Department of Conservation biodiversity indicators: 2015 assessment—supplementary material

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New Zealand Government

Department of Conservation
Te Papa Atawhai

Cover: Lake Diana, upper Wilkins River, 2014. *Photo: Rod Hay (all rights reserved)*

CONTENTS

Introduction

This report underpins the intermediate outcome 'the diversity of our natural heritage is maintained and restored' in the Department of Conservation's (DOC's) Annual Report for the year ending 30 June 2015. It provides more detailed information on a subset of DOC's biodiversity indicators. Highlights from this are summarised in DOC's Annual Report for 2014/15.

The DOC Annual Report and technical report are available on the DOC website.

Summary information on biodiversity indicators 2015

Table 1 lists each indicator and describes whether it is updated in this report.

Table 1. List of biodiversity indicators and whether they are updated in this (2015) report.

COMPONENT OF ECOLOGICAL INTEGRITY	INDICATOR	REPORTING CYCLE	INDICATOR REPORTED
Representation			
	Percentage of environmental unit under indigenous vegetation and protected	Annual—protection analyses 5-yearly—dependent on LCDB update	Yes
	Percentage of environmental unit in marine reserves and marine mammal sanctuaries	Annual	Yes
	Percentage of environmental unit in freshwater ecosystems and protected	Annual	Yes
	Change in extent and integrity of nationally uncommon, significantly reduced habitats ecosystems that are protected	Annual—protection analyses Integrity assessment in development	Yes
Species occupancy			
	Number of extinctions	5-yearly	Yes
	Number of 'threatened' and 'at risk'species	5-yearly	Yes
	Demographic response to management at a population level for selected 'threatened' and 'at risk' taxa	Annual—based on random subsample/ selected indicator species 5-yearly—dependent on re-measurement cycle	Yes
	Size-class structure of canopy dominants	Annual—based on random subsample 5-yearly—dependent on re-measurement cycle	No
	Representation of plant functional types	Annual—based on random subsample 5-yearly—dependent on re-measurement cycle	No
	Demography of widespread animal species	Annual—based on random subsample/ selected indicator species 5-yearly—dependent on re-measurement cycle	Yes
	Representation of animal guilds	Annual/5-yearly—dependent on re-measurement cycle *In development*	No
	Extent of potential range occupied by focal taxa	Annual/5-yearly—dependent on re-measurement cycle *In development*—freshwater case study reported	Yes

Continued on next page

Table 1 continued

COMPONENT OF ECOLOGICAL INTEGRITY	INDICATOR	REPORTING CYCLE	INDICATOR REPORTED
Indigenous dominance			
	Occurrence and intensity of mast flowering and fruit production	Annual	Yes
	Number, extent and control of fire	Annual	No
	Distribution and abundance of exotic weeds and animal pests considered a threat	Annual—based on random subsample/ selected indicator species 5-yearly—dependent on re-measurement cycle	Yes—in Landcare report
	Pressure index	Annual/5-yearly—dependent on re-measurement cycle *In development*—proof of concept reported	Yes—in Landcare report
Ecological integrity			
	Management of priority ecosystems	Annual/5-yearly—dependent on re-measurement cycle *In development*—proof of concept for priority ecosystems reported	Yes

Supplementary indicator reports

The following text provides more detail on the indicators DOC reports on.

1. Percentage of environmental unit under indigenous vegetation and protected

Measures 6.1.1 and 6.1.2[1]

Percentage of environmental unit under indigenous cover and protected

Definition

Percentage of Land Environments of New Zealand (LENZ) environments in indigenous cover and legally protected. This measure is a quantification of the transformation of the New Zealand landscape and assesses the degree to which the potential for indigenous biodiversity is realised.

Methods

This measure combines three national datasets to produce a table showing the overall changes in New Zealand's native vegetation by Environment type—places that are grouped together because they are more similar to each other environmentally than they are to other places. The percentage of LENZ environments under indigenous vegetation and legally protected was evaluated using the national Landcover Database (LCDB) v4 categorised by indigenous versus modified vegetation for New Zealand as a whole. The data presented use Landcover information from 2012. We are using the LENZ Level 1 (20 Group), developed by Landcare Research and managed by the Ministry for the Environment—a secondary analysis was also run at the Level 4 scale (500 groups) to detect changes at a higher resolution. The legal protection layer (see Appendix 1) includes DOC-managed land, Nga Whenua Rahui and QE2 covenants taken from the NaPALIS (National Property And Land Information System) in May 2015.

The landcover categorisation into indigenous or modified vegetation can be found in Appendix 2. These data were updated in May 2015 to LCDB v4. The threat categories for Environment types relate to the percentage of environments legally protected and/or the percent of remaining native cover. Using this measure, we identified two categories of threat; acutely (<10% indigenous cover remaining) and chronically threatened (10–20% indigenous cover remaining). Environment types in the threatened categories are likely to contain some of our most severely reduced and poorly protected ecosystems, habitats and species.

Results

Table 2a shows the native cover in 2012 by environment and legal protection as calculated in May 2015. As previously reported, the data show no marked change in indigenous cover at the LENZ level 1 group. As of 2015, the lowland areas throughout the North Island and in the eastern South Island are the regions with the least area under protection (less than 10%). Of these, less than 1% of the eastern South Island plains and western, central and southern North Island lowlands are covered by indigenous vegetation and protected. These percentage figures differ only minimally from last year's figures. This is because any acquisitions of land by DOC are proportionally very small in relation to the large scale of LENZ Level 1. With the release of LCDB4 (based on 2012 imagery) late last year, there have been minimal changes due to land use changes between 2008 and 2012. Table 2b indicates the change in threat classification level of the LENZ level 4 groups over this period. Between 2008 and 2012, two environments had improved.

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[1] See chart in Biodiversity monitoring and reporting system technical fact sheet at http//www.doc.govt.nz/upload/documents/about-doc/role/policies-and-plans/biodiversity-monitoring-and-reporting-system.pdf for the full list of DOC measures.

Table 2a. Percentage of environmental unit under indigenous vegetation and protected.

LENZ (CLASSIFICATION LEVEL 1)	LAND ENVIRONMENT NAME	THREAT CLASSIFICATION	TOTAL AREA OF EACH LENZ LEVEL I CLASSIFICATION (ha) ACROSS ALL NEW ZEALAND, EXCLUDING OFFSHORE ISLANDS	PROPORTION PROTECTED 2008 (%)	PROPORTION INDIGENOUS IN 2008 AND PROTECTED (%)	PROPORTION PROTECTED 2012 (%)	PROPORTION INDIGENOUS IN 2012 AND PROTECTED (%)
A	Northern lowlands	Chronically threatened	1,853,478.54	5.5	4.7	5.5	4.7
B	Central dry lowlands	Chronically threatened	691,613.91	2.1	1.1	2.1	1.1
C	Western and southern North Island lowlands	Acutely threatened	636,262.40	1.2	0.9	1.2	0.9
D	Northern hill country		2,103,296.97	22.1	21.5	22.0	21.5
E	Central dry foothills		1,323,344.36	28.8	20.7	28.8	21.1
F	Central hill country and volcanic plateau		5,245,896.73	20.5	19.8	20.5	19.8
G	Northern recent soils	Chronically threatened	338,895.38	7.9	5.1	7.9	5.1
H	Central sandy recent soils		135,380.29	22.0	20.6	22.0	20.6
I	Central poorly-drained recent soils	Acutely threatened	121,102.84	3.2	2.0	3.2	2.0
J	Central well-drained recent soils	Acutely threatened	293,522.47	2.1	0.8	2.1	0.8
K	Central upland recent soils		160,771.06	28.1	15.6	28.1	15.6
L	Southern lowlands	Chronically threatened	802,595.89	8.1	7.1	8.1	7.1
M	Western South Island recent soils		220,661.73	50.8	45.0	50.8	45.0
N	Eastern South Island plains	Acutely threatened	2,044,918.04	1.0	0.4	1.0	0.4
O	Western South Island foothills and Stewart Island		1,415,944.33	82.5	81.0	82.6	81.7
P	Central mountains		3,248,187.29	77.4	75.8	77.4	76.1
Q	Southeastern hill country and mountains		3,277,186.74	22.8	21.3	22.8	21.3
R	Southern Alps		1,931,525.68	95.4	95.2	95.4	95.2
S	Ultramafic soils		33,513.42	93.4	92.9	93.9	92.4
T	Permanent snow and ice		157,155.93	97.8	97.8	97.8	97.8
Other*	Other*		211,421.53	20.9	13.5	20.5	13.4
Total	**Total**		**26,246,675.53**	**33.7**	**32.3**	**33.7**	**32.4**

* Other is the NULL class in LENZ layer. These are predominantly in Rivers, Estuaries and Lakes.

Table 2b. Level 4 environmental units that have undergone change in threat classification status.

LENZ (CLASSIFICATION LEVEL 4)	THREAT CLASSIFICATION 2008	THREAT CLASSIFICATION 2012	CHANGE FROM 2008 TO 2012	TOTAL AREA OF EACH LENZ LEVEL 4 CLASSIFICATION (ha) ACROSS ALL NEW ZEALAND, EXCLUDING OFFSHORE ISLANDS	PROPORTION PROTECTED (%)	PROPORTION INDIGENOUS IN 2008 AND PROTECTED (%)
B4.1b	Chronically Threatened	At Risk	Improvement	373.64	9.91	5.80
B9.1b*	Acutely Threatened	Chronically Threatened	Improvement	6,314.83	2.29	0.52

* Note, B9.1.b changed in status from acute to chronic due to a marginal increase in indigenous cover (9.9998 % indigenous to 10.0002 %).

Interpretation and implications

These quantitative data on environment types, their degrees of representation in protected areas, and their threat status, will help conservation managers consider opportunities for protection. For example, if a landowner wants to sell or covenant an area of land, the question arises of whether that Environment type is already well represented in protected areas and therefore a low priority, or whether it is a highly-threatened environment type and therefore a high priority for protection. Large land status changes would be needed to influence the threat classification at the Level 1 grouping, whereas at Level 4, small changes can influence the threat classification more readily. Lowland areas in the North Island and eastern South Island remain poorly protected and vulnerable to development.

2. Percentage of environmental unit in marine reserves and marine mammal sanctuaries

Measures

Measures 6.1.1 and 6.1.2[2]
Percentage of environmental unit in marine reserves and marine mammal sanctuaries

Definition

The area of New Zealand's marine environment managed by the Department of Conservation as marine reserves and marine mammal sanctuaries.

The measures do not include:

- Marine areas managed by the Department under other land status types that are not specific to the marine environment (e.g. nature reserves, wildlife reserves and other public conservation land).
- Marine protected areas (MPAs) that are not managed by the Department (e.g. those established under the Fisheries Act).

Methods

All data (marine reserve or sanctuary name, date and legal area) are taken directly from the relevant Order in Council or Act[3], unless otherwise stated. Please note that the figures stated may differ from other reported figures, particularly those calculated using GIS.

These data are mostly drawn from an unpublished internal DOC spreadsheet (doccm-1445030), which summarises GIS and legal statistics for New Zealand's marine protected areas and other marine sites. The measures are assessed in the context of (a) coastal marine bioregions; (b) marine areas within the 12 nautical mile territorial limit; and (c) marine areas within the 200 nautical mile Exclusive Economic Zone (EEZ) limit.

Results

Table 3 lists the percentage of each of New Zealand's biogeographic regions that is protected within marine reserves. Table 4 lists gazetted marine reserves as at 30 June 2015, and Table 5 lists marine mammal sanctuaries gazetted at that date. Table 6 summarises the total marine area managed by DOC.

[2] See chart in Biodiversity monitoring and reporting system technical fact sheet at http//www.doc.govt.nz/upload/documents/about-doc/role/policies-and-plans/biodiversity-monitoring-and-reporting-system.pdf for the full list of DOC measures.

[3] Most marine reserves and marine mammal sanctuaries are created under the Marine Reserves Act and Marine Mammals Protection Act respectively. However, some have been created under the following legislation: Fiordland (Te Moana o Atawhenua) Marine Management Act 2005, Subantarctic Islands Marine Reserves Act 2014 and Kaikōura (Te Tai o Marokura) Marine Management Act 2014. Because the legal documents establishing the Cape Rodney to Okakari Point and Hikurangi Marine Reserves did not include legal areas, the GIS areas have been used for these two sites.

Table 3. Percentage of each of New Zealand's biogeographic regions that is protected within marine reserves.

BIOGEOGRAPHIC REGION[a]	AREA OF BIOGEOGRAPHIC REGION (km^2)[b]	TOTAL AREA (LEGAL AREA) OF MARINE RESERVES (km^2)[c]	PROPORTION OF BIOGEOGRAPHIC REGION IN MARINE RESERVES (%)
Bioregional MPA process completed			
Subantarctic Islands	11,936	9331.63	78.18
Kermadec Islands	7,179	7480.00	100.00
West Coast South Island	13,158	175.49	1.30
Regional MPA process not yet completed[d]			
East Coast South Island	11,288	111.41	1.01
Fiordland	10,241	102.98	1.01
Northeastern	38,073	89.25	0.23
South Cook Strait	12,241	38.93	0.32
West Coast North Island	14589	32.48	0.22
North Cook Strait	13,671	30.22	0.22
East Coast North Island	11,637	28.98	0.25
Southern South Island	20,986	10.75	0.05
Chatham Islands	12,318	0.00	0.00
Three Kings	2,226	0.00	0.00
Snares Islands	2,154	0.00	0.00
New Zealand EEZ[e]	3,964,500	0.00	0.00

[a] As defined by the New Zealand Marine Protected Areas Classification, Protection Standard and Implementation Guidelines (2008).

[b] Rounded to nearest km. As calculated for 'Coastal marine habitats and marine protected areas in the New Zealand Territorial Sea: a broad scale gap analysis' (Department of Conservation and Ministry of Fisheries 2011).

[c] As reported in the 2014 Tier 1 Statistic for Marine Protected Areas.

[d] Similar or sub-regional processes have been completed in the Fiordland and Kaikoura (part of the ECSI) Marine Areas.

e. The EEZ is not a bioregion, but is dealt with separately by the MPA Policy. The Marine Reserves Act does not provide for marine reserves in the EEZ.

Table 4. New Zealand marine reserves as at 30 June 2015 (44 marine reserves).

IDENTIFIER	MARINE RESERVE NAME	DATE ESTABLISHED	LEGAL AREA (km^2)	PROPORTION OF NZTS (%)
MR1	Cape Rodney-Okakari Point Marine Reserve	1975	5.47*	0.003
MR2	Poor Knights Islands Marine Reserve	1981	24.10	0.013
MR3	Kermadec Islands Marine Reserve	1990	7480	4.128
MR4	Kapiti Island Marine Reserve	1992	21.67	0.012
MR5	Whanganui A Hei (Cathedral Cove) Marine Reserve	1992	8.40	0.005
MR6	Tuhua (Mayor Island) Marine Reserve	1992	10.60	0.006
MR7	Long Island–Kokomohua Marine Reserve	1993	6.19	0.003
MR8	Te Awaatu Channel (The Gut) Marine Reserve	1993	0.93	0.001
MR9	Piopiotahi (Milford Sound) Marine Reserve	1993	6.90	0.004
MR10	Tonga Island Marine Reserve	1993	18.35	0.010
MR11	Westhaven (Te Tai Tapu) Marine Reserve	1994	5.36	0.003
MR12	Long Bay-Okura Marine Reserve	1995	9.80	0.005
MR13	Motu Manawa-Pollen Island Marine Reserve	1995	5.00	0.003
MR14	Te Angiangi Marine Reserve	1997	4.46	0.002
MR15	Pohatu Marine Reserve	1999	2.15	0.001
MR16	Te Tapuwae o Rongokako Marine Reserve	1999	24.52	0.014
MR17	Auckland Islands (Motu Maha) Marine Reserve	2003	4,980.00	2.748
MR18	Ulva Island - Te Wharawhara Marine Reserve	2004	10.75	0.006
MR19	Te Hapua (Sutherland Sound) Marine Reserve	2005	4.49	0.002

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Table 4 continued from previous page

IDENTIFIER	MARINE RESERVE NAME	DATE ESTABLISHED	LEGAL AREA (km^2*)	PROPORTION OF NZTS (%)
MR20	Hawea (Clio Rocks) Marine Reserve	2005	4.11	0.002
MR21	Kahukura (Gold Arm) Marine Reserve	2005	4.64	0.003
MR22	Kutu Parera (Gaer Arm) Marine Reserve	2005	4.33	0.002
MR23	Taipari Roa (Elizabeth Island) Marine Reserve	2005	6.13	0.003
MR24	Moana Uta (Wet Jacket Arm) Marine Reserve	2005	20.07	0.011
MR25	Taumoana (Five Finger Peninsula) Marine Reserve	2005	14.66	0.008
MR26	Te Tapuwae o Hua (Long Sound) Marine Reserve	2005	36.72	0.020
MR27	Te Matuku Marine Reserve	2005	6.90	0.004
MR28	Horoirangi Marine Reserve	2006	9.04	0.005
MR29	Parininihi Marine Reserve	2006	18.44	0.010
MR30	Te Paepae o Aotea (Volkner Rocks) Marine Reserve	2006	12.67	0.007
MR31	Whangarei Harbour Marine Reserve	2006	2.37	0.001
MR32	Tapuae Marine Reserve	2008	14.04	0.008
MR33	Taputeranga Marine Reserve	2008	8.55	0.005
MR34	Tāwharanui Marine Reserve	2011	3.94	0.002
MR35	Moutere / Antipodes Island Marine Reserve	2014	2,172.86	1.199
MR36	Moutere Hauriri / Bounty Islands Marine Reserve	2014	1,046.25	0.577
MR37	Moutere Ihupuku / Campbell Island Marine Reserve	2014	1,132.50	0.625
MR38	Akaroa Marine Reserve	2014	5.12	0.003
MR39	Hikurangi Marine Reserve	2014	103.95*	0.057
MR40	Kahurangi Marine Reserve	2014	84.19	0.047
MR41	Punakaiki Marine Reserve	2014	35.20	0.020
MR42	Waiau Glacier Coast Marine Reserve	2014	45.57	0.026
MR43	Tauparikākā Marine Reserve	2014	0.17	0.000
MR44	Hautai Marine Reserve	2014	8.53	0.005
Total			**17,430.00**	**9.620**

* GIS areas (not legal areas) have been used for these two marine reserves—see earlier footnote.

Table 5. Marine mammal sanctuaries in New Zealand as at 30 June 2014.

MARINE MAMMAL SANCTUARY NAME	DATE GAZETTED	AREA (km^2)*
1 Banks Peninsula Marine Mammal Sanctuary	1988	4,076.96
2 Auckland Islands Marine Mammal Sanctuary	1993	5,057.10
3 Te Waewae Bay Marine Mammal Sanctuary	2008	348.84
4 Catlins Coast Marine Mammal Sanctuary	2008	653.88
5 Clifford and Cloudy Bay Marine Mammal Sanctuary	2008	1,386.00
6 West Coast North Island Marine Mammal Sanctuary	2008	11,935.42
7 Te Rohe o Te Whānau Puha Whale Sanctuary	2014	4,690.56
8 Ōhau New Zealand Fur Seal Sanctuary	2014	0.04
Total area		**28,137.86**

* Data for sanctuaries 1, 3, 4, 5 and 6 are derived from the legal area of each marine mammal sanctuary (DOC Conservation Units), whereas data for 2, 7 and 8 are calculated using GIS. The legal (Conservation Unit) area for the Auckland Islands Marine Mammal Sanctuary (2) includes the non-marine area of the islands themselves, while the two Kaikoura sanctuaries (7 and 8) do not have legal areas stated. This also explains the discrepancy between the areas calculated for the Auckland Islands Marine Mammal Sanctuary and the Auckland Islands Marine Reserve, which overlap spatially.

Table 6. Summary of marine areas managed by DOC.

		AT 30 JUNE 2014 (APPROXIMATE)	CHANGE SINCE LAST ANNUAL REPORT
Marine reserves	Total area	17,430 km^2	Increase of 278 km^2
	Percentage of NZ Territorial Sea	9.8%	Increase of 0.15%
	Percentage of NZ marine area	0.4%	Increase of 0.01%
Marine mammal sanctuaries	Total area	28,138 km^2	Increase of 4,691 km^2
	Percentage of NZ Territorial Sea	14.2%	Increase of 1.3%
	Percentage of NZ marine area	0.7%	Increase of 0.1%
Combined coverage of marine reserves and marine mammal sanctuaries*	Total area	40,637 km^2	Increase of 4,864 km^2
	Percentage of NZ Territorial Sea	21.1%	Increase of 2.7%
	Percentage of NZ marine area	1.0%	Increase of 0.06%

* These 'combined' figures are new measures in this annual supplementary information report. They serve to avoid 'double counting' of those areas where marine reserves overlap with marine mammal sanctuaries (in the vicinity of Taranaki, Kaikoura Banks Peninsula, and Auckland Islands). Because the overlap of marine reserves and marine mammal sanctuaries can be calculated only by GIS (and not by legal area measurements), this lower portion of the table is calculated directly from GIS figures held by DOC.

Approximately 9.8% (17,430 km^2) of New Zealand's marine area inside the 12 nautical mile territorial limit is protected within marine reserves. Almost all (17,083 km^2 or 96.5%) of this total is protecting the ecologically important offshore island marine areas of the Kermadec and Subantarctic groups, whereas only 617 km^2 (3.5%) of the total is around the coast of the New Zealand mainland.

Several new areas were established in the 2014/15 year. In August 2014, the 104 km^2 Hikurangi Marine Reserve was established, along with two marine mammal sanctuaries of 4691 km^2, under the Kaikōura (Te Tai o Marokura) Marine Management Act 2014. In September 2014, five new marine reserves (Kahurangi, Punakaiki, Waiau Glacier Coast, Tauparikākā and Hautai) with a total area of 175 km^2 were established on the South Island West Coast.

In addition to the marine reserves, 2.5% (4590 km^2) of the marine environment inside the territorial limit is in other types of 'marine protected areas'[4], but in most cases[5] these are managed by agencies other than the Department and so are not reported in detail here. No such marine protected areas occur in the EEZ beyond the territorial limit. Marine mammal sanctuaries are reported here as marine areas managed by the Department, but the protection they provide does not qualify them as 'marine protected areas'.

Interpretation and implications

Marine reserves place a high level of protection over specified locations of the marine environment. Currently, New Zealand has 44 marine reserves, the first established at Cape Rodney to Okakari Point in 1975. While legal protection is provided by marine reserves over large areas at the Kermadec and Subantarctic islands, most of New Zealand's 14 coastal marine biogeographic regions remain significantly under-represented in marine protected areas.

Nine of these bioregions have less than 1% of their total areas protected within marine reserves and the full range of New Zealand's marine habitats is not yet represented in marine protected areas. Accordingly, the completion of MPA planning processes for all regions of

4 As defined by the NZ MPA Policy.

5 The 4.2 km^2 Sugarloaf Islands Marine Protected Area in Taranaki is the only other MPA managed by DOC.

New Zealand remains a high priority and DOC (with the Ministry for Primary Industries) leads on implementation of the MPA Policy to enable this to happen. As part of that, the South-East Marine Protection Forum is working to produce MPA recommendations in 2016 for an area of the southeast South Island.

Marine mammal sanctuaries identify areas of importance to marine mammals, and may be used to place controls on specified activities to help the protection of such animals. Currently, New Zealand has eight marine mammal sanctuaries. Five of these around mainland New Zealand are primarily to help protect Hector's dolphins (including the Maui dolphin subspecies), while the Auckland Island sanctuary mainly aims to protect southern right whales and New Zealand sealions. Two sanctuaries were established near Kaikoura in 2014: one to protect whales and one to protect a New Zealand fur seal breeding colony.

3. Percentage of environmental unit in freshwater ecosystems and protected

Measure 6.1.2

Proportion of environmental unit under indigenous cover and protected

Measure 6.1.4

Proportion of threatened naturally uncommon and significantly reduced habitats protected

Definition

The percentage of freshwater ecosystems in protected areas relative to their total extent across New Zealand. This measure presents an overview of the amount of legal protection for freshwater habitats based on the mapping of wetlands, lakes, rivers and catchments.

Methods

This measure combines two national datasets to produce a table showing the overall percentage of rivers (by length in km) and lakes, wetlands[6] and catchments (by area in hectares) that are within protected areas. Spatial information on the extent of freshwater ecosystems was sourced from the FENZ national database[7]. We used the NATIS GIS database to access the most recent (c. 2015) information on protected areas. The legal protection layer includes all public conservation land (PCL), including stewardship land. Covenants and other type of conservation land not classified as PCL were excluded. We also separated stewardship land from other types of PCL. Data used in this analysis may differ from other reported figures due to discrepancies between gazetted area and GIS area calculations. This year the analysis has focused on percentage of different lake types in protected areas.

Results

The percentage of freshwater ecosystems in protected areas administered by the Department ranged from 29% for rivers to 60% for wetlands (Fig. 1). Relative to their historic extent, only 6% of wetlands are in protected areas nationally. Stewardship land accounts for a significant amount of freshwater ecosystem protection. For example, stewardship land covers 18,306 ha of lakes and over 34,556 km of rivers.

Figure 2 reports on the percentage of different lake types in protected areas. The volcanic, tectonic and dam lakes have lower levels of protection across New Zealand. Volcanic lakes particularly have low levels of protection given they are the second largest lake type by area after glacial lakes. Note: most geothermal lakes are protected by stewardship status but have the smallest total lake area.

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6 Wetlands for this analysis was limited to inland palustrine wetlands mapped in FENZ (Ausseil et al. 2008)

7 http://www.doc.govt.nz/our-work/freshwater-ecosystems-of-new-zealand/

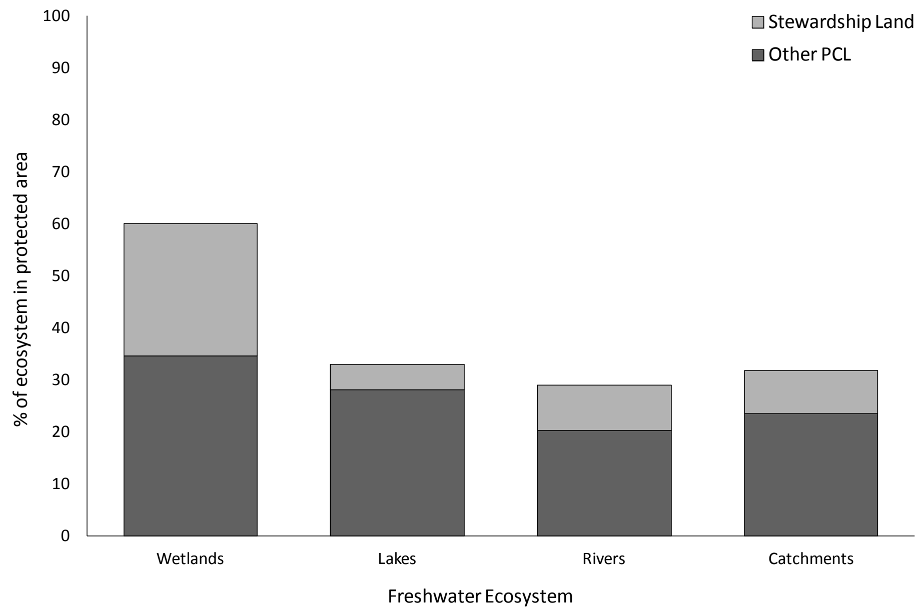

Figure 1. Percentage of wetlands, lakes, rivers and catchments in protected areas.

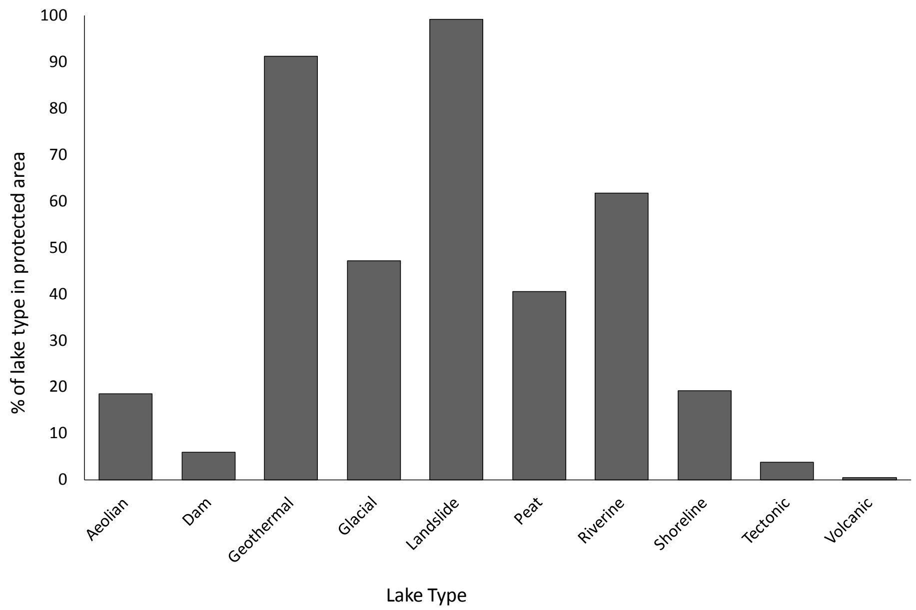

Figure 2. Percentage of different lake types in protected areas (PCL and Stewardship Land).

Interpretation and implications

The data on freshwater ecosystem protection will help conservation managers identify opportunities for protection of under-represented wetlands, lakes and rivers. In addition to data on the total percentage of protection (Fig. 1) it is important to have information for specific types of freshwater habitats (Fig. 2). Protection levels should also be assessed at the biogeographical region level, which is possible using the FENZ database. The case study on lake types indicates that volcanic and shoreline lakes are a priority for protection.

4. Demography of widespread animal species

Measure 5.1.2

Demography of widespread animal species

Definition

This measure assesses the status and trends in communities of widespread and common species at a national scale. An unbiased sample of locations on public conservation land is used to derive bird species richness, occupancy and density. Population estimates for widespread indicator species also contribute to this measure. These are species which remain geographically widespread and relatively abundant within their natural ranges yet sensitive to changes in their environment from change in threats (such as herbivory, habitat loss or predation). South Island robins (*Petroica australis*) and grey-faced petrels (*Pterodroma macroptera*) have been identified as useful indicators for measuring changes in demography of a species which are vulnerable to known pressures. The South Island robin is a widespread forest bird species and is vulnerable to predation by rats (*Rattus* spp.) and stoats (*Mustela ermina*). Grey-faced petrels are pelagic seabirds vulnerable to changes in the marine environment (e.g. food supply) and predation on land.

Several other widespread species are currently been assessed for their suitability as indicators (forest tree weta (*Hemideina* spp.), large-leaved mistletoe (*Peraxilla* spp.), seagrass (*Zostera* spp.)) while several others have been evaluated and then discounted (e.g. little blue penquin (*Eudyptula minor*) and Chatham Island speargrass (*Aciphylla traversii*)).

SOUTH ISLAND ROBINS

Methods: The numbers of robins inhabiting two forest blocks (Walker Creek and Knobs Flat) within the Eglinton Valley, Fiordland have been monitored intensively since 2005. The data collected have provided a valuable time series useful for the real-time evaluation of various pest management regimes and the performance of monitoring methods. Sufficient data have also been collected to allow development of predictive population models to assess the long-term benefits of different conservation management techniques.

Results: Pest control at Walker Creek has contributed overall to an increasing trend in robin numbers. Following the significant increase in the numbers of rats within the Eglinton Valley in 2006, intensive pest management was initiated at Walker Creek. Numbers increased slightly at Walker in 2007 following management but then declined by 48% to a low of 15 by 2008 (Fig. 3). Pest management was implemented again in September 2009 in response to an increase in rat numbers. There was a subsequent increase in robin numbers the following season 2010 to 39 birds. The small decline in robins between August 2010 and August 2011 (from a peak of 39 to 27 birds) was thought to be the result of significant winter mortality (deep snow for prolonged periods) and increasing rat numbers (8% tracking rates). Pest control was subsequently implemented in the

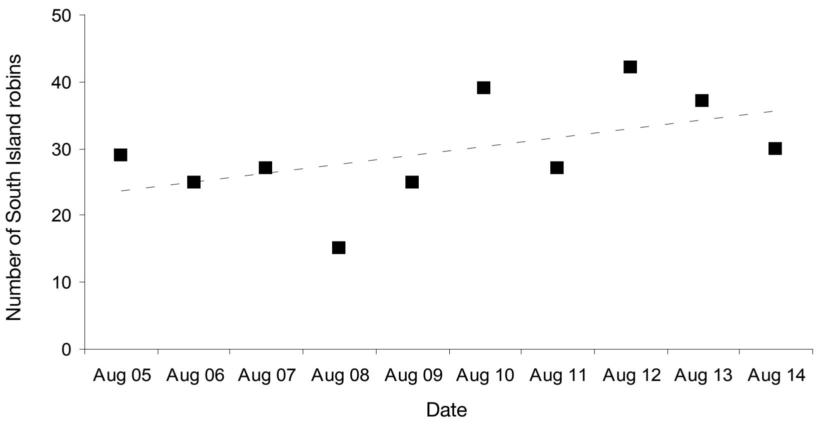

Figure 3. Estimate of number of South Island robins derived from territory mapping at Walker Creek.

spring of 2011 and a particularly productive 2011/12 breeding season followed with robin numbers at Walker Creek increasing by 36% to a total of 42 birds in August 2012. Numbers of robins remained high in 2013, with a total of 37 birds, but then dropped in 2014 to 30 birds. The decrease was thought to be the result of a high number of rats (indicated by a high rat tracking rate (28%)) in the southern end of the Eglinton valley (Walker Creek) at a time when the birds were breeding and vulnerable. Rat numbers were subsequently controlled by November (1% tracking rate). This shows the importance of the timing of pest control operations in relation to breeding of vulnerable species. Pest control at Walker Creek has contributed overall to an increasing trend in robin numbers and we anticipate further increases in future years.

At Knobs Flat, where pest control was not initiated until 2011, the the initial reduction in robin numbers was even more marked, with the population declining by 67% to 12 birds in 2008. Although there has been a subsequent increase in robins, the rate of recovery has been slower than that seen at Walker Creek and is yet to surpass the known population (42 robins) reached in 2006. The population in 2014 was the same as 2013 (25 robins) and the overall trend has therefore remained one of slow decline (Fig. 4). It is hoped that the initiation of pest control at Knobs Flat in 2011 (along with large areas in the rest of the Eglinton Valley) and good winter survival rates will reverse this trend within a relatively short period.

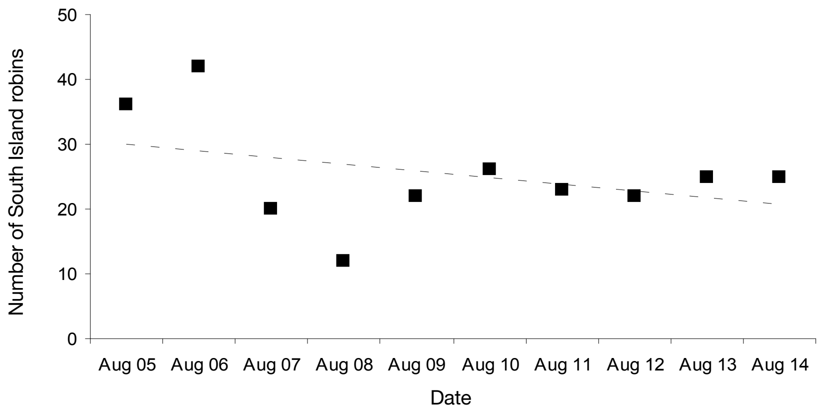

Figure 4. Estimate of the number of South Island robins derived from territory mapping at Knobs Flat.

Interpretation and implications: Robins are an engaging presence within forests throughout New Zealand and are often attracted to human activities within them. Although robins are still widespread, their numbers and distribution have contracted markedly over the previous century. Ongoing predation pressure, especially that resulting from periodic irruptions of rodents (rats, mice (*Mus musculus*)) and mustelids (stoats, weasels (*Mustela nivalis*), ferrets (*Mustela putorius*)), is particularly damaging. Rapid declines in robin numbers (and for many other forest birds), such as those observed in the Eglinton Valley, appear to be the inevitable consequence of these irruptions. Without the effective management of predator populations, particularly in peak predator years, the recovery and long-term survival of robins and other bird species at healthy levels within mainland forests remains uncertain.

GREY FACED PETREL—PILOT SURVEY

Methods: Islands without predators were sampled, so that the status and trend of grey-faced petrel populations could be correlated with changes in the marine environment. Populations estimated to be greater than 100 pairs were sampled, as detecting changes in small populations that have high probabilities of being impacted by stochastic events is problematic

Three islands—Otata Island, Burgess Island (Pokohinu) and Moutohora Island—were selected for a pilot study in 2014 based on the following criteria: previous estimates of their grey-faced petrel populations were available, they were relatively accessible, they represented a range of island and population sizes and were partly or jointly managed by DOC (Fig. 5).

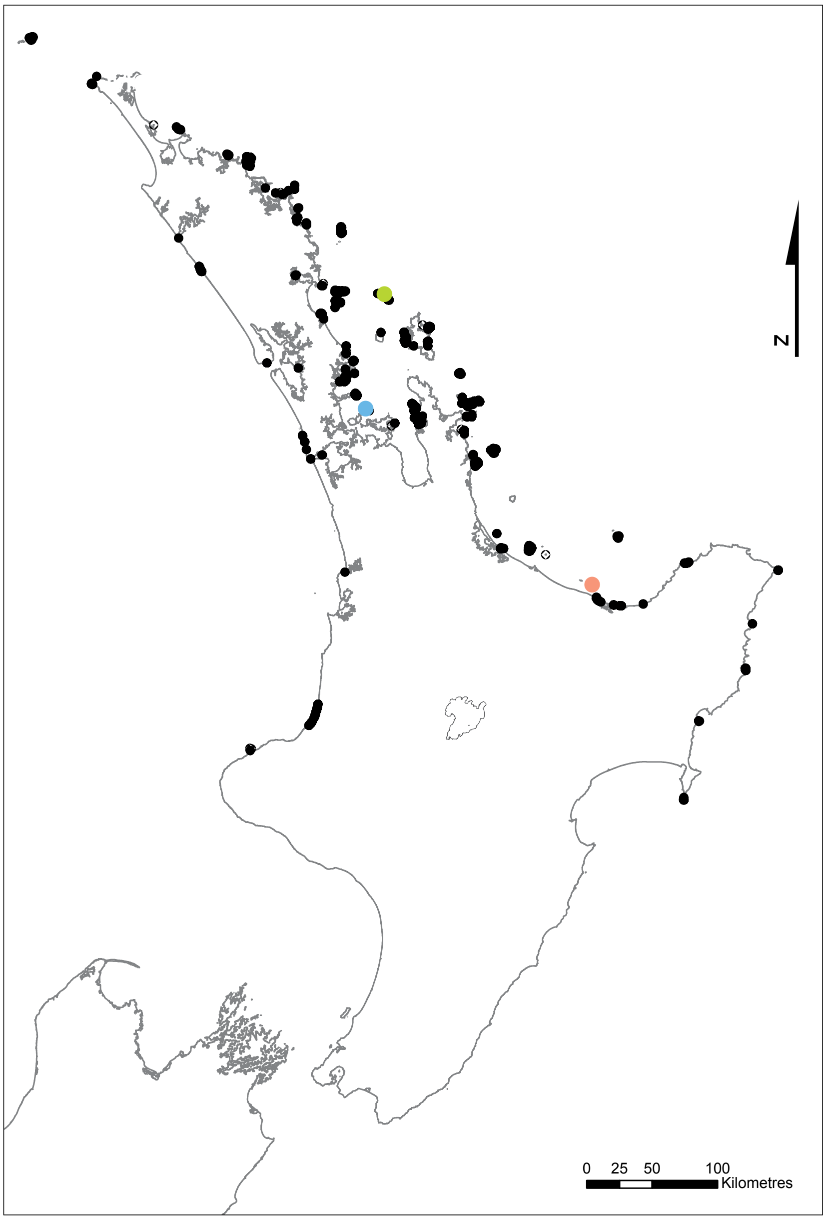

Figure 5. Distribution of grey-faced petrels and location of islands used in pilot study. Green = Burgess Island (Pokohinau), blue = Otata Island, brown = Moutohora Island.

Results: *Otata Island*: Fifteen random points were surveyed for the pilot study. At each survey point circular plots (radius 1.0 m and 2.5 m) were surveyed for burrows. No burrows were detected but approximately 50 burrows were observed as the teams traversed over the island.

Burgess Island (Pokohinau): The 2.5 m radius circular plot size detected burrows and gave a reasonable estimate of 10,000 ± 3000 burrows.

Motohoura Island: Using 5.0 m radius circular plots, the pilot study estimated 49,300 ± 6700 burrows for the surveyed part of the island (*n* = 32 with 28% of the island not represented in the sampling), with an acceptable level of precision.

Interpretation and implications: The study of the three islands contributed to the development of a standardised monitoring method, and a sampling design that can detect long-term trends on islands of variable size and grey-faced petrel abundance.

Norway rats (*Rattus norvegicus*) were eradicated from Otata Island and the other islands in the Noises group throughout the 1980s (Towns & Broome 2003). Long-term trends show that the population is either stable or in decline, but highly variable.

Feral goats (*Capra hircus*) were eradicated from Burgess Island in 1973 and kiore (pacific rat; *Rattus exulans*) were eradicated in 1990 (Ismar et al. 2012). The island has been free of introduced mammals since then. The pilot estimate showed that the grey-faced petrel population is increasing.

On Motohoura Island in 1986, 820 burrows were estimated within a 1.4 ha area prior to the eradication of Norway rats and rabbits (*Oryctolagus cuniculus*) (1987), and 1036 were estimated in 1991, following the eradication (Harrison 1992, Imber et. al. 2003). In 2000, it was estimated that there were 20,000 to 50,000 breeding pairs (Taylor, 2000b). Whitehead et al. (2014) estimated that Moutohora Island supported between 10,590 and 128,300 breeding pairs of grey-faced petrels during the 2007, 2008 and 2010 breeding seasons (Table 7). The pilot estimate showed that the population is increasing. Further refinement of the sampling design and standardised method shows promise for reliable long-term estimates of trends in the grey-faced petrel population.

Table 7. Comparison of grey-faced petrel burrow estimates and occupancy over time.

ISLAND	YEAR	BURROWS	OCCUPANCY	REFERENCE
Otata	1963	200		Cunningham & Moors 1985
	1985	150	<50	Cunningham & Moors 1985
	2007	75		McKay et. al. 2007
	2014	127		J. Thoresen, unpubl. data, 2014
	2014	0		2014 pilot study random points
	2014	50		2014 pilot study informal walk
Burgess	1980	500		McCallum 1980
	2000	>5,000		Taylor 2000
	2014	10,000		2014 pilot study
Motohoura	1976	30,000		Imber 1976
	1982	3,000 (1.4 ha)		Harrison 1992
	1985	2,000 (1.4 ha)	35	Harrison 1992, Imber 2000
	1986	820 (1.4 ha)	57, 27	Harrison 1992, Imber 2000
	1987	(1.4 ha)	25	Imber 2000
	1988	(1.4 ha)	27	Imber 2000
	1990	(1.4 ha)	35	Imber 2000
	1991	1036	22, 42	Harrison 1992, Imber 2000
	1993	2,250	42	Imber 2000
	1994	(1.4 ha)	52	Imber 2000
	1999	109,000	50-90	Imber 2003
	2000	20,000–50,000		Taylor 2000
	2003	95,000	50-90	Imber 2003
	2006, 2007, 2008, 2010	10,590–128,300		Whitehead et. al 2014
	2014	155,000 (72% of island)	31	This pilot (for surveyed part of island)

5. Extent of potential range occupied by focal taxa

Species that are limited by adverse ecological factors, such as predators or habitat disruption, often have much smaller, fragmented ranges than those less affected. The extent to which these species occupy their potential range is regarded as a surrogate for cumulative pressure on them. Here we present an example using a case study of Waituna Lagoon, Southland and include the explanatory measures needed to interpret the change in potential range for the species of interest.

Measure 5.2.1

Extent of potential range occupied by focal indigenous taxa

Definition

The extent to which focal indigenous taxa occupy their potential range within a site indicates the cumulative pressures on them. Data on water chemistry (Measure 1.3.2 Water chemistry) and hydrological change (Measure 1.4.3 Hydrological change) is needed to determine whether freshwater sites managed by the Department are maintaining natural ecosystem processes. Information on water chemistry will identify the risk of eutrophication (high nutrients) within priority lake, wetland and river ecosystems. Information on hydrological change (e.g. increased or decreased water levels) is needed to ensure the water regime is appropriate for indigenous species. The data presented can constitute regional summaries of the status of different types of freshwater ecosystems, or information on the status and trend of high priority sites.

CASE STUDY: WAITUNA LAGOON

This measure provides a report on the effects of changes in water chemistry and hydrological change on *Ruppia* spp. in Waituna Lagoon, a priority freshwater site.

Methods: The opening and closing of coastal lagoons causes significant changes in the hydrology and water chemistry within the lagoons. Aquatic macrophyte species, such as *Ruppia megacarpa* and *Ruppia polycarpa*, are adapted to this fluctuating environment. However, their resilience may be threatened if openings are more frequent and sustained. Degradation of water chemistry caused by intensification of land use in the upstream catchment may further stress macrophyte communities.

Waituna Lagoon is part of the Awarua-Waituna wetland complex in Southland, an ecosystem management unit managed by the Department with comprehensive outcome monitoring. Lagoon water level and water chemistry parameters are compared with the results of repeated annual surveys of 48 sites across the Lagoon (2009–15) to report on changes in *Ruppia* spp. presence.

Results: Managed openings of Waituna Lagoon, for the purposes of land drainage, result in rapid changes in Lagoon water levels and chemistry. As the Lagoon becomes tidal, salinity increases. When the Lagoon is closed, water chemistry is degraded as a result of high nutrient (nitrogen and phosphorous) loads from the agriculturally intensified upstream catchment (Table 8).

The occurrence of *Ruppia* spp. declined between 2009 and 2011 and again between 2012 and 2014. After the Lagoon closed in 2011 and 2015 there were a substantial increases in the occurrence of *R. polycarpa* (Fig. 6). In 2014, less than 20% of monitored sites supported *Ruppia* spp. compared with more than 60% in 2009, 2012 and 2015 following Lagoon closure. The overall abundance of macrophytes appears to be directly related to the opening status of Waituna Lagoon.

Table 8. Water chemistry parameters* (mean ± s.d.) in Waituna Lagoon during open and closed periods for the key growing season (1 August – 31 March) of *Ruppia* spp.

YEAR	TOTAL NITROGEN (mg/L)		TOTAL PHOSPHORUS (mg/L)		SALINITY (ppt)	
	Open	Closed	Open	Closed	Open	Closed
2009	0.33 (–)	1.08 (0.21)	0.03 (–)	0.26 (–)	28.0 (–)	2.8 (0.5)
2010	0.49 (0.14)	0.64 (0.18)	0.07 (0.07)	0.05 (0.05)	29.5 (3.5)	7.9 (2.4)
2011	0.37 (0.09)	1.76 (0.01)	0.06 (0.06)	0.91 (0.04)	30.2 (2.1)	0.4 (0.1)
2012	1.23 (–)	0.77 (–)	0.02 (–)	0.03 (–)	16.6 (–)	5.3 (–)
2013	0.43 (0.3)	1.52 (–)	0.03 (0.01)	0.05 (–)	36.3 (6.8)	11.3 (–)
2014	0.43(0.3)	–	0.01(0.005)	–	39.3 (6.9)	–
2015	–	1.13 (0.30)	–	0.03 (0.01)	–	4.3 (3.3)

* Data courtesy of Environment Southland.

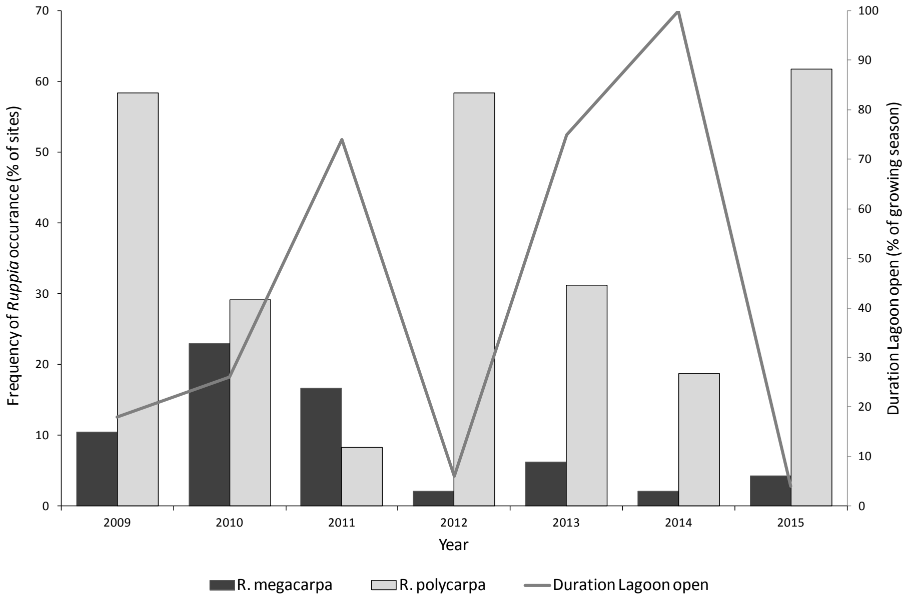

Figure 6. Frequency of occurrence of *Ruppia megacarpa* and *R. polycarpa* in Waituna Lagoon between 2009 and 2015.

Interpretation and implications: Declines in the occurrence of *Ruppia* spp. are associated with the duration of the open phase and the period plants are subject to saline conditions and low water levels. The resilience of the system is also at risk, with the lagoon becoming increasingly algae dominated as a result of increased nutrient enrichment from the high loads of nitrogen and phosphorus being carried in from farmland inthe Lagoon's catchment.

Artificial openings of the lagoon provide an opportunity to manage and limit the effects of eutrophication; however, they also limit *Ruppia* spp. growth. As *Ruppia* spp. are a key feature of Waituna Lagoon, providing habitat for aquatic species and helping to regulate water quality, management actions need to balance these effects. The Department is working with key stakeholders to explore options for managing Lagoon openings and reducing nutrient loads.

6. Extinct taxa

Measure 4.1.1

Preventing declines and reducing extinctions.

Definition

Taxa (species, subspecies, varieties and forma) that have become extinct since human settlement (here defined as the last 1000 years).

Methods

Taxa are assessed as being extinct only if there is no reasonable doubt, after repeated surveys in known or expected habitats at appropriate times (diurnal, seasonal and annual) and throughout the taxon's historic range, that the last individual has died. Taxa that are extinct in the wild but occur in captivity or cultivation are not listed in this category; these are listed instead as 'Nationally Critical' with qualifier 'EW' (Extinct in the Wild)—for further information, see Townsend et al. (2008).

Results

The total number of extinct taxa has gone from 65 in the 2008–11 threatened taxa lists to 77 in 2012–14. Birds form the great majority of this total (56), and changes to the total in this group result almost entirely from corrections to the list of species that went extinct in the pre-European period; there have been no new extinctions of birds. In fact, one bird species, the South Island kokako, was moved from the Extinct to the Data Deficient category following a possible sighting.

One additional extinct plant and one moth have been added to this category. The plant *Lepidium amissum* has been extinct for about 100 years, but has only recently been recognised as a distinct species. The moth *Xanthorhoe bulbulata* has not been found since 1989, despite intensive searching, and only two adults were seen after 1950.

More than 70 other taxa have not been seen for more than 20 years. However, these are not formally listed as extinct, because the necessary level of certainty has not been reached for these small and cryptic species.

This indicator will be reported on again in 5 years.

7. Status of Threatened and At Risk taxa

Measure 4.2.1/4.3.1

Improve the status of 'threatened' taxa and 'at risk' taxa

Definition

'Threatened' taxa are those that are facing imminent extinction. 'At Risk' taxa are those that either have small populations but are not currently declining, or are declining but have large populations or large areas of occupancy, so are not facing imminent extinction.

Methods

The New Zealand Threat Classification System (NZTCS) is used to assess the threat status of New Zealand taxa, with the status of each taxon group being assessed over a 3-year cycle (in future, to be 5-yearly). The NZTCS methodology was revised in 2008 to improve its utility (Townsend et. al. 2008)[8]. Threatened taxa are grouped into three categories: 'Nationally Critical' (at greatest risk of extinction), 'Nationally Endangered' and 'Nationally Vulnerable'. At Risk taxa are declining (though buffered by a large total population size and/or a slow decline rate), biologically scarce, recovering from a previously threatened status, or survive only in relict populations. Four At Risk categories exist: 'Declining', 'Recovering', 'Relict' and 'Naturally Uncommon'. There is no ranking or hierarchy of threat status amongst these because At Risk categories reflect different types of risk, not different levels of risk. 'Data deficient' taxa are those that are likely to be threatened but too poorly known to allow assessment into a category.

Results

The results of the 2012–14 cycle of listings are compared with the results of the 2008–11 cycle in Table 9, and broken down into more detail in Table 10. Figures for the 2008–11 cycle are taken from Hitchmough (2013)[9], and differ very slightly from those reported in the 2012 annual report, because of corrections made during preparation of the document. Marine fish, algae, lichens, fungi, lice, spiders, nematodes and some minor invertebrate groups were not reassessed during the 2012–14 review cycle and so totals included for these groups are from the most recent previous assessment.

Most changes between 2008–12 and 2012–14 result from improved coverage of groups previously not assessed, and improved knowledge or changed interpretation of the available information. However, 55 taxa (26 vascular plants, 13 birds, 3 reptiles, 6 freshwater fish, 6 moths, 1 weta) have declined sufficiently to trigger a change to a more severely threatened category, and 14 taxa (4 vascular plants, 1 marine mammal, 7 birds, 2 reptiles) have recovered under management sufficiently to move to a less severely threatened category. Another 34 species are classified in the At Risk—Recovering category following successful management intervention in the past.

These trends will be reported on again in 5 years (2020).

Work on the 2015–20 cycle of list reviews has started.

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[8] Townsend, A.J.; de Lange, P.J.; Duffy, C.A.J.; Miskelly, C.M.; Molloy, J.; Norton, D.A. 2008: New Zealand Threat Classification System manual. Department of Conservation, Wellington. 35 p.

[9] Hitchmough, R. 2013: Summary of changes to the conservation status of taxa in the 2008–11 New Zealand Threat Classification System listing cycle. New Zealand Threat Classification Series 1. Department of Conservation, Wellington. 20 p.

Table 9. Number of Threatened and At Risk taxa identified in the 2008–11 and 2012–14 Threat Classification Lists.

	NUMBER OF DATA DEFICIENT TAXA	NUMBER OF THREATENED TAXA	NUMBER OF AT RISK TAXA
2008–11 Threat Classification List	3940	799	2741
2012–14 Threat Classification List	4342	985	2772

Table 10. Breakdown of current conservation status statistics by taxonomic group and NZTCS category. For some groups only a subset of taxa (those thought to be of concern) were assessed; column totals do not necessarily reflect the true total number of taxa in the group.

CATEGORY	GROUP, ASSESSMENT YEAR							
	VACULAR PLANTS 2012	MOSSES 2014	LIVER-WORTS 2014	ALGAE 2005	LICHENS 2011	FUNGI 2011	BATS 2012	MARINE MAMMALS 2013
Extinct	8	0	0	0	0	0	0	0
Data Deficient	77	21	171	23	975	1481	1	12
Nationally Critical	155	14	8	1	4	62	1	5
Nationally Endangered	62	4	5	0	4	20	2	2
Nationally Vulnerable	72	2	3	0	3	6	1	1
Declining	102	0	3	0	4	10	1	0
Recovering	7	0	0	0	0	0	0	0
Relict	13	0	2	0	0	0	0	0
Naturally Uncommon	627	48	105	37	173	12	0	0
Migrant	0	0	0	0	0	0	1	7
Vagrant	12	7	0	0	0	0	0	19
Coloniser	17	0	0	0	0	0	0	0
Not Threatened	1428	10	441	0	636	14	0	11
Introduced and naturalised	1	3	9	0	0	0		
Grand Total	2596	109	747	61	1799	1605	7	58

Table 10 continued

CATEGORY	GROUP, ASSESSMENT YEAR							
	BIRDS 2012	REPTILES 2012	FROGS 2013	FRESH-WATER FISH 2013	MARINE FISH 2005	MARINE INVERTS 2013	FRESH-WATER INVERTS 2013	DIPTERA 2014
Extinct	56	2	3	1	0	0	0	0
Data Deficient	2	4	1	1	37	30	172	115
Nationally Critical	25	3	2	5	0	6	46	0
Nationally Endangered	18	10		6	0	1	11	0
Nationally Vulnerable	34	19	2	10	0	4	16	1
Declining	17	26	3	14	2	21	9	1
Recovering	13	4	0	0	0	0	0	0
Relict	17	11	7	0	0	0	0	0
Naturally Uncommon	45	9	0	5	52	236	80	146
Migrant	24	2	0	0	10	0	0	0
Vagrant	138	6	0	0	4	0	1	0
Coloniser	9	0	0	3	0	0	5	0
Not Threatened	38	13	0	12	113	16	296	1
Introduced and naturalised	37	1	3	20	0			
Grand Total	474	110	21	77	218	314	646	264

Table 10 continued

CATEGORY	GROUP, ASSESSMENT YEAR							
	BEETLES 2014	HEMIPTERA 2014	HYMENOPTERA 2014	LEPIDOPTERA 2014	ORTHOPTERA 2014	PLASMIDS 2014	LICE 2011	FLEAS 2014
Extinct	4	0	0	1	0	0	2	0
Data Deficient	52	67	118	46	19	1	3	3
Nationally Critical	35	9	2	23	2	1	4	0
Nationally Endangered	7	0	0	12	2	0	0	0
Nationally Vulnerable	3	0	0	29	3	0	9	1
Declining	6	0	0	13	1	0	1	2
Recovering	0	0	0	0	2	0	4	0
Relict	18	1	0	19	6	0	0	1
Naturally Uncommon	243	48	21	46	35	3	6	6
Migrant	0	0	0	0	0	0	0	0
Vagrant	0	0	1	0	0	0	0	0
Coloniser	0	0	0	0	0	0	0	0
Not Threatened	73	24	3	11	89	20	5	9
Introduced and naturalised	1		9	0	8	0	0	11
Grand Total	442	149	154	201	168	25	34	33

Table 10 continued

CATEGORY	GROUP, ASSESSMENT YEAR							
	MITES 2014	SPIDERS 2011	EARTHWORMS 2014	SNAILS 2014	NEMATODES 2011	ONYCOPHORA 2014	MINOR GROUPS 2011	TOTAL
Extinct	0	0	0	0	0	0	0	77
Data Deficient	5	538	105	197	51	11	3	4342
Nationally Critical	3	3	0	36	3	0	8	466
Nationally Endangered	3	1	0	39	0	0	0	209
Nationally Vulnerable	7	0	0	77	1	0	6	310
Declining	4	1	1	16	2	0	1	261
Recovering	3	0	0	0	1	0	0	34
Relict	4	7	0	23	0	0	1	130
Naturally Uncommon	2	147	31	179	0	3	2	2347
Migrant	0	0	0	0	0	0	0	44
Vagrant	1	1	0	0	10	0	0	200
Coloniser	0	0	0	0	0	0	0	34
Not Threatened	24	401	40	35	509	8	4	4284
Introduced and naturalised	83	39	2	0	136	0	0	363
Grand Total	139	1138	179	607	713	22	25	13101

8. Demographic response to management at a population level for selected Threatened and At Risk taxa

Measure 4.2.4:

Demographic response to management at a population level for selected taxa

Definition

Robust demographic data for intensively managed species, in terms of births, deaths and population size, are related to management effort and variability in factors responsible for declines. The data presented can constitute actual current trend or predicted population trend with and without management. This measure provides a report for three forest-dwelling species vulnerable to predation by stoats, rats and cats (*Felis catus*):

- The long-tailed bat (*Chalinolobus tuberculatus*), one of only two terrestrial mammals found in New Zealand.
- Kākāpō (*Strigops habroptila*), a flightless, ground-nesting parrot species.
- Kiwi (*Apteryx* spp.), a flightless, ground-nesting rail.

Methods

Three methods are described:

- Predicted population from a population model (long-tailed bats).
- Complete census of number of individuals (kākāpō).
- Distribution and chick survival for a managed population (kiwi).

LONG-TAILED BATS

Methods: Predation, particularly by introduced rats, has been identified as the major cause of decline of the Nationally Critical South Island long-tailed bat. The response of long-tailed bats to rat control in beech forest in the Eglinton Valley, Fiordland has been measured. This was done by estimating survival using mark-recapture field data from 1993 to 2015 in Program MARK. The survival of juvenile and adult female long-tailed bats, along with the proportion of females breeding, was recorded in three colonies each year and modelled using an age-classified population projection matrix. The effect of periodic predation by rats on long-term survival and population trends of bats was compared with bat-population response when rat population irruptions were managed. The intrinsic rate of increase, λ, was calculated for both management and no management scenarios and the results were projected over a 25-year scenario (Fig. 7). For a population to be stable or growing, management must result in λ being equal to or greater than 1. The confidence intervals were calculated using the variance of survival figures within each time period.

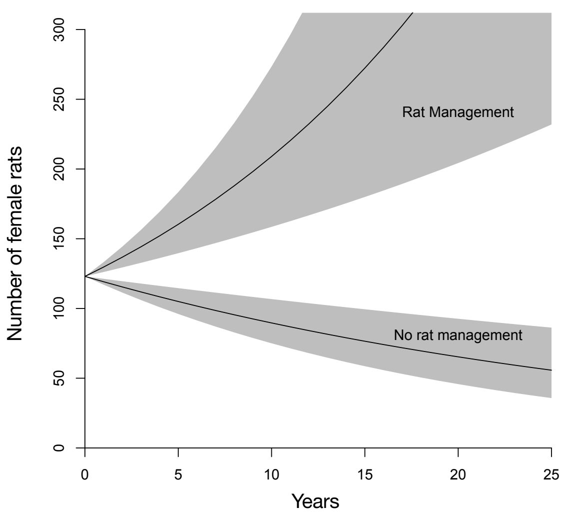

Figure 7. Predicted population trends in numbers of female long-tailed bats (*Chalinolobus tuberculatus*) in the Eglinton Valley over 25 years with and without management of rats (shaded areas represent 95% confidence intervals).

Results: The modelling was based on the current data of 10 years with low rat numbers, 5 years with medium rat numbers and 6 years with high rat numbers. The management of rats in the Eglinton Valley was instigated after a rat irruption was predicted in the 2006/07 summer following heavy (mast) seeding of beech. Three more mast events have occurred since

2007, with rats having been controlled. The intrinsic rate of increase for the time period with rat management is >1.0 (λ = 1.05), therefore the population increases (Fig. 7), whereas the rate of increase for the time period without rat management is <1.0 (λ = 0.99), causing the population to decline. These predicted trends are based on a start point of the 123 breeding adult females that were known to be alive in 2006.

Interpretation and implications: Numbers of introduced predators in temperate beech forests fluctuate dramatically in relation to food availability. The beech trees flower and seed heavily (mast) at irregular intervals, usually every 3–5 years, dramatically increasing the food supply for introduced rodents. Irruptions in mouse and rat numbers that follow then trigger the prolific breeding of stoats and increase the predation pressure on native fauna even further. Effective management of predator irruptions is essential for improving the long-term survival of threatened native species in these forests. Our data indicate that the management regime instituted in the Eglinton Valley is effective at reversing declines of long-tailed bats in the valley.

KĀKĀPŌ

Methods: Population estimates were carried out between 1974 and 1990. Since about 1990, the whole population has carried transmitters, so from 1990 on, the number of birds known to be alive is approximately equal to the total population size, so data collected represents the whole population.

Results: With the arrival of Europeans and their cats, rats and stoats in the mid to late 1800s, the rate of decline of kākāpō accelerated such that by the 1970s they were thought to be confined to remote parts of Fiordland where only a few male birds were known to survive. In 1977, a population of more than 100 birds was discovered on southern Stewart Island. Between 1977 and the late 1980s, these birds were transferred from Stewart Island, where they being eaten by cats, to islands that were mostly predator-free (Maud Island, Codfish Island / Whenua Hou) and Te Hauturu-o-Toi / Little Barrier Island). The rate of decline decreased, but the population still did not increase. In 1995, in response to this lack of increase, kākāpō management was intensified, and spending on research increased. Six new management techniques were developed: nests were monitored intensively; chicks that did not thrive were rescued and hand raised; rats were controlled around nests and eventually eliminated from the islands; breeding effort became predictable from the fruiting of forest trees; and birds were moved between islands to make the most of fruiting. By 2009, kākāpō management had become so successful that there were now more young birds than old ones and management moved to a new phase—recovery rather than rescue.

Interpretation and implications: The kākāpō is the world's largest parrot, the only flightless one and the only lek-breeding one. It is confined to New Zealand and its flightlessness, ground nesting and infrequent breeding have made it particularly vulnerable to hunting and introduced stoats, rats and cats. Kākāpō research and management is now focused on overcoming the bird's low fertility, which is thought to be a consequence of inbreeding and a bottlenecked population. Matings between kākāpō are planned and manipulated to maximise the genetic diversity of offspring, and artificial insemination has been developed and used also to minimise the loss of genetic diversity. No kākāpō breeding occurred in the 2014/15 financial year. No birds died, although an unknown age male which died in the 2013/14 year was discovered in the 2014/15 year. The population at the end of May 2015 was 126 individuals. (Fig. 8).

KIWI

Methods: Kiwi are distributed across the country in predominantly indigenous forest areas through Northland, Coromandel, Bay of Plenty, Taranaki and across the central North Island, particularly the Matemateonga, Kaweka and, Kaimanawa Ranges, into Te Urewera and the Raukumara Range. In the South Island, kiwi are found in Kahurangi National Park, the Paparoa Range, Arthurs Pass, small areas around Okarito and Haast, and through Fiordland and Stewart Island. They are also present on a few pest-free islands as well as in both DOC- and privately-

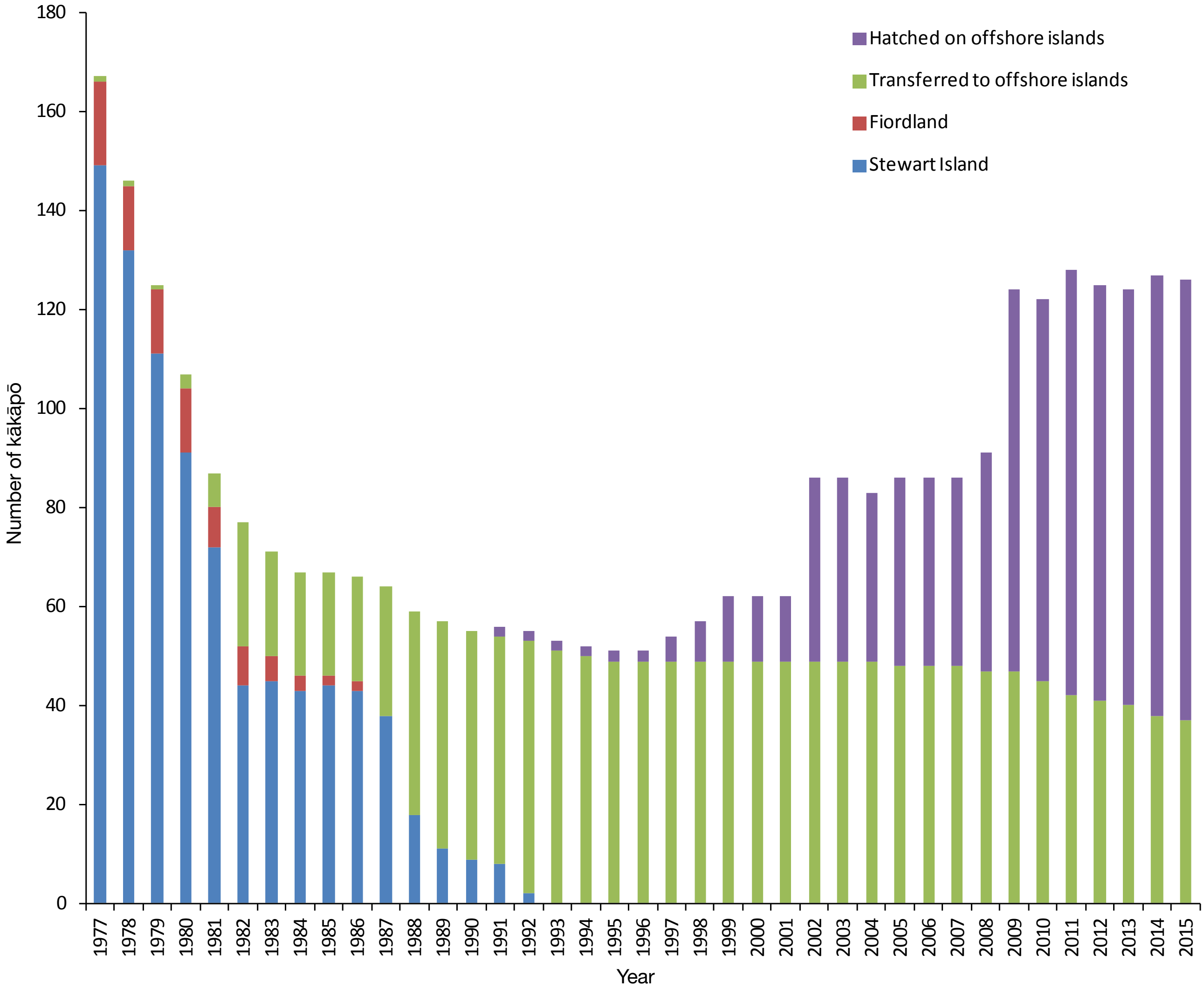

Figure 8. Total number of kākāpō.

run sanctuaries. Details of operations that are known to have benefited kiwi have been extracted from DOC's Operational Activities spatial files. These include any that target possums (via aerial application of 1080 baits), mustelids (stoats and ferrets), and cats and dogs (*Canus familiaris*), as well as those operations that specifically mention any of the kiwi species—including translocations. An unbiased sample of locations on public conservation land (Tier 1 programme) is used to detect presence/absence of kiwi using acoustic recorders. Kiwi have been detected at 83 of 408 stations in the 2011–14 monitoring seasons. Contributing to this in generating an indicative kiwi distribution, are positive records from the kiwi call counts programme between 1990 and 2015. These are collected as part of a national programme with two facets: a formal monitoring programme, where DOC staff and volunteers visit specific sites at specific times, annually in some Northland locations, and five-yearly elsewhere; and an informal monitoring programme, which is open to anyone who visits the backcountry and is able to distinguish kiwi calls from other nocturnal animals.

Results: Kiwi currently occupy approximately 6.5 million hectares of New Zealand's land area. This represents only 28% or 47% of the area previously occupied in pre-human or pre-European times, respectively. Of this, roughly 55% (3.6 million hectares) falls under DOC's purview (Fig. 9). Details of operations that are known to have benefited kiwi have been extracted from DOC's Operational Activities spatial files. These include any that target possums (via aerial application of 1080 baits), mustelids (stoats and ferrets), and cats and dogs (*Canus familiaris*), as well as those operations that specifically mention any of the kiwi species—including translocations.

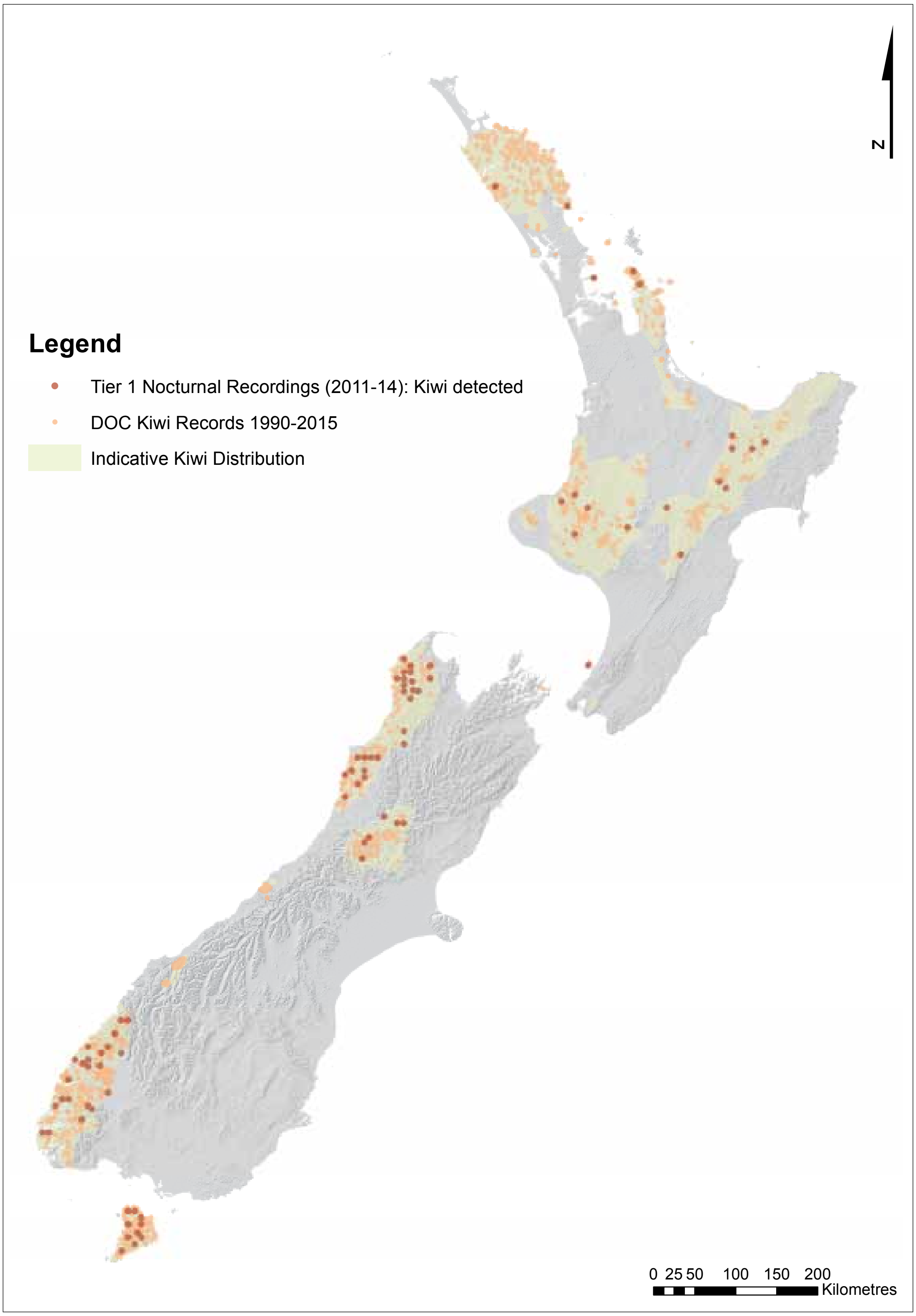

Figure 9. DOC kiwi sanctuaries and Kiwi distribution using expert mapping, call counts and detections derived from an unbiased sample across public conservation land.

Management that benefits kiwi occurs on just over 820,000 hectares or 22% of the 3.6 million hectares that kiwi occupy on land administered by DOC (Fig. 10).

Populations of kiwi are monitored within sanctuaries so the effects of management can be evaluated at these locations. Progress at DOC's Tongariro Sanctuary is reported below.

Stoats are a serious threat to kiwi, by killing the majority of kiwi chicks born in the wild. Landscape-scale predator control, either through trapping or aerial application of 1080 baits, is

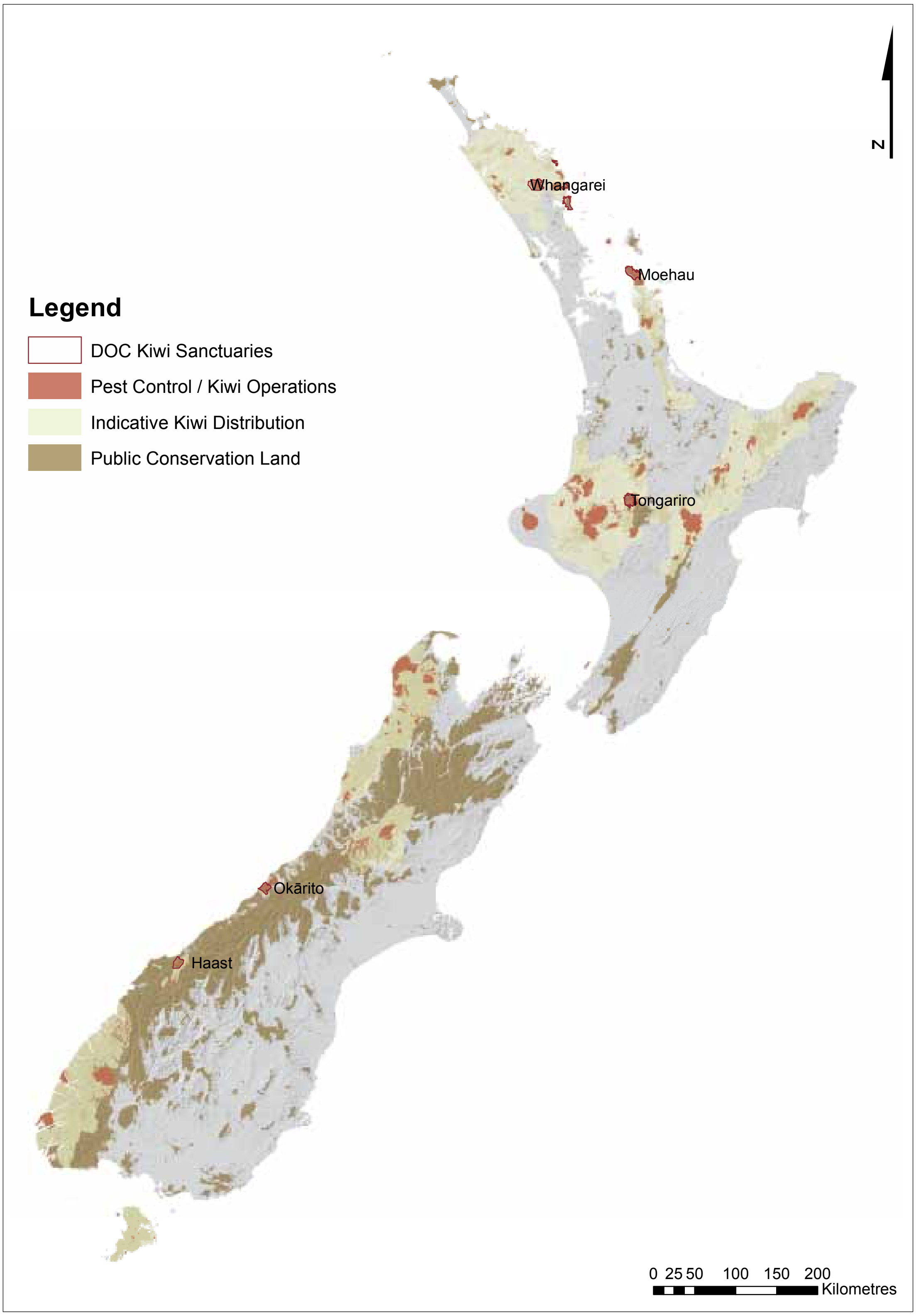

Figure 10. DOC Operations benefiting or aimed at kiwi on Public Conservation Land.

currently recognised as the most effective way of facilitating kiwi recovery in the wild. Since 2006, the benefits of aerial 1080 on survival rates of radio-tagged kiwi chicks has been measured in Tongariro Forest in the central North Island. This area is now being used to assess whether more-frequent operations with lower sowing rates still achieve improvements in kiwi numbers. In 2006, the sowing rate was 4 kg 1080/ha. In 2011, 2 kg/ha was applied. In the most recent operation (2014) the sowing rate was reduced to 0.75 kg/ha. Subadult and adult kiwi have also been monitored to determine survival in Tongariro Forest (Fig. 11) and this information, along with chick survival data, will be used to model the response of kiwi populations to aerial 1080 as a management tool.

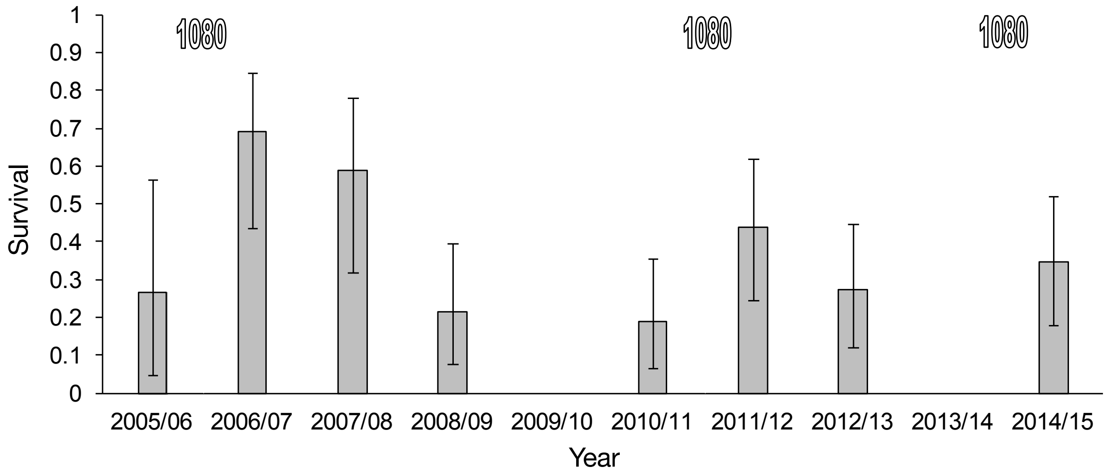

Figure 11. Survival of kiwi chicks in Tongariro Forest in relation to 1080 operations in 2006, 2011 and 2014. The nonparametric Kaplan-Meier procedure allows for survival rates of chicks to vary with age as they grow and become less vulnerable to predators over time.

Interpretation and implications: If the prehistoric density of kiwi was 1 per 10 ha, as has been estimated, there would have been about 2.3 million kiwi in New Zealand. By 2015, the national population of kiwi is estimated to be only about 67,500 birds, or 3% of their original number. As a result of conservation management, the four rarest taxa are now increasing, as are many populations of the other taxa being managed by community groups and by DOC; however, unmanaged populations of the four brown kiwi forms are likely to be declining by 3% per annum, and unmanaged tokoeka and great spotted kiwi by 2% per annum.

The use of aerial 1080 at Tongariro has resulted in an increase in chick survival, with some indication that the benefit extends to the second season after application. The amount of toxin applied also appears to influence the survival rate, with lower sowing rates resulting in smaller increases in survival rate. The current season of monitoring occurred during a major fruiting (mast) event, resulting in higher numbers of rats and stoats returning to the site more rapidly than in previous years. This may have contributed to the lower survival rates documented this season. The next aerial 1080 operation planned is for 2017 and will maintain the 0.75 kg/ha sowing rate. The information gathered from that operation will be used to model the kiwi population's response to aerial 1080 and provide recommendations for the frequency and sowing rate required to allow kiwi population recovery in the wild.

9. Management of priority ecosystems

Objective

Ecosystem representation and change in ecological integrity of managed ecosystems

Definition

This section relates spatial data describing the extent and composition of ecosystems (Measure 6.1.1) in prioritised management units to management effort. Data presented describe:

- Pressures acting on management units
- Whether those pressures are targeted by management intervention
- Reported area under management in priority ecosystem management units (Measures 2.2.1 Distribution and abundance of exotic weeds and pests considered a threat and 2.2.2 Indigenous systems released from exotic pests).

Ecological integrity of systems with given levels of management intervention is predicted using a deterministic model. This is similar to the aggregated index of pressure on PCL reported in the accompanying Landcare report of biodiversity indicators; but draws on local managers' estimates of pressure reduction rather than field measurement and a point-score approach with modelled interactions, to estimate overall state. Measures expected to relate to modelled ecological integrity include aspects of water quality (e.g. Measure 1.3.2 Water chemistry), ecosystem composition (e.g. Measure 5.1.1 Size-class structures of canopy dominants) and ecosystem function.

Methods

Ecosystem Management Units (EMUs) are places experts consider to be the best examples of each ecosystem class in New Zealand. 'Best' includes consideration of comprehensiveness and representativeness of the class, current condition and DOC's ability to manage those places. These were prioritised using the systematic conservation planning tool 'Zonation' (Moilanen et al. 2004–2012). The Department has a goal to manage the top 500 of these units to a high standard, achieving 'healthy and functioning' ecosystems.

The range of ecosystems represented in managed EMUs is described as hectares of ecosystem class. The ecosystem classifications used here are derived from Singers & Rogers (2014), Freshwater Ecosystems of New Zealand (Leathwick, et al. 2010) and an unpublished classification of lake ecosystems developed by Dave Kelly (Department of Conservation).

Change in ecological integrity (EI) was predicted based on the pressures (e.g. predators, weeds, adjoining landuses) that local staff indicated were present in each ecosystem; the potential impact of those pressures, if left unmanaged, on that type of ecosystem (estimated by experts using a four-point scale); and the level to which local staff estimate the pressures will be reduced over the 50-year term of a management prescription (if fully funded).

Three measures of management were compared:

- 'Full implementation' is full suite of management activity methods as described and planned in the complete site management prescription.
- 'Funded implementation' represents the activities that were allocated resources (staff time or operational expenditure) in each year's management prescriptions, assuming each activity covered all of the affected ecosystems in each management unit (and making allowance for activities that have inherent periodicity (e.g. cyclical pest control operations)).
- 'Actual implementation' is a measure of the area of each ecosystem type over which pressures were managed, derived from mapped actual operational activities[10].

Results

Numbers of EMUs receiving management have increased over the last 3 years. Implementation initially focussed on higher-ranked sites and EMUs which have not been implemented have lower rank (Table 12). However, in 2014/15, nearly 40% of sites where management began were ranked outside the top 500.

For areas some ecosystem types (alpine, cool forest) more land has received management than would be the case if only the top 500 EMU prescriptions had been fully implemented. Other ecosystem types (e.g. braided rivers, geothermal, and ultramafic) have smaller areas under management than was determined adequate for representation (Table 13). At the finer level of ecosystem classification, several types of mild forest, lake and warm forest ecosystems have less than 75% of the area that would be protected in the top 500 funded for management.

Progress towards implementing full ecosystem management has been limited. Generally, more pressures are present at EMUs than can be managed, but only a fraction of those identified as manageable have had funding allocated towards them (Table 14). While more EMUs have been implemented each year since 2012 there has been a pattern of implementing fewer pressures at each one (Fig. 12).

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[10] These data have two limitations: first, it is likely that reporting has been incomplete and second, only a subset of pressures used to predict change in EI are mapped. Those that are not included in Operational Activities mapping were assumed to have been managed across all of the affected ecosystems in each Management Unit.

Table 12. Number of terrestrial and freshwater Ecosystem Management Units implemented since 2012, mean rank of those units, and number in the Top500[11].

YEAR	EMUs IMPLEMENTED	MEAN RANK	NUMBER IN TOP 500
2012	149	221.1	137 (92%)
2013	49 (total 198)	272.8	42 (85%)
2014	285 (total 483)	399.0	171 (60%)
Not Started	328	474.8	140 (43%)

Table 13. Ecosystem representation in Top 500 ranked EMUs and managed ecosystems within EMUs in 2014/15.

ECOSYSTEM CLASS	Ha IN EMUs	Ha IN TOP 500 EMUs	Ha WITH MANAGEMENT FUNDED	PERCENTAGE	COUNT ECOSYSTEM TYPES < 75% PROTECTED
Alpine	808,034	288,218	547,843	190	1
Beech	610,876	176,812	490,868	278	0
Braided river	93,889	77,547	47,993	62	1
Broadleaved-dominant	31,902	26,586	27,822	105	0
Cliffs and screes	73,649	26,930	50,197	186	0
Conifer-broadleaved	373,176	206,336	299,713	145	2
Conifer-broadleaved-beech	362,301	179,687	280,291	156	1
Conifer-dominant	117,573	87,185	90,053	103	6
Dunes	27,768	19,910	21,259	107	1
Geothermal	1,520	1,074	383	36	2
Kauri	52,238	42,824	40,076	94	1
Lake	193,317	47,090	51,242	109	14
Non-forest below treeline	109,475	68,937	83,434	121	1
Saline	46,827	37,546	45,481	121	0
Temperature inversion	52,595	40,076	34,199	85	0
Ultramafic	27,956	22,026	19,024	86	3
Wetland	135,775	86,672	92,975	107	1

Table 14. Number of pressures[12] and management interventions as planned, funded and reported in implemented Ecosystem Management Units.

YEAR	MEDIAN PRESSURES PRESENT IN EMU	MEDIAN PRESSURES WITH PLANNED MANAGEMENT	MEDIAN PRESSURES WITH FUNDED MANAGEMENT	MEDIAN PRESSURES WITH REPORTED MANAGEMENT
2012/13	10	6	6	3
2013/14	9	6	4	1
2014/15	11	7	5	Not yet available

[11] Data extracted from DOCs Business Planning Database 26 March 2015. Rank calculated September 2013. EMUs which do not have ranks were excluded from the calculation of mean.

[12] Estimate of pressures managed is conservative, because in some cases a pressure will be reduced by a secondary effect of an activity targeting another pest. Generally, management prescriptions indicated every pressure 'covered by' an activity, but this was not recorded in 2012/13, and may not have been fully adopted in later years. In addition, a number of activities were allocated to unspecified or 'Other' pressures and these are not counted.

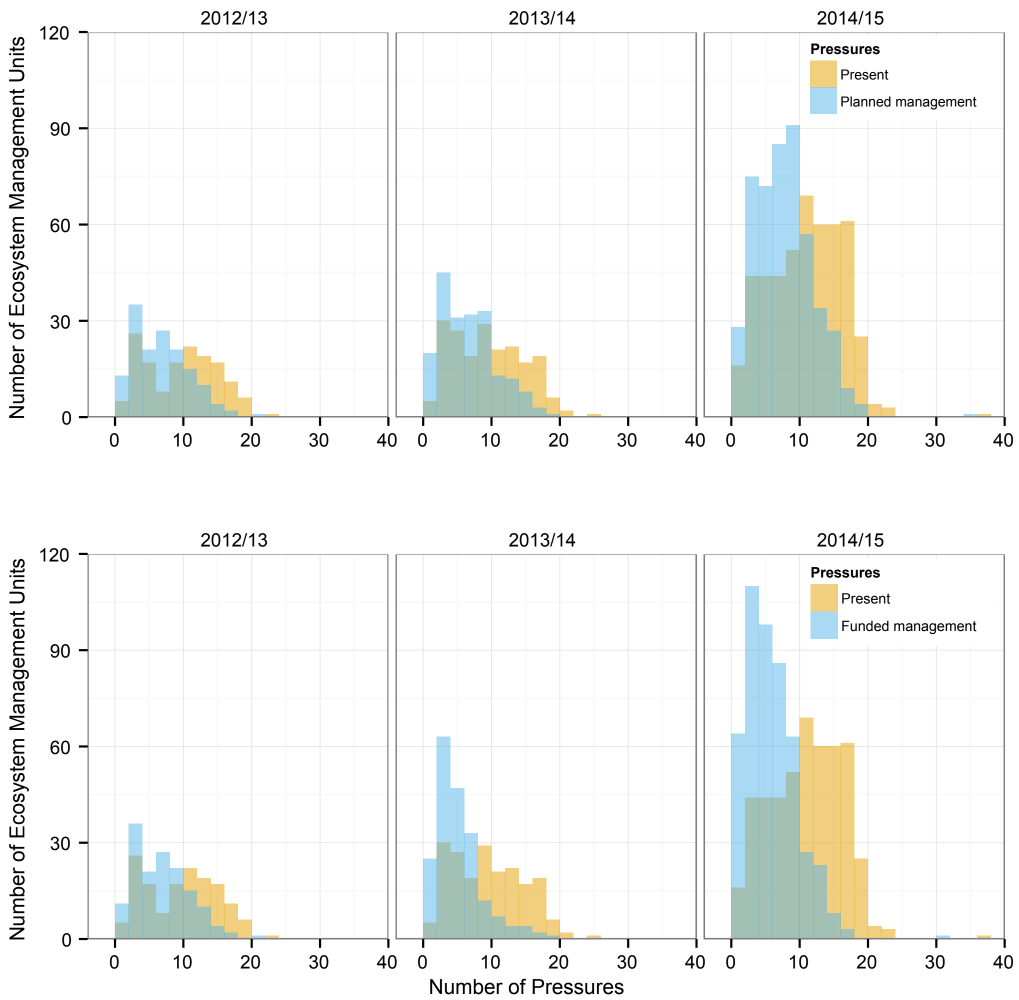

Figure 12. Number of pressures and management interventions in implemented Ecosystem Management Units planned (top) and funded (bottom) by year.

Incomplete implementation of prescriptions has resulted in lower gains in EI would be expected if management prescriptions were fully implemented. In addition, comparison of management for which funding was allocated versus reporting of actual management implemented indicates a gap in either implementation of work or its reporting (Table 15).

This difference is inconsistent across ecosystem types with kauri forests, geothermal, dune and wetland ecosystems showing a large difference between predicted outcomes of potential and funded management intervention (Fig. 13).

Interpretation and implications

Implementing management of the Top 500 ranked EMUs would conserve representative examples of all terrestrial, lake and wetland ecosystems and nearly all river types. However, management to date has tended to focus on ecosystems that are widespread, often occur on public conservation lands, and have a legacy of management in the recent past. Less management has been implemented in ecosystems that are naturally uncommon such as braided rivers, geothermal environments and temperature inversion / frost flats.

Information about progress towards implementing ecosystem management across a full range of ecosystems, and the estimated contribution of that management to restoring or maintaining ecological integrity will be presented to DOC's Planning Services Unit each year. This will help conservation planners and managers identify opportunities for management of under-represented ecosystem classes, including forming management partnerships for sites which are outside public conservation land.

Table 15. Predicted average change in EI (+/– 95% confidence interval) of planned, funded and reported management of EMUs by ecosystem class.

BROAD ECOSYSTEM CLASS	PLANNED MANAGEMENT OF 'IMPLEMENTED' EMUs (2014/15)	FUNDED MANAGEMENT OF 'IMPLEMENTED' EMUs (2014/15)	REPORTED MANAGEMENT OF EMUs (2013/14)
Alpine	0.25 +/- 0.03	0.15 +/- 0.02	0.06 +/- 0.03
Beech	0.35 +/- 0.03	0.21 +/- 0.03	0.08 +/- 0.05
Braided River	0.26 +/- 0.05	0.14 +/- 0.04	0.06 +/- 0.05
Broadleaved-dominant	0.5 +/- 0.05	0.32 +/- 0.06	0.12 +/- 0.07
Cliffs and Screes	0.27 +/- 0.06	0.20 +/- 0.05	0.09 +/- 0.06
Conifer-broadleaved	0.42 +/- 0.03	0.16 +/- 0.03	0.10 +/- 0.05
Conifer-broadleaved-beech	0.37 +/- 0.04	0.18 +/- 0.04	0.12 +/- 0.08
Conifer-dominant	0.38 +/- 0.03	0.22 +/- 0.04	0.05 +/- 0.04
Dunes	0.32 +/- 0.04	0.18 +/- 0.03	0.04 +/- 0.02
Geothermal	0.53 +/- 0.10	0.18 +/- 0.15	0.01 +/- 0.05
Kauri	0.35 +/- 0.06	0.14 +/- 0.04	0.07 +/- 0.09
Lake	0.08 +/- 0.02	0.06 +/- 0.01	0.03 +/- 0.02
Non-forest below treeline	0.33 +/- 0.03	0.20 +/- 0.03	0.07 +/- 0.04
Saline	0.32 +/- 0.03	0.22 +/- 0.04	0.06 +/- 0.03
Temperature Inversion	0.34 +/- 0.04	0.20 +/- 0.04	0.10 +/- 0.07
Ultramafic	0.19 +/- 0.08	0.16 +/- 0.07	0.00 +/- 0.01
Wetland	0.27 +/- 0.02	0.15 +/- 0.02	0.03 +/- 0.01

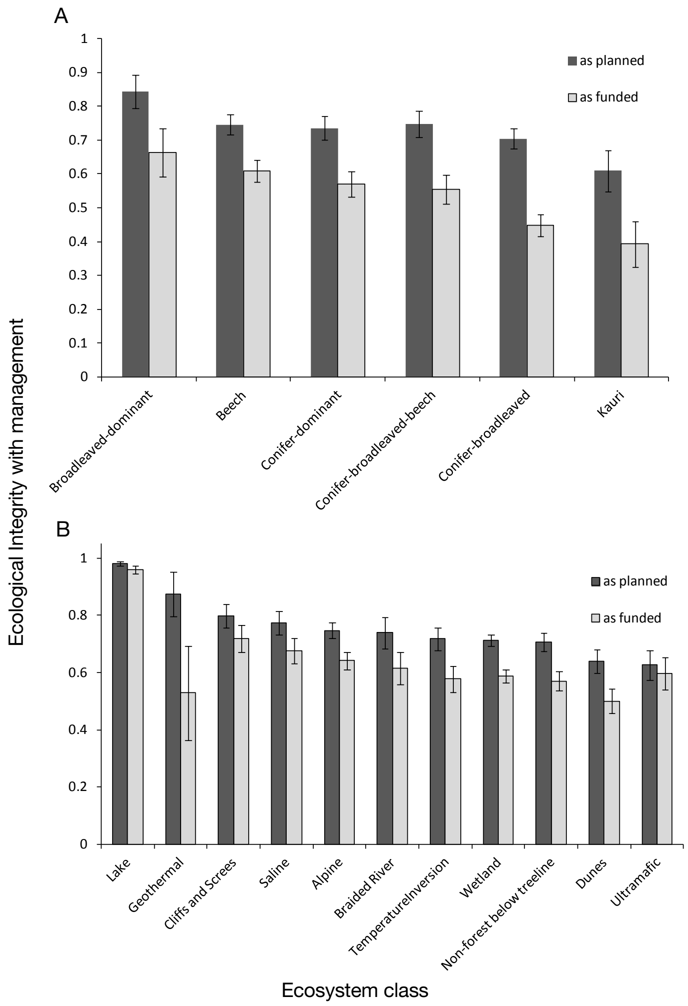

Figure 13. Difference in Predicted Ecological Integrity after management for implemented ecosystem management prescriptions as planned and funded in 2014/15. A. Forest, B. Non-forest.

In addition to data on the area of each ecosystem type managed, it is important to consider whether that management is sufficient to meet the goal of a 'healthy and functioning ecosystem' and to consider which pressures exist at sites but are not currently managed. This will contribute to annual management prescription review.

10. Change in extent and integrity of nationally uncommon, significantly reduced habitats/ecosystems that are protected

Measure 6.1.4

Proportion of threatened naturally uncommon ecosystems under protection

Definition

Naturally uncommon ecosystems, such as basaltic outcrops, coastal turfs, and geothermal ecosystems, frequently occur outside existing public conservation areas and represent a distinct set of environmental conditions often associated with rare and threatened endemic species. Seventy-two different types of naturally uncommon ecosystems have been identified in New Zealand (Williams et al. 2007), 45 of which are threatened (Holdaway et al. 2012). This measure assesses the proportion under formal protection for those 45 ecosystems considered threatened.

Methods

DOC and Landcare Research continue to collaborate to produce maps of the current extent of each of the 72 naturally uncommon ecosystems. Thirty-four ecosystems have maps at a final draft stage; of these, 23 represent threatened (i.e. critically endangered, endangered or vulnerable) ecosystems (Table 16)[13]. Land tenure and protection status were assessed as described above

Table 16. Threat status of 34 ecosystems with maps at a final draft stage.

CRITICALLY ENDANGERED	ENDANGERED	VULNERABLE	NOT THREATENED
Shell barrier beach (chenier plain)	Active sand dunes	Basic coastal cliffs	Granitic gravel fields and sand plains
Coastal turf	Shingle beaches	Young tephra (<500 years) plains and hill slopes	Ultrabasic cliffs, scarps and tors[a]
Old tephra plains (frost flats)	Calcareous coastal cliffs	Basic cliffs, scarps and tors[b]	Recent lava flows (<1000 years)
Hydrothermally altered ground	Volcanic dunes	Moraines	Ultrabasic hills
Inland saline (salt pans)	Ultrabasic sea cliffs	Calcareous cliffs, scarps and tors[c]	Ultrabasic screes and boulderfields
Seabird guano deposits	Sinkholes		Cliffs, scarps and tors of quartzose rocks[d]
Marine mammal haulouts	Domed bogs		Cliffs, scarps and tors of acidic rocks[e]
Strongly leached terraces and plains	Braided riverbeds		Coastal cliffs on quarzose rocks
Seabird burrowed soils	Sandstone erosion pavements		Coastal cliffs on acidic rocks
			Coastal rock stacks
			Acid rain systems

[a] Ultrabasic cliffs and scarps (linear features) are mapped separately from Ultrabasic tors (points)
[b] Basic cliffs and scarps (linear features) are mapped separately from Basic tors (points)
[c] Calcareous cliffs and scarps (linear features) are mapped separately from Calcareous tors (points)
[d] Cliffs and scarps (linear features) of quartzose rock are mapped separately from tors (points) of quartzose rock
[e] Cliffs and scarps (linear features) of acidic rock are mapped separately from tors (points) of acidic rock

[13] All maps are subject to ongoing checking and have not been ground- truthed. This may result in changes in extent reported when compared to previous years, this does not necessarily reflect a change in actual extent.

for wetlands. A critical caveat is that maps have been produced by use of pre-existing maps, modelling and interpretation of aerial imagery. These maps have not been ground-truthed or assessed in any way for accuracy. As such, the statistics presented here must be interpreted with caution.

The remaining 38 ecosystems yet to have draft maps prepared are at different stages of completion. They can be categorised into 5 groups: 2 are now part of a wider mapping project for wetlands, 24 are in progress, for 3 we are investigating a mosaic approach to resolve spatial and thematic resolution issues, 4 need to be drafted by experts on that ecosystem and for 5 the information base is currently too weak for them to be mapped.

Land tenure and protection status were assessed as described above in section 1.

Results

Five of the 23 mapped threatened ecosystems (shell barrier beaches, and hydrothermally altered ground (now cool), coastal turfs, volcanic dunes, and young tephra plains and hillslopes) have less than 20% of their total area protected as public conservation land or other formal protection; as such, they are a high priority for future protection efforts (Fig. 14). Of the 22 mapped threatened ecosystems that occur on public conservation land, 12 ecosystems (Iinland saline (salt pans), seabird guano deposits, strongly leached terraces and plains, old tephra plains (frost flats), shingle beaches, calcareous coastal cliffs, active sand dunes, sandstone erosion pavements, braided riverbeds, young tephra (< 500 years) plains and hill slopes, moraines, calcareous tors[14]) have more than 20% of this classed as 'Stewardship Land' (Fig. 15).

For some ecosystems these proportions are different than those reported in 2013/14. Examples include acid rain systems (the proportion of their total area that is under some form of protection has increased from 0% to 92%), seabird guano deposits (area under 'other formal protection has increased from 0% to 9%) and seabird burrowed soils (the proportion of their extent on PCL that is on classified conservation land versus stewardship land has increased from 73% to 99%. There are four reasons these proportions could change: a) the mapped extent of an ecosystem may have changed due to refinements of that spatial layer (Table 17); b) erroneous boundaries in the land tenure spatial layers may have been corrected (Fig. 14); c) formerly omitted protected areas may have been added land tenure spatial layer from which that information was sourced (Fig. 15); or d) a true change in land tenure or conservation classification status has occurred. The first three reasons reflect increased accuracy of the source data, whereas the last reason reflects true change in the indicator.

Given the minimal changes in mapped extents of the ecosystems since 2013/14 (Table 17), most of the observed changes over the past year are due to changes in accuracy of the land tenure

Table 17. Threat status of thirty-four ecosystems with maps at a final draft stage.

ECOSYSTEM	CHANGE (ha)
Sinkholes	+33.61
Shingle beaches	–10.78
Young tephra (<500 years) plains and hillslopes	–4.46
Inland saline (salt pans)	+1.89
Coastal rock stacks	–1.22
Active sand dunes	–0.51

[14] Calcarous tors (mapped as points) considered separately from calcareous cliffs and scarps (mapped as linear features)

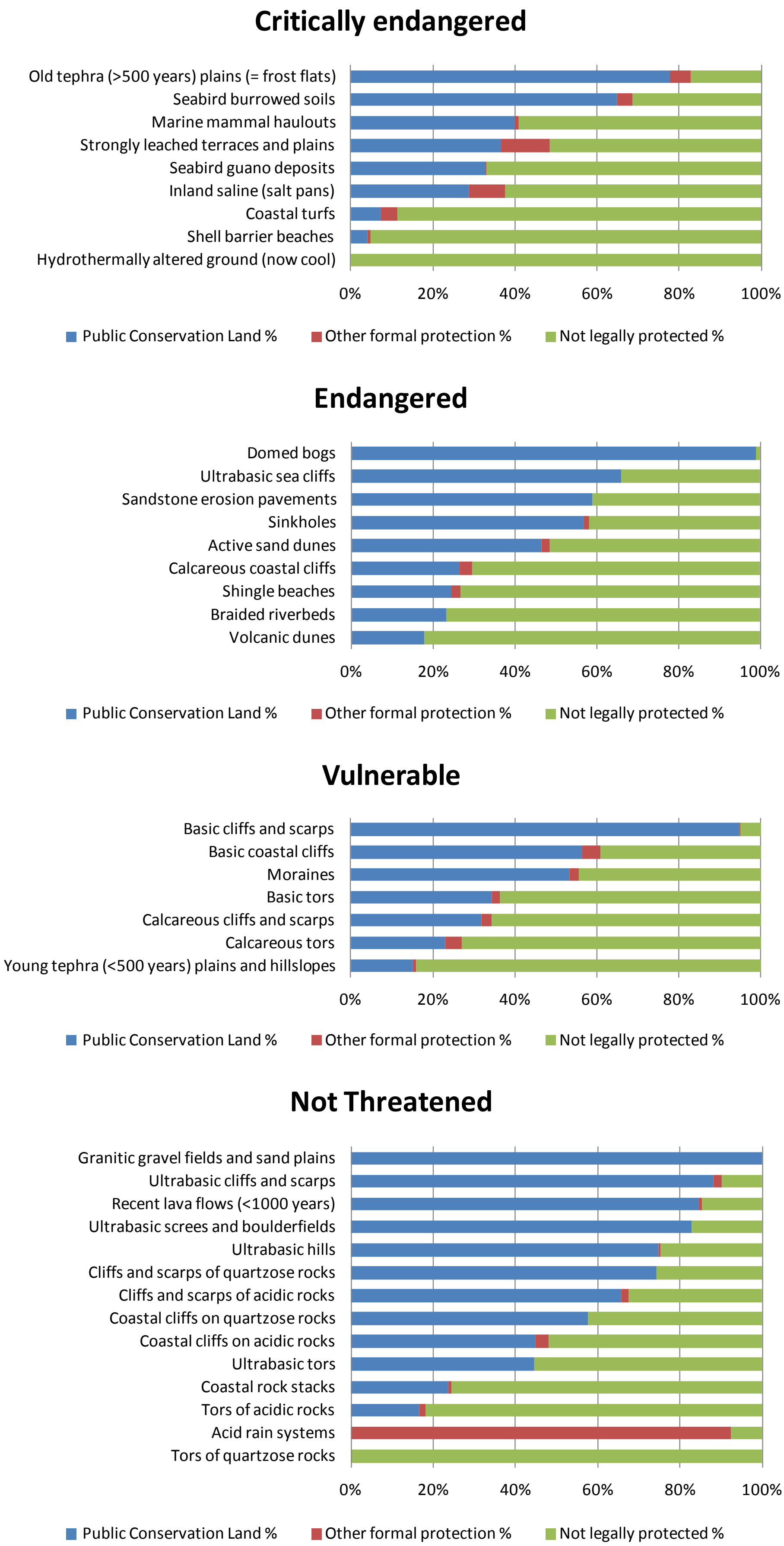

Figure 14. Proportion of the total extent of each of 33 mapped naturally uncommon ecosystems under different land tenures. Ecosystems are grouped by threat status. Note: 'coastal rock stacks' can be outside of New Zealand's cadastral extent. If this is the case they are classified in our reporting as 'not legally protected'.

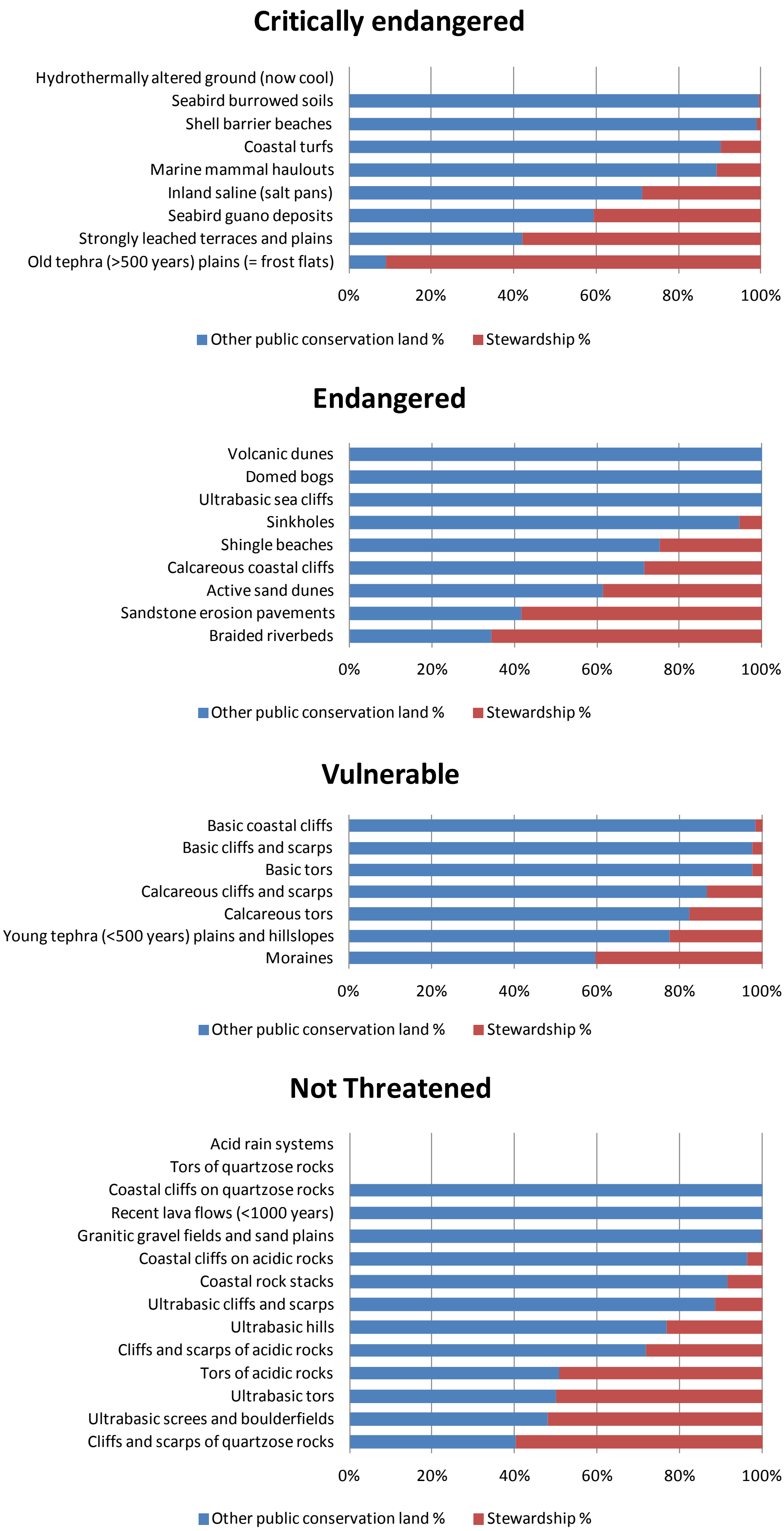

Figure 15. The proportion of the total extent on PCL of each of the 33 threatened naturally uncommon ecosystems as land classed as stewardship v. classified conservation land. Ecosystems are grouped by threat status.

spatial layers. When the mapped extents of the ecosystems are assessed by a wider group of experts and ground-truthing is undertaken, changes due to increased accuracy of these ecosystem spatial layers may result. The change in seabird burrowed soils is the one example above that represents true change and is a result of reclassification of stewardship land to establish the new Aotea Conservation Park on Great Barrier Island.

Interpretation and implications

Naturally uncommon ecosystems have been included in national conservation policy[15] and the recent application of the IUCN's Ecosystem Red-List criteria to these ecosystems now provides a rational basis to identify which ecosystems are the most threatened[16] and so inform conservation priority setting. Of the 45 threatened ecosystems, the five ecosystems that have so far been identified as having less than 20% of their total area under formal protection are of high priority verification by ground-truthing to underpin future protection efforts. The twelve threatened ecosystems having more than 20% of their total extent on public conservation land (classed as stewardship land) are a high priority for verification by ground-truthing and subsequent determination of their conservation status to a category that offers greater protection from development.

For each ecosystem type, the goal is to document the change in extent of the area that is protected. To document true change, however, it will be necessary to first partition out that component of calculated change that is due to the increased accuracy of underpinning layers.

Changes to the reported area have several explanations: They may result from the mapped extent increasing due to ongoing improvement (e.g. sinkholes). Other changes result from temporal changes in the GIS layers representing land tenure, either actual or corrections to earlier layer (e.g. boundary adjustments.) or erroneous omissions from the protected areas layer (e.g. in May 2015 some areas of stewardship land were missing from the PCL spatial layer). These areas were subsequently added so influencing the June 2015 calculations.

Measure 6.1.4

Proportion of significantly reduced habitats under protection

Definition

Active sand dunes are those dune lands whose physical landscape and ecological character results from continuously moving wind—blown sand or high rates of sediment supply from the beach face. In New Zealand, they are predominantly associated with coastal environments. As such, this report is restricted to coastal dunes. A recent assessment of the risk of ecosystem collapse listed active sand dunes as endangered on the basis of declines in area and function (Table 16).

Methods

Historically, the total area of sand dunes has been assessed at regular intervals and historical estimates of total extent were available for 1911, 1950, 1970s, 1980s and the 1990s. Current distribution data for active sand dunes were sourced from DOC, providing a mapped estimate of current (2008) extent. This current map was developed using a mix of existing data and recent remote imagery. The mapping is part of the collaborative project between DOC and Landcare Research to produce maps of the current extent of each naturally uncommon ecosystem more generally (details above). Land tenure and protection status were assessed as described above in section 1.

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15 MfE 2007. Protecting our Places: Information about the Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land. Ministry for the Environment and Department of Conservation, Wellington.

16 'Coastal rock stacks' can be outside of New Zealand's cadastral extent. If this is the case they are classified in our reporting as 'not legally protected'.

Results

In 1911, the national area of active coast dunes in New Zealand was estimated at around 129,740 ha (Cockayne 1911). In 1950, the area was 127 000 ha (Cockayne 1958), indicating very3little decline from 1911. By the 1990s, the distribution of active sand dunes had been reduced to 38,949 ha (Hilton et al. 2000) (Fig. 16). Taking 1995 as the average year of the 1990s' estimate, this equates to a 70% reduction over that 45-year period. A recent estimate obtained by overlaying current land cover maps (imagery from 2008) estimated the total extent of active sand dunes as 25,208 ha. This indicates a further reduction of 35% over the 13 years from approximately 1995 to 2008. Post-1950 declines in area were well fitted by an exponential decline model (Fig. 16). This model estimates a total decline over the last 50 years of 76%. Active sand dunes have 48% of their total area under PCL or some other form of protection (Fig. 14). Of that component of PCL, 39% is on lands classed as stewardship land (Fig. 15).

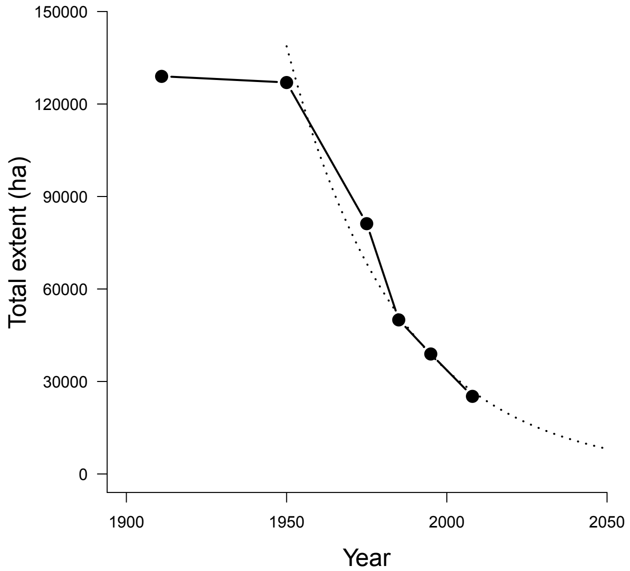

Figure 16. Area estimates of active sand dunes between 1900 and 2050 based on data from Hilton et al. 2000.

Interpretation and implications

Most remaining active dune systems are facing significant threats, particularly from invasive plant species, coastal development and projected sea-level rise. Despite some localised restoration projects, the threats facing active sand dunes are likely to continue in the future. Although increased protection would reduce some of the threats related to coastal development, declines in function/ecosystem health caused by weeds and resulting dune stabilisation are the main future threats. Successional processes instigated by invasive weeds stabilise dunes, effectively causing collapse of active dune systems, even if legal protection is in place. This is exacerbated by the lack of a balancing capacity for new active dunes to appear in currently stable areas, with many of those likely areas being highly developed built-up coastal settlements and other forms of private land. We therefore expect active sand dunes to continue declining at the current rate, which would lead to declines of 76% over the next 50 years.

11. Occurrence and intensity of mast flowering and fruit production

Measure 1.2.2

Mast flowering and fruit production

Definition

This measure records flowering and fruit production of selected species and sites throughout New Zealand.

Methods

The Department of Conservation conducts seedfall monitoring at 72 locations in a range of forest types across New Zealand (Fig. 17). Seed is collected at regular intervals from permanently located traps, counted by species and assessed for viability. The majority of seed is collected in South Island beech forest where the data is used to predict the likelihood of mast seeding: the cause of predator irruptions. Rodent and mustelid monitoring indices are monitored in parallel with seed collection to help inform management decisions on the need for pest control while contributing to our general understanding of the relationship between seedfall and small mammal abundance in a variety of forest types.

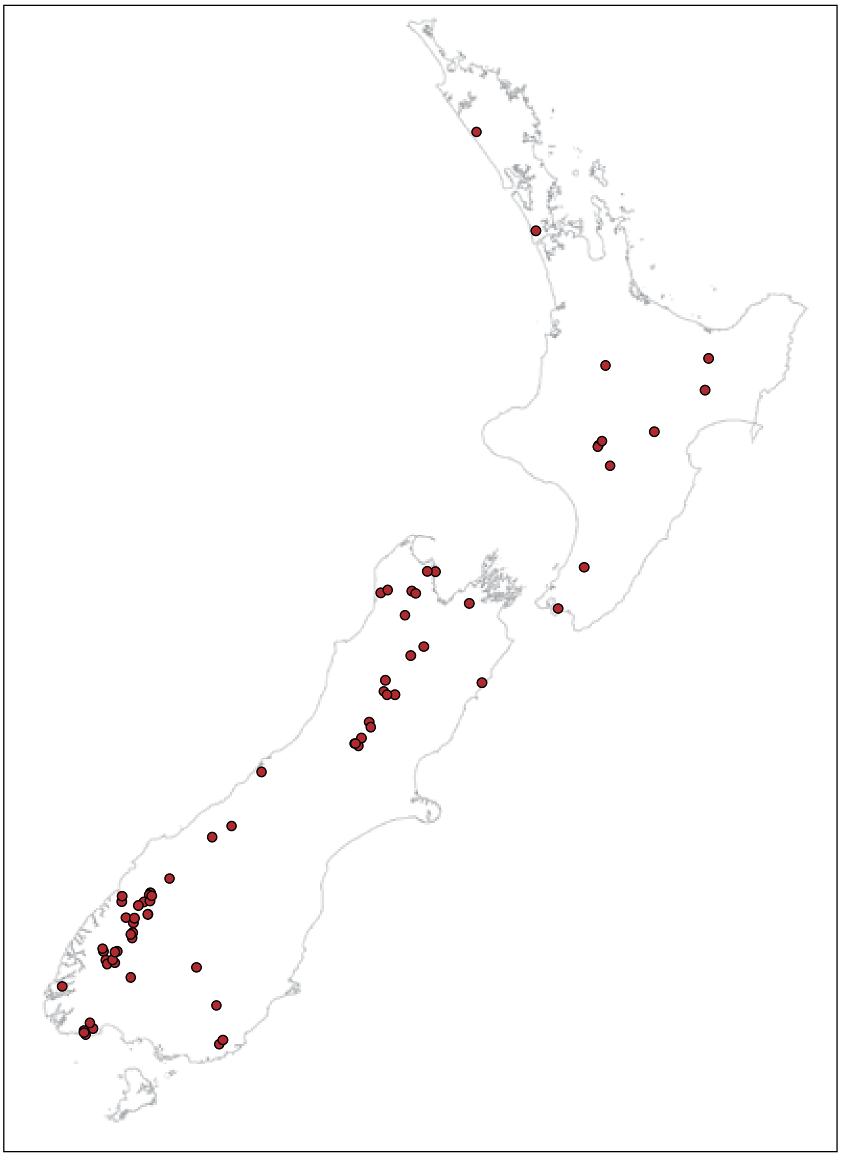

Figure 17. Seedfall monitoring locations.

Results

Mast seeding is the synchronous production of highly variable seed crops between years within a population of plants (Kelly 1994). Masting occurs within a number of New Zealand forest tree and tussock species. During autumn 2014, a very heavy mast occurred over much the South Island beech forests. Wardle (1984) considers a 'full' mast year as one producing more than 4000 seeds/m². Figures 18 and 19 show the relative intensity of beech seedfall at monitoring locations during the 2014 mast. Some sites recorded extremely high levels of seeding (e.g. Lewis Pass and the Catlins—13,000 seeds/m², Landsborough and Hawdon—10,000 seeds/m²); most produced between 2000 and 8000 seeds/m², while others in South Westland and western Fiordland, produced comparatively few seeds (e.g. Canham et al. 2014).

Interpretation and implications

Beech forest: Spatial and temporal variation in tree seed production is an important driver of population dynamics at the community-level (Monks 2007). High seedfall events provide a massive pulse of nutrients to seed consumers, resulting in a cascade of responses by native invertebrates, birds and introduced mammals. New Zealand beech (*Fuscospora* spp. and

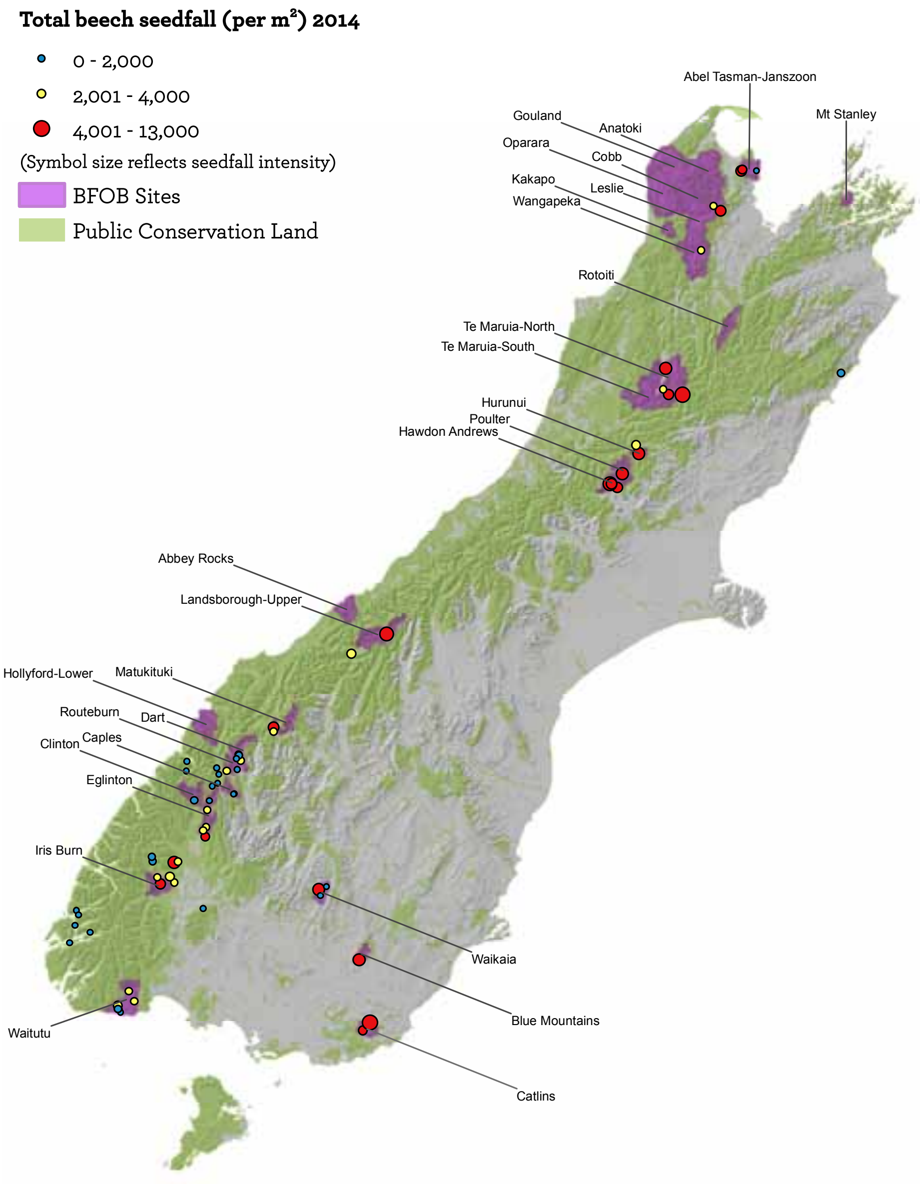

Figure 18: Relative intensity of beech seedfall during the 2014 mast at monitoring locations in South Island and location of Battle for our Birds sites.

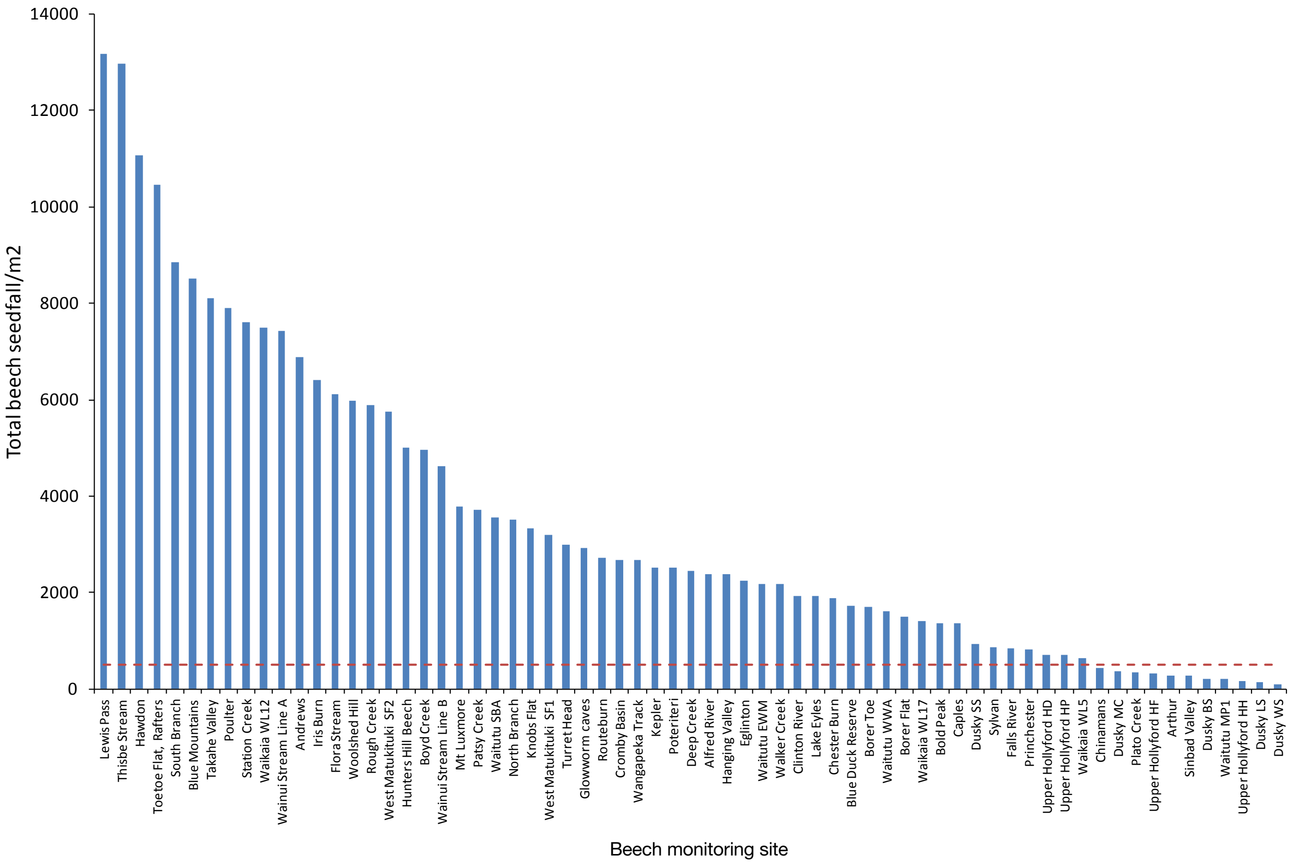

Figure 19. Relative intensity of beech mast seeding at South Island monitoring sites. The dashed constant line represents the lower trigger level of 500 seeds/m^2 for concern about predator impacts on vulnerable wildlife.

Lophozonia menziesii) trees drop most of their seed between February and May, creating an abundant food resource for rodents (rats and/or mice). Rodent populations can respond by growing exponentially (1.1–1.3% per day) throughout the year until early summer, by which time most seed has germinated. Stoats, which feed on rats and mice, respond in turn by increasing litter sizes and juvenile survivorship during the summer following seedfall. The resulting rat and stoat 'plagues' can have catastrophic effects on vulnerable native wildlife. For example, populations of mohua (*Mohoua ochrocephala*) went extinct at Mt Stokes, Marlborough (Gaze 2001) and came close to extinction in the Eglinton Valley, Fiordland (Dilks et al. 2003) during predator plagues in 1999/2000.

Biodiversity managers use seedfall intensity to identify triggers for concern about the impact of introduced predators on native species. Triggers range from 500 to 2000 seeds/m^2 depending on pest abundance at the time of seedfall and the vulnerability of native species present at the site. These triggers form the basis of decisions about the necessity for pest control.

In response to the 2014 beech mast, DOC identified 565,000 hectares of high priority South Island beech forest for treatment with aerial 1080 to control rats and stoats (Fig. 18). The objective of this 'Battle for Our Birds' (BfoB) is to avert predicted predator plagues, providing protection to native bird, bat and invertebrate species and opportunity for on-going maintenance and recovery of vulnerable populations. Results from these operations available to date are reported below.

Rat control: Figure 20 shows tunnel tracking index (TTI; a relative measure of abundance) of rats before and after 1080 operations at the 25 BfoB sites in which rats were present prior to control. Nineteen (76%) operations reduced rats to below 10% TTI; 15 (60%) reduced rats to 1% or less. Desired results were not achieved in 3 operations (TTI >20%), but still killed enough of the population to avert a biodiversity disaster (G. Elliot, DOC, pers. comm.). These results will be used to investigate factors influencing operational efficacy.

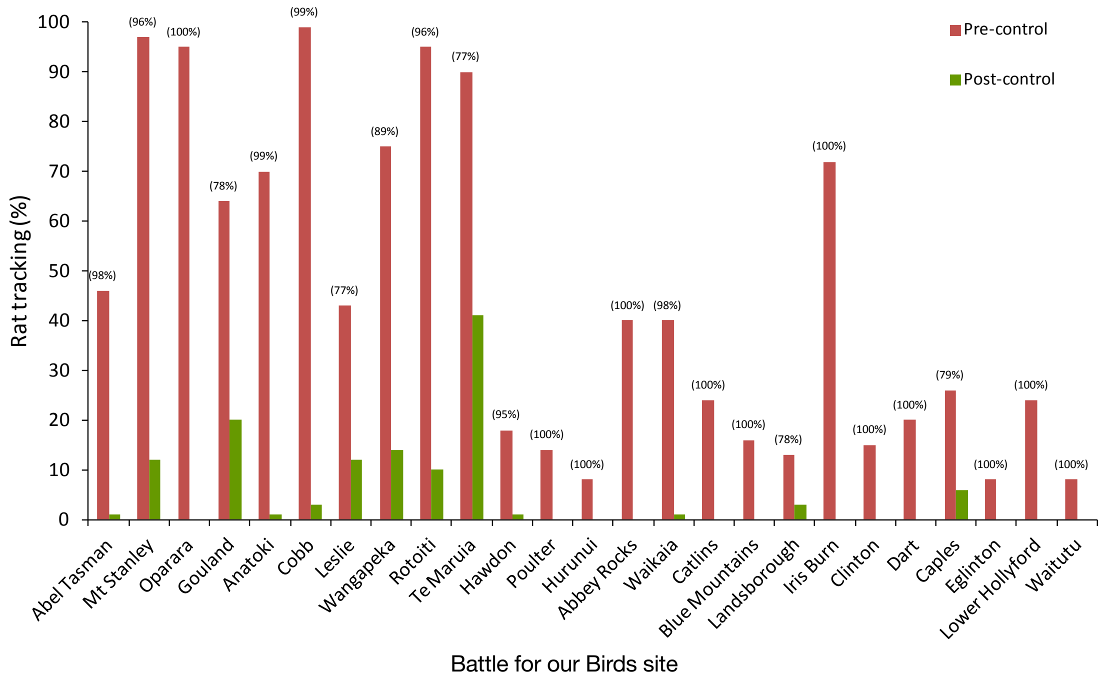

Figure 20. Pre- and post-control rat tracking rates at South Island Battle for our Birds sites. Values in parentheses indicate percentage of rat population killed.

Stoat control: At the time of preparing this report, results for post-control stoat tracking were available from 15 sites, 13 of which (87%) had tracking rates < 10%, 2 exceeded 10% (Catlins 17%, and Leslie 33%). Tracking rates can reach 100% during uncontrolled stoat plagues; therefore, at all sites so far analysed, plagues have been averted.

Outcome monitoring

At the time of preparing this report, preliminary results from post-control monitoring of the following threatened species were available:

South Island robin and rifleman (*Acanthisitta chloris*): Robin and rifleman nests were monitored before and after aerial 1080 operations at Mt Stanley in treatment and non-treatment areas. Table 18, which shows preliminary results, provides assurance that intervention at Mt Stanley has provided a high level of protection to vulnerable nesting bird species.

Mohua: Mohua nesting success and survival was monitored in association with the Dart and Routeburn BfoB operations. Mohua survival over summer following aerial 1080 was 92.6% and nesting success was close to 100%. This is considerably better than that expected during a predator plague; for example, 50% of nesting females and 67% of nests were destroyed by stoats in the Eglinton Valley following a beech mast in 1987 (Elliott 1996).

Table 18. Preliminary results from robin and rifleman monitoring at Mt Stanley before and after Battle for our Birds aerial 1080 control.

SPECIES	NUMBER OF NESTS MONITORED	NESTING SUCCESS IN NON-TREATMENT AREA (%)	NESTING SUCCESS IN TREATED AREA (%)	NUMBER OF INDIVIDUALS WHICH DIED DURING THE MONITORING PERIOD
Robin	62	6.5	50	0
Rifleman	15	28.9	100	0

Rock wren (*Xenicus gilviventris*): Nesting success of rock wren in treated areas of Kahurangi was 85% following pest control compared with 30% in nearby non-treatment areas. This is attributed to very low stoat abundance following 1080 operations.

A more complete picture of the biodiversity outcomes from BfoB operations will be available following monitoring of the 2015/16 breeding season, including results from monitoring of weka (*Gallirallus australis*), whio (*Hymenolaimus malacorhynchos*), kea (*Nestor notabilis*) and short- and long-tailed bats. These will be reported on next year.

Mixed-species forest: Mast seeding occurs in a variety of New Zealand tree species other than beech, including four species of podocarp (Beveridge 1973), perhaps most notably, rimu (*Dacrydium cupressinum*). A common component of lowland podocarp/broadleaf forest, rimu masts every 2–5 years, with little seed produced in intervening years (Norton & Kelly 1988). Following heavy masting in 2002, abundant rimu fruit (up to 2100 seeds/m^2) drove population irruptions of ship rats in Rakeahua Valley (Stewart Island/Rakiura) (Harper 2005) and mice in Waitutu Forest (Ruscoe et al. 2004). Rimu driven rodent irruptions have been implicated the decline and local extinction of several New Zealand forest bird species, including mohua, rifleman, kaka (*Nestor meridionalis*) and yellow-crowned parakeets (*Cyanoramphus auriceps*) (see Harper 2005).

Seedfall monitoring at Waitutu—an exmaple of masting in pododcarp/broadleaf forest: Waitutu Forest is situated in the southwest of the South Island. During 2002, seedfall monitoring was established on an uplifted marine terrace dominated by podocarp/broadleaf forest. Rimu and beech are common canopy species at this site. Tracking tunnels for monitoring small mammal abundance were established in association with seedfall traps in 2007. Since then, rimu has masted[17] three times: 2009, 2013 and 2014. In each year, mouse populations have erupted (Fig. 21).

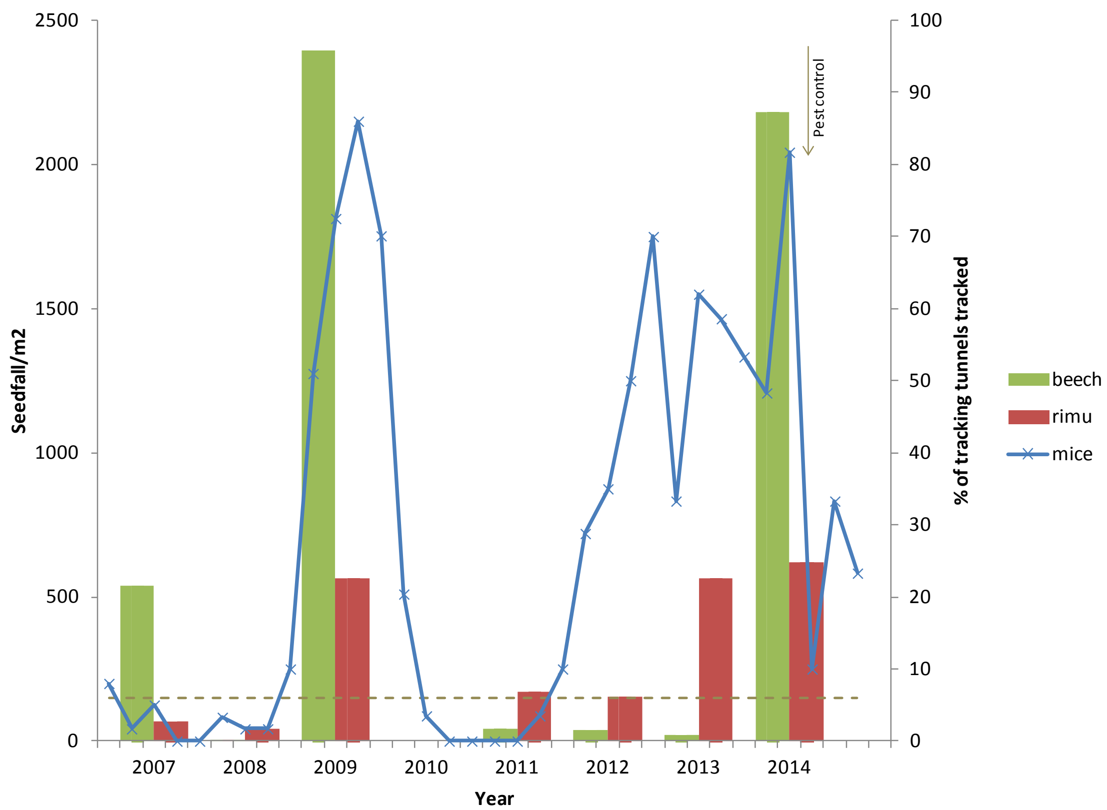

Figure 21. Rimu and total beech seedfall and mouse tracking rates at Waitutu forest. The dashed constant line represents the level of seedfall which defines a rimu mast year following Kelly (1988). (Seedfall data for 2010 is not available.)

[17] Following Norton & Kelly (1988), rimu mast years are defined as those with total seedfall exceeding 150 seeds/m^2.

While rimu and beech are both masting species, production of seed is not necessarily synchronous. During the rimu mast of 2013, beech produced very little seed, demonstrating how these species can independently drive pest irruptions. Asynchronous masting in mixed-species forests can therefore result in more frequent population booms of seed comsumers compared with forest where only beech or rimu is present. Consequently, vulnerable species may be subjected to a higher frequency of predation pressures. When masting does coincide, a super abundance of seed can be produced, with cascading effects on food webs and catastrophic implications for native wildlife.

In-situ monitoring of cone development on nearby Codfish Island / Whenua Hou indicates rimu is likely to mast in 2016 (D. Eason, DOC, pers. comm.). Seedfall and rodent abundances will be closely monitored at Waitutu to provide biodiversity managers with the necessary information to plan for pest control to avert mast seed driven predator plagues.

Expansion of seedfall monitoring: The seedfall monitoring network was expanded in 2014/15 to include locations in the Kaweka, Urewera and Southern Ruapehu ranges. In conjunction with rodent and forest bird monitoring, these sites complement existing monitoring in the Tararua Ranges and Orongorongo Valley to help determine the extent to which mast seeding drives predator irruptions in North Island forest types. This information is important for biodiversity managers advert further declines and extinctions of vulnerable species and strengthens our ability to develop predictive models of masting (e.g. Monks 2007).

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Appendix 1

Protected areas definition

Protected areas are defined as:

natis1.NATISADM.ADMINISTRATIVE_NAPALIS_ProtectedArea: PCL

(Vested = 'No' AND Control_Managed = 'No' AND Overlays = 'No' AND Private_Ownership = 'No') AND Section IN ('S25_STEWARDSHIP_AREA', 'S19_CONSERVATION_PARK', 'S24_3_FIXED_MARGINAL_STRIP', 'S23B_WILDLIFE_MANAGEMENT_AREA', 'S4_NATIONAL_PARK', 'S23A_AMENITY_AREA', 'S22_GOVERNMENT_PURPOSE_RESERVE', 'S18_HISTORIC_RESERVE', 'S23_LOCAL_PURPOSE_RESERVE', 'S20_NATURE_RESERVE', '17_RECREATION_RESERVE', 'S19_1_A_SCENIC_RESERVE', 'S19_1_B_SCENIC_RESERVE', 'S21_SCIENTIFIC_RESERVE', 'S2_WAITANGI_ENDOWMENT_FOREST', '20_WILDERNESS_AREA', 'S22_SANCTUARY_AREA', 'S21_ECOLOGICAL_AREA')

natis1.NATISADM.ADMINISTRATIVE_NAPALIS_ProtectedArea: PPL

(Vested = 'No' AND Control_Managed = 'No' AND Overlays = 'No' AND Private_Ownership = 'Yes') AND Section IN ('S25_STEWARDSHIP_AREA', 'S19_CONSERVATION_PARK', 'S24_3_FIXED_MARGINAL_STRIP', 'S23B_WILDLIFE_MANAGEMENT_AREA', 'S4_NATIONAL_PARK', 'S23A_AMENITY_AREA', 'S22_GOVERNMENT_PURPOSE_RESERVE', 'S18_HISTORIC_RESERVE', 'S23_LOCAL_PURPOSE_RESERVE', 'S20_NATURE_RESERVE', '17_RECREATION_RESERVE', 'S19_1_A_SCENIC_RESERVE', 'S19_1_B_SCENIC_RESERVE', 'S21_SCIENTIFIC_RESERVE', 'S2_WAITANGI_ENDOWMENT_FOREST', '20_WILDERNESS_AREA', 'S22_SANCTUARY_AREA', 'S21_ECOLOGICAL_AREA')

natis1.NATISADM.ADMINISTRATIVE_NAPALIS_CovenantArea

Type = 'PPL Agreement'natis2.NATISADM.ADMINISTRATIVE_NWR_Kawenata

natis2.NATISADM.ADMINISTRATIVE_QEII_Covenants

Appendix 2

Indigenous/modified definitions applied to Land Cover Database (LCDB) classes

LCDB CLASS	INDIGENOUS/MODIFIED?
Alpine Grass/Herbfield	Indigenous
Broadleaved Indigenous Hardwoods	Indigenous
Built-up Area (settlement)	Modified
Deciduous Hardwoods	Modified
Depleted Grassland	Indigenous
Estuarine Open Water	Indigenous
Exotic Forest	Modified
Fernland	Indigenous
Flaxland	Indigenous
Forest - Harvested	Modified
Gorse and/or Broom	Modified
Gravel or Rock	Indigenous
Herbaceous Freshwater Vegetation	Indigenous
Herbaceous Saline Vegetation	Indigenous
High Producing Exotic Grassland	Modified
Indigenous Forest	Indigenous
Lake or Pond	Indigenous
Landslide	Indigenous
Low Producing Grassland	Modified
Mangrove	Indigenous
Manuka and/or Kanuka	Indigenous
Matagouri or Grey Scrub	Indigenous
Mixed Exotic Shrubland	Modified
Orchard, Vineyard or Other Perennial Crop	Modified
Permanent Snow and Ice	Indigenous
River	Indigenous
Sand or Gravel	Indigenous
Short-rotation Cropland	Modified
Sub Alpine Shrubland	Indigenous
Surface Mine or Dump	Modified
Tall Tussock Grassland	Indigenous