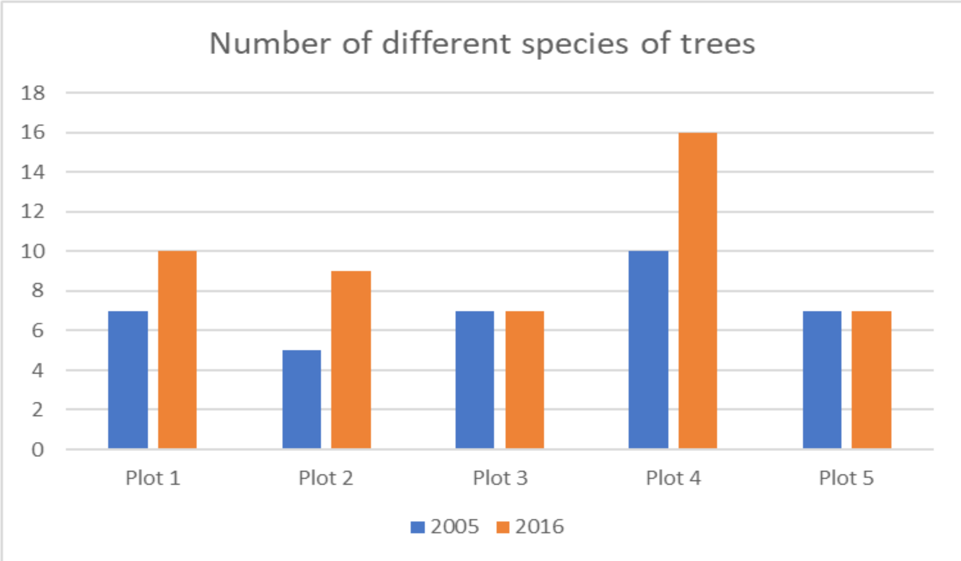
The graph below compares the number of saplings for each of the five plots in the two different years.



The number of saplings has increased significantly in plots 2, 3 and 4, is similar in plot 1 and the same in plot 5.

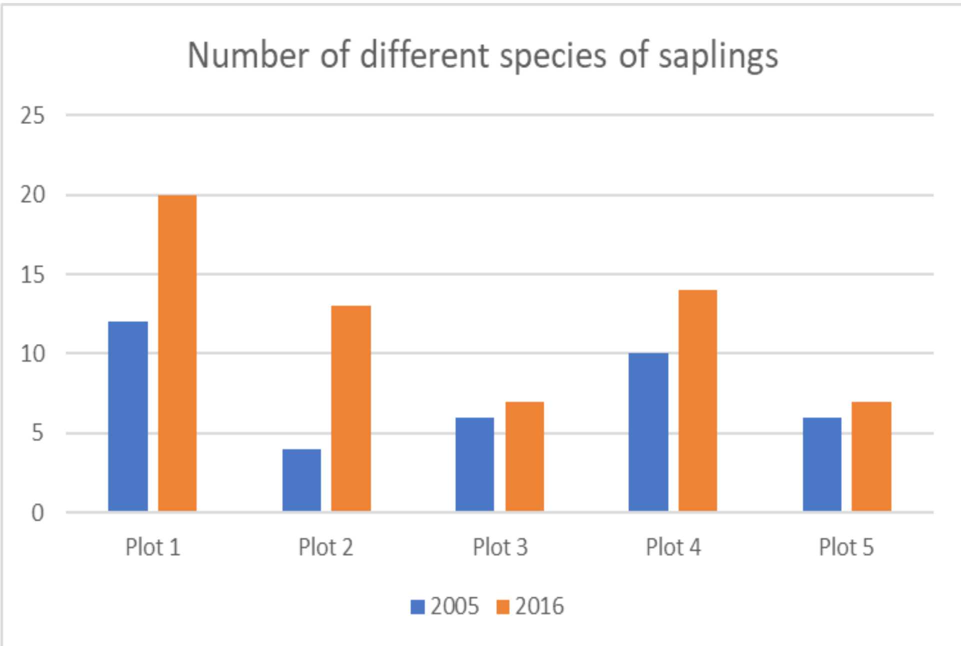
❖ 2 Number of different species of vegetation present in 2016 compared with that in 2005.

The graph below shows the change in the total number of different species for **trees** in all 5 plots for the 2 different years.



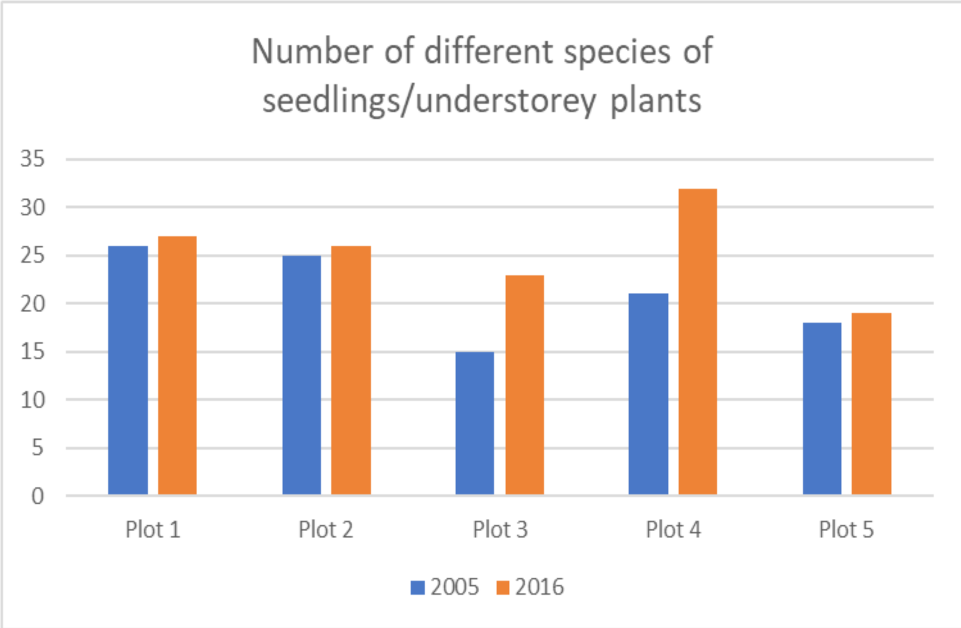
The number of different tree species has increased significantly in 3 plots, and is the same in plots 3 and 5.

The graph below shows the change in the total number of different species for **saplings (** < 2.5 cm dbh and higher than 1.35 m) in all 5 plots for the two different years.



We see that the number of different sapling species has increased in all 5 plots, 3 of them significantly.

The table below shows the change in the total number of different species for both **seedlings** (plants between 15 cm and 135 cm in height) and **understorey** plants (all species less than 15 cm high) in all 5 plots for the two different years.



We see that the number of different seedling/understorey species has increased in all 5 plots.
Plots 3 and 4 had significant increases in the number of different species.

A palatable species, Broadleaf, *Griselina littoralis,* had a significant increase in the number of seedlings from 2005 to 2016 across 4 of the plots as shown in the table below

Plot	**2005**	**2016**
1	5	13
2	9	15
3	0	11
4	2	12
5	0	0

Another palatable species, white rata, *Metrosideros diffusa* was present in plots 1 to 3 in both 2005 and 2016. An increase in seedlings from 3 in 2005 to 16 in 2016 could be due to the removal of browsing animals.

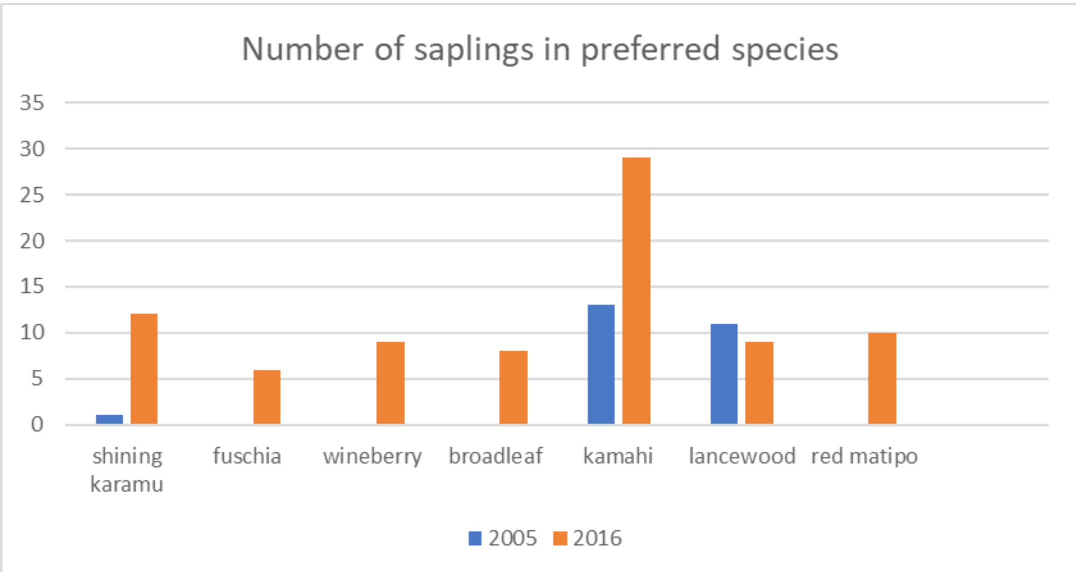
❖ 4 Change in species in 2016 compared with the species in 2005

Analysing the data we found new species in 2016 compared with 2005.
The changes included: Trees: losing 1 and gaining 4
Shrubs: gaining 3
Ferns: losing 3 and gaining 7
Graminoid: (grasses etc) gaining 1
Forb: (flowering plants not graminoids) losing 3, gaining 3

The woody plant not found in 2016 was *Coprosma linariifolia*
The new woody plants identified in 2016 were
Coprosma pseudociliata, *Pittosporum tenuifolium* (black matipo), *Pennantia corymbossa* (kaikomako), *Pseudopanax colensoi* (three finger), *Melicytus lanceolotus* (narrow leaved mahoe), *Netera villosa*, and *Veronica salicilfolia* (koromiko).
The last three species were not recorded as being anywhere on Pomona island in 2005 (B Rance).

❖ 5 Palatability of saplings, and a fern, in 2016 compared with 2005.

Palatability is divided into different classes: preferred, not selected and avoided.
Eight different species (seven trees and 1 fern) listed as "preferred species" in the NVS system were selected to compare the change in the number of that species present.
The species selected were C*oprosma lucida* (shining karamu), *Fuschia excorticate* (fuschia), *Aristoella serrata* (wineberry), G*riselinia littoralis* (broadleaf), W*einmannia racemose* (kamahi), P*seudopanax crassifolium* (lancewood), M*yrsine australis* (red matipo) and the fern A*splenium flaccidum* (hanging spleenwort).



The results show that in 2005 only 3 of the listed palatable species saplings were present in the plots with browsing mammals (deer and possum) present.
In 2016 there was a recruitment of new palatable species into the plots. As a result, there is a very significant increase in 6 of the 7 sapling species.
This indicates very strongly that the absence of browsing animals has allowed the numbers of young plants (saplings) of these six species to increase significantly.

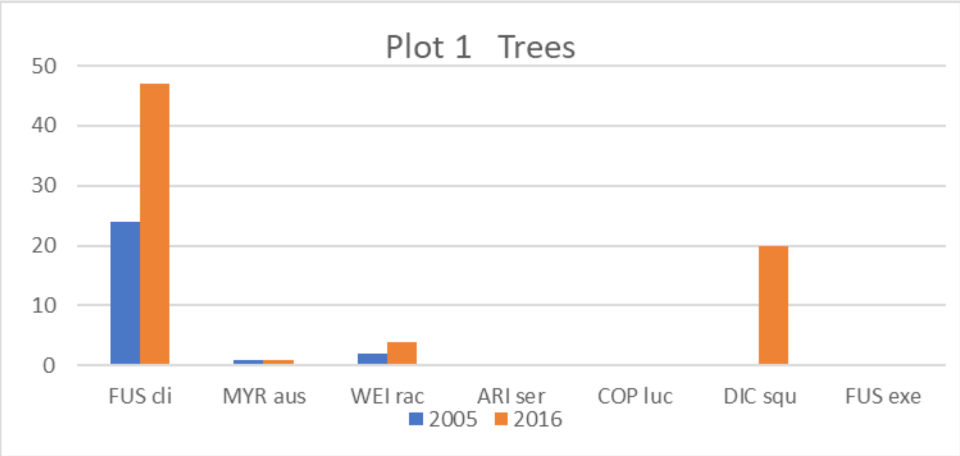
For the fern *Asplenium flaccidum* (hanging spleenwort) the change was from a presence in 7 understorey subplots to a presence in 8 understorey subplots.

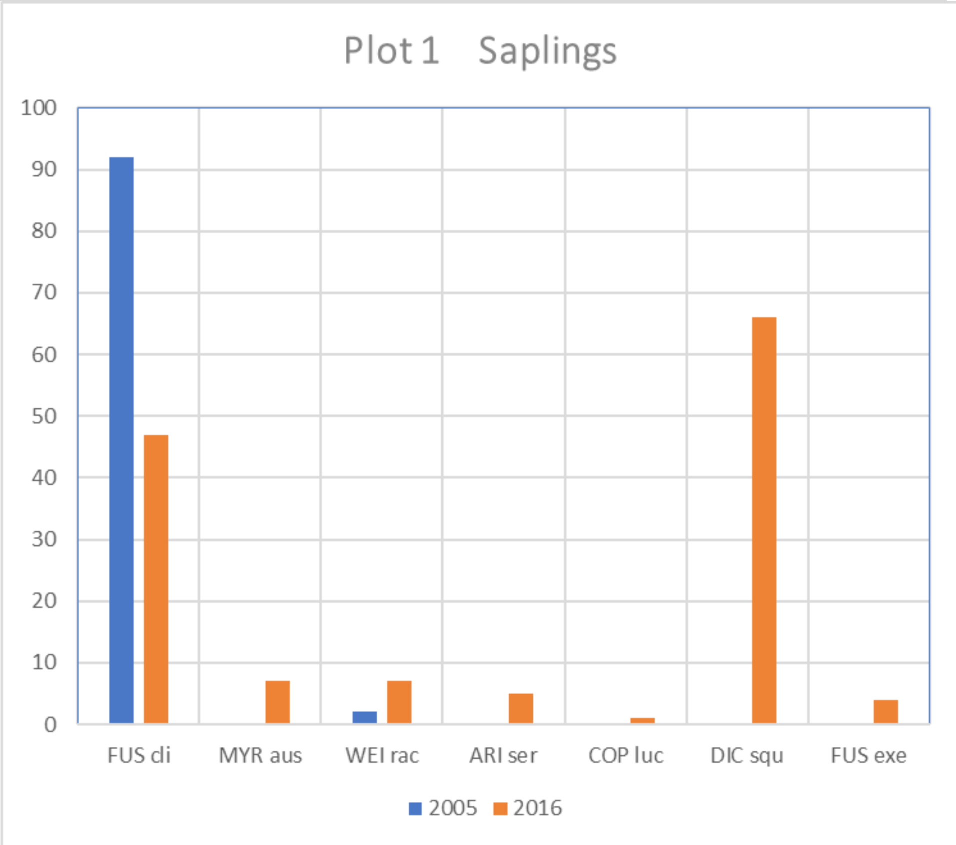
❖ 6 What type of species are changing?

The graphs below show, **to the same vertical scale**, the number of trees and saplings in Plot 1 for the 2 different years.
The graph shows the predominant species, mountain beech, together with 6 palatable species.

Species used are

FUS cli	*Fuscospora cliffortioides*	(mountain beech)
MYR aus	*Mrysine australis*	(red matipo)
WEI rac	*Weinmannia racemosa*	(kamahi)
ARI ser	*Aristtotelia serrata*	(wineberry)
COP luc	*Coprosma lucida*	(shining karamu)
DIC squ	*Dicksonia squarrosa*	(tree fern)
FUS exe	*Fuchsia excorticata*	(fuchsia)

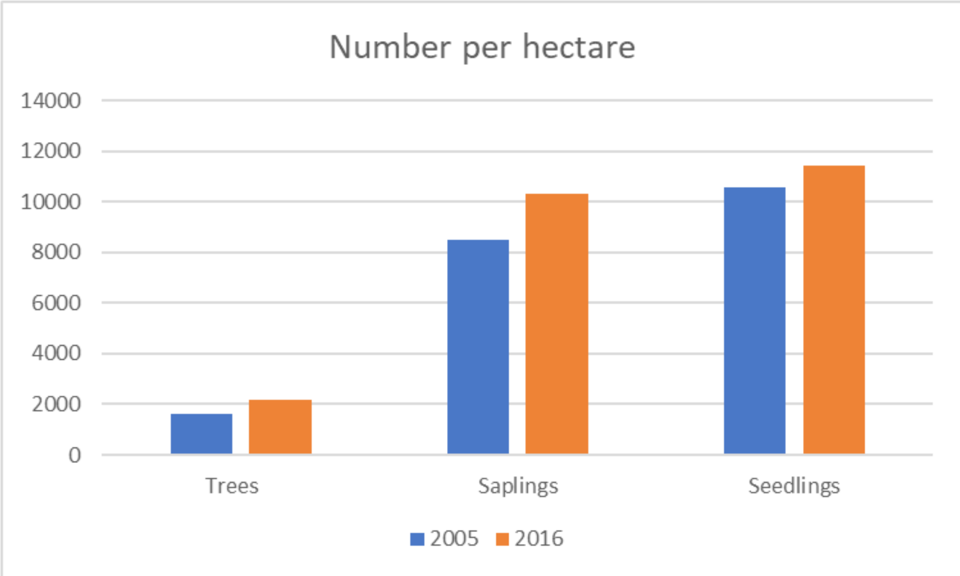




The graphs show not only the total increase in trees and saplings, but also the recruitment of 6 different deer/possum palatable species in plot 1 over the years when those browsing animals have been removed. We can confidently state that the number of palatable/preferred species increase has been facilitated by the removal of browsing animals. [There was no significant change in canopy cover.]

❖ 7 **Total amount of vegetation present in 2016 compared with that in 2005.**

The following graph shows the number of plants in each category per hectare – giving an indication of the plant density increase.



The graph shows there is an increase in the number of plants in each category – ie the vegetation in each category is denser in 2016 than in 2005.

6 Conclusions and recommendations

❖ 1 **Amount of vegetation**

Bullet points 1 and 7 above show the numerical density change in the amount of vegetation. The number of saplings present increased significantly in 3 plots, increased a little in one plot and was the same in plot 5. The number of trees increased significantly in 2 plots, increased in 1 plot and was similar in 2 plots. There was little change in the canopy so the successful eradication of browsing red deer and possums from Pomona Island is the most likely explanation for the increase in plant numbers and density.

❖ **2** **Palatable plant species**.

Bullet points 5 and 6 above show an observed measured significant increase in the number of plants in palatable species in both trees and saplings. The successful eradication of browsing red deer and possums from Pomona Island is the most likely explanation for this increase in the number of palatable plants.

❖ **3** **Number of plant species**

Bullet point 2 above shows the number of different plant species in each plot for trees, saplings and seedings/understorey. The number of different tree species increased significantly in 3 plots and was the same in 2 plots. The number of different sapling species increased in all 5 plots, 3 of them significantly. The number of different seedling/understorey species increased in all 5 plots, 2 of them significantly. The number of plants in each species in each plot increased (or was the same in 2 tree plots) with the only identifiable change for this 11 year period being the successful eradication of browsing red deer and possums from the island.

❖ 4 **Future**

Over the next 10 - 20 years palatable tree species (for deer and possums) should continue to grow and recruit into the subcanopy. Over the next 10-20 years the understorey should continue to become denser, with the possible further recruitment of different species.

This will advance the restoration of Pomona Island towards a browse – free island as existed pre human.

Full re-measurement of the plots should be carried out in or about 2027 to monitor any further changes in vegetation.

This study gives further evidence of what can be achieved with the removal of browsing animal pests from our New Zealand forests.

7 Acknowledgements

Thanks to the 2016 field team led in the field by George Ledgard and consisting of George Ledgard, Sue Marwick, Fay Edwards, Sharon Lake and David Fortune.

Thanks to Chris Shaw for the task of inputting the data into the NVS data base

Thanks to George Ledgard and Lynley King for report suggestions and checking.

8 References

Hurst JM, Allen RB 2007a. A permanent plot method for monitoring indigenous forests- field protocols. Lincoln, New Zealand, Manaaki Whenua Landcare Research.

Hurst JM, Allen RB 2007b. The Recce method for describing New Zealand vegetation - field protocols.

Porter SM, MacTavish JMB. A baseline ecological survey (vegetation, birds, invertebrates, in 2005) of Pomona and Rona islands, Lake Manapouri, Fiordland national Park, New Zealand)

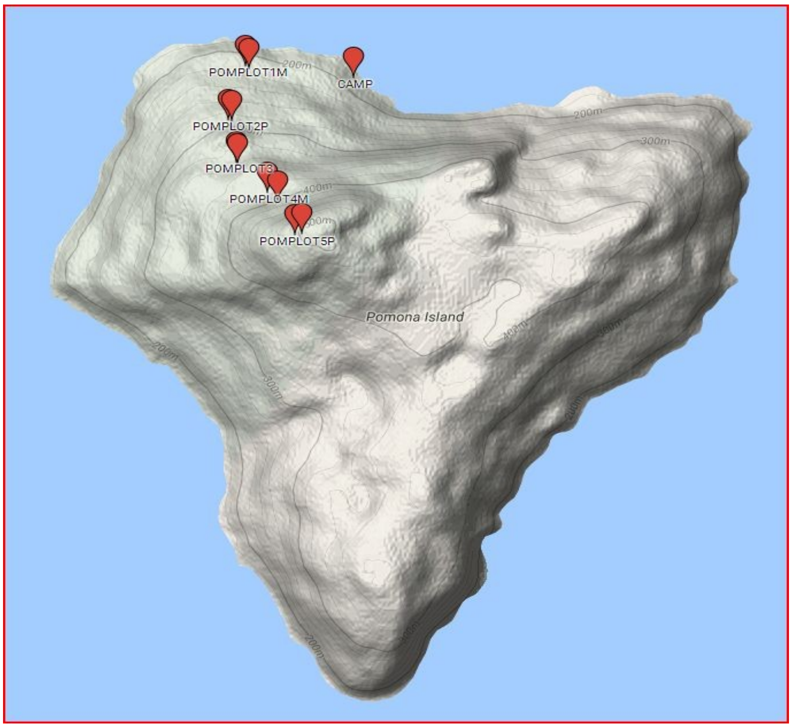
Rance B 2005. Pomona Island species list.

The complete data can be found at:

https://nvs.landcareresearch.co.nz/Data/Search by entering "Pomona Island" into the search box.

Appendix 1:

Showing position of the 5 vegetation plots, and our campsite, on Pomona island.



Plot	Latitude	Longitude
Pomona 1	-45.499740000	167.467211000
Pomona 2A	-45.502599000	167.466751000
Pomona 3A	-45.503532000	167.467902000
Pomona 4M	-45.504809000	167.468954000
Pomona 5A	-45.500008000	167.471104000
Pomona campsite	-45.503779000	167.468288000

Appendix 2:

Photos showing the change in the vegetation in plot 1 (nearest lake Manapouri).
Colour photos were taken in 2016 and black and white in 2005.

Plot 1: Corner M (west) to corner P (east).
The increase in the number and size of plants in middle foreground is apparent.

Plot 1: M to D (uphill)
Again many more sapling are evident in the under storey.

Plot 1: P to M
The vegetation has grown such that the person standing in the photo is just visible.