Department of Conservation biodiversity indicators: 2014 assessment—supplementary material

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Department of Conservation
Te Papa Atawhai

Cover: Lake Crucible. *Photo: John Leathwick.*

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 2014. It provides more detailed information on a subset of DOC's biodiversity indicators which are not covered in the Landcare Research report *Department of Conservation biodiversity indicators: 2014 assessment*[1] Both reports are summarised in DOC's Annual Report for 2013/14.

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

Summary information on biodiversity indicators

Table 1 lists each indicator (by number) and describes where more detailed information about them can be obtained.

Table 1. List of biodiversity indicators and where more information about them can be obtained.

INDICATOR	LOCATION OF INFORMATION
1. % of environmental unit under indigenous vegetation and protected.	Refer to this report for a general overview at LENZ 20 group level updated using protection data from June 2014 and more recent analyses at LENZ 500 group level.
2. % of environmental unit in marine protected areas .	Refer to this report.
3. % of environment in freshwater ecosystems and protected.	Refer to this report.
4. Size-class structure of canopy dominants.	Refer to Landcare Research report.
5. Representation of plant functional types.	Refer to Landcare Research report.
6. Demography of widespread animal species.	This indicator contributes to the Landcare Research analysis on the status of New Zealand's biodiversity with a current focus on bird communities. This report provides a case study on South Island robins updated using data collected this past year.
7. Representation of animal guilds.	This indicator is not being reported in 2014 The first report on the measure will be made in 2015/16 and annually thereafter.
8. Extent of potential range occupied by focal taxa.	This indicator is being reported for the first time as a case study for selected taxa in freshwater ecosuystems.
9. Number of extinctions.	This will be updated as part of the three-yearly reporting cycle in the 2014/15 report.
10. Number of 'threatened' and 'at risk' species.	Updated for freshwater species. A full report as part of the three-yearly reporting cycle will be available in 2014/15.
11. Demographic response to management at a population level for selected 'threatened' and 'at risk' taxa.	Refer to this report.
12. Number, extent and control of fire.	Refer to this report.
13. Change in extent and integrity of nationally uncommon, significantly reduced habitats/ ecosystems that are protected.	Refer to this report.
14. Occurrence and intensity of mast flowering and fruit production.	Refer to this report.
15. Distribution and abundance of exotic weeds and animal pests considered a threat.	Refer to Landcare Research report report and case study for a freshwater ecosystem later in this report.

[1] 'DOC biodiversity indicators: 2013 assessment' by Landcare Research http://www.doc.govt.nz/about-doc/role/corporate-publications/annual-reports-archive/annual-report-for-year-ended-30-june-2012/

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[2]

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. The percentage of LENZ environments under indigenous vegetation and legally protected was evaluated using the national Landcover Database (LCDB) v3.3 categorised by indigenous versus modified vegetation for New Zealand as a whole. The data presented use Landcover information from 2008. This information will be updated once LCDB4 becomes available. We are using the LENZ database, developed by Landcare Research and managed by the Ministry for the Environment. DOC previously used it at Level 1 scale to identify 20 types of 'Environment' across New Zealand—places that are grouped together because they are more similar to each other environmentally than they are to other places. 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 calculated in June 2014.

The landcover categorisation into native versus modified vegetation can be found in the DOC spreadsheet LCDB LENZ L1 Protected Summary (DOCDM-1023236). These data were updated in August 2013 to LCDB v3.3. The threat categories for Environment types relate to the percentage of environments legally protected and/or the per cent 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 2008 by environment and legal protection as calculated in June 2014. As previously reported, the data show no marked difference in indigenous cover at the LENZ level 1 group. As of 2008, 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 due to the way in which any acquisitions are proportionally very small in relation to the large scale of LENZ Level 1. With the release of LCDB4 (based on 2012 imagery) in the next year, there may be some more noticeable 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, these results are consistent to those found by

[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.

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

* 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 2001	THREAT CLASSIFICATION 2008	CHANGE FROM 2001–2008	TOTAL AREA OF EACH LENZ LEVEL 4 CLASSIFICATION (ha) ACROSS ALL NEW ZEALAND, EXCLUDING OFFSHORE ISLANDS	PROPORTION PROTECTED (%)	PROPORTION INDIGENOUS IN 2008 AND PROTECTED (%)
B1.1c	Chronically Threatened	Acutely Threatened	Decline	6,290.09	0.86	0.81
B1.3a	Chronically Threatened	Acutely Threatened	Decline	38,940.55	0.63	0.49
B3.1a	Chronically Threatened	Acutely Threatened	Decline	55,637.37	1.84	0.95
B3.1c	Chronically Threatened	Acutely Threatened	Decline	19,649.12	0.72	0.64
B9.1b	Acutely Threatened	Chronically Threatened	Improvement	6,314.83	2.29	0.52
H1.2d	At Risk	Critically Underprotected	Improvement	1,759.06	3.26	1.28
J2.1d*	Chronically Threatened	Acutely Threatened	Decline	3,202.43	5.63	3.91
N3.1e	Chronically Threatened	Acutely Threatened	Decline	104,568.57	1.95	1.56

* Figures for J2.1d differ markedly from last year's due to the way in which the Protected Areas were calculated. This was due to a shift from the Conservation Units based areas to the new National Property and Land Information System (NaPALIS) based areas which inadvertently included Vested areas in the Protected Areas calculation last year. The inclusion of B3.1a, B9.1b and N3.1e this year is due to the use of the updated Land Cover Database v3.3 containing boundary readjustment and minor class rectifications, these changes have pushed these areas over the required threat classification threshold

Landcare Research in their recent publication[3]. Six of these environments had declined in their threat classification status from 2001 to 2008 and two environments had improved. See DOCDM-1259179 for a complete listing of all environments and their status.

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 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 protected areas

Measures

Percentage of environmental unit in marine protected areas.

Definition

The area of marine reserves and marine mammal sanctuaries.

Methods

All data (marine reserve name, date and legal area) are taken directly from the relevant Order in Council. Please note that areas may not be completely accurate and may differ from other reported figures, particularly those calculated using GIS.

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 2014, and Table 5 lists marine mammal sanctuaries gazetted at that date. Table 6 collates the total marine area managed by DOC.

Approximately 9.5%, or 1.7 million hectares, of New Zealand's Territorial Sea is protected within marine reserves. About 9.3% of this is protecting New Zealand's ecologically important offshore islands (0.2% of mainland New Zealand's Territorial Sea is within marine reserves). In 2014, the Subantarctic Islands Marine Reserves Act was enacted and established new marine reserves around three of New Zealand's subantarctic islands. These new marine reserves, around Campbell Island / Motu Ihupuku, the Bounty Islands and Antipodes Island, totalled over 435,000 hectares. In June 2014, Akaroa Harbour Marine Reserve was established, with an area of 512.15 hectares. Applications for five new marine reserves on the South Island's West Coast received concurrence from the Minister for Primary Industries in 2014 and are currently being implemented.

Interpretation and implications:

Currently, New Zealand has 38 marine reserves. The oldest marine reserve was established at Leigh in 1975. About 12% of the Territorial Sea is protected in marine protected areas (= marine reserves plus other types of marine protected areas) but no marine protected areas exist beyond the Territorial Sea, in the EEZ. While substantial legal protection is provided through marine reserves for the Kermadec and Subantarctic islands, 12 of New Zealand's 14 coastal marine

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[3] Cieraad, E.; Walker, S.; Barringer, J.; Price, R. 2013. Indigenous cover remaining and biodiversity protection in New Zealand's land environments: an update using LCDB3 and current information on protected areas. Landcare Research Contract Report LC1380.

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]	PERCENTAGE OF BIOGEOGRAPHIC REGION IN MARINE RESERVES[d]
Substantial representation			
Kermadec Islands	7,179	7480.00	100
Subantarctic Islands	11,936	9331.63	78.18
Less than 1% representation			
East Coast North Island	11,637	28.98	0.25
East Coast South Island	11,288	7.27	0.06
Fiordland	10,241	102.98	1.01
North Cook Strait	13,671	30.22	0.22
Northeastern	38,073	89.25	0.23
South Cook Strait	12,241	38.93	0.32
Southern South Island	20,986	10.75	0.05
West Coast North Island	14589	32.48	0.22
Chatham Islands	12,318	0	0.00
Three Kings	2,226	0	0.00
Snares Islands	2,154	0	0.00
West Coast South Island	13,158	0	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 2012 Tier 1 Statistic for Marine Protected Areas, with the addition of the three new marine reserves recently implemented in the Subantarctic Biogeographic Region.

[d] Rounded to two decimal places.

Table 4. New Zealand marine reserves as at 30 June 2014 (38 marine reserves).

IDENTIFIER	MARINE RESERVE NAME	DATE ESTABLISHED	LEGAL AREA (ha*)	PROPORTION OF NZTS (%)
MR1	Cape Rodney-Okakari Point Marine Reserve	1975	547	0.003
MR2	Poor Knights Islands Marine Reserve	1981	2,410	0.013
MR3	Kermadec Islands Marine Reserve	1990	748,000	4.128
MR4	Kapiti Island Marine Reserve	1992	2,167	0.012
MR5	Whanganui A Hei (Cathedral Cove) Marine Reserve	1992	840	0.005
MR6	Tuhua (Mayor Island) Marine Reserve	1992	1,060	0.006
MR7	Long Island–Kokomohua Marine Reserve	1993	619	0.003
MR8	Te Awaatu Channel (The Gut) Marine Reserve	1993	93	0.001
MR9	Piopiotahi (Milford Sound) Marine Reserve	1993	690	0.004
MR10	Tonga Island Marine Reserve	1993	1,835	0.010
MR11	Westhaven (Te Tai Tapu) Marine Reserve	1994	536	0.003
MR12	Long Bay-Okura Marine Reserve	1995	980	0.005
MR13	Motu Manawa-Pollen Island Marine Reserve	1995	500	0.003
MR14	Te Angiangi Marine Reserve	1997	446	0.002
MR15	Pohatu Marine Reserve	1999	215	0.001
MR16	Te Tapuwae o Rongokako Marine Reserve	1999	2,452	0.014
MR17	Auckland Islands (Motu Maha) Marine Reserve	2003	498,000	2.748
MR18	Ulva Island - Te Wharawhara Marine Reserve	2004	1,075	0.006
MR19	Te Hapua (Sutherland Sound) Marine Reserve	2005	449	0.002

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Table 4 continued from previous page

IDENTIFIER	MARINE RESERVE NAME	DATE ESTABLISHED	LEGAL AREA (ha*)	PROPORTION OF NZTS (%)
MR20	Hawea (Clio Rocks) Marine Reserve	2005	411	0.002
MR21	Kahukura (Gold Arm) Marine Reserve	2005	464	0.003
MR22	Kutu Parera (Gaer Arm) Marine Reserve	2005	433	0.002
MR23	Taipari Roa (Elizabeth Island) Marine Reserve	2005	613	0.003
MR24	Moana Uta (Wet Jacket Arm) Marine Reserve	2005	2,007	0.011
MR25	Taumoana (Five Finger Peninsula) Marine Reserve	2005	1,466	0.008
MR26	Te Tapuwae o Hua (Long Sound) Marine Reserve	2005	3,672	0.020
MR27	Te Matuku Marine Reserve	2005	690	0.004
MR28	Horoirangi Marine Reserve	2006	904	0.005
MR29	Parininihi Marine Reserve	2006	1,844	0.010
MR30	Te Paepae o Aotea (Volkner Rocks) Marine Reserve	2006	1,267	0.007
MR31	Whangarei Harbour Marine Reserve	2006	237	0.001
MR32	Tapuae Marine Reserve	2008	1,404	0.008
MR33	Taputeranga Marine Reserve	2008	855	0.005
MR34	Tāwharanui Marine Reserve	2011	394	0.002
MR35	Moutere / Antipodes Island Marine Reserve	2014	217,286	1.199
MR36	Moutere Hauriri / Bounty Islands Marine Reserve	2014	104,625	0.577
MR37	Moutere Ihupuku / Campbell Island Marine Reserve	2014	113,250	0.625
MR38	Akaroa Marine Reserve	2014	512	0.003
Total			**1,715,249**	**9.466**

* Note: All figures are rounded to the closest zero, including the total.

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

MARINE MAMMAL SANCTUARY NAME	DATE GAZETTED	LEGAL (CONSERVATION UNIT) AREA (ha)*
1 Banks Peninsula Marine Mammal Sanctuary	1988	407,696
2 Auckland Islands Marine Mammal Sanctuary	1993	505,710
3 Te Waewae Bay Marine Mammal Sanctuary	2008	34,884
4 Catlins Coast Marine Mammal Sanctuary	2008	65,388
5 Clifford and Cloudy Bay Marine Mammal Sanctuary	2008	138,600
6 West Coast North Island Marine Mammal Sanctuary	2008	1,193,542
Total area		**2,345,820**

* These data are derived from the legal area of each marine mammal sanctuary (DOC Conservation Units), which likely differs from area calculated using GIS, due to aspects such as differing projection.

For the Auckland Islands Marine Mammal Sanctuary, the Conservation Unit area included the area of the islands themselves and so for this Sanctuary the area of the GIS shape area has been provided. This explains the discrepancy between the area 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 (APPROXINATE)	CHANGE SINCE LAST ANNUAL REPORT
Marine reserves	Total area	1.7 million ha	Increase of 435,675 hectares
	Percentage of Territorial Sea	9.5%	Increase of 2.4%
	Percentage of marine area	0.4%	Increase of 0.1%
Marine mammal sanctuaries	Total area	2.4 million ha	No change
	Percentage of Territorial Sea	12.9%	No change
	Percentage of marine area	0.6%	No change

biogeographic regions remain significantly underrepresented, with less than one percent of the majority of these being protected within marine reserves. In addition, the full range of our marine habitats are not yet represented in marine reserves. As such, these regions remain a high priority for the implementation of marine protected areas. The recently initiated marine protected area planning process for Otago, along with recently approved marine protected area proposals for the West Coast South Island, will help with addressing these gaps.

3. Percentage of environmental unit in freshwater ecosystems and protected areas

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[4] 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. For wetlands, protection levels were summarised for different wetland types. We used the NATIS GIS database to access most recent (c. 2013) 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. For interpretation, the percentage of wetlands in protected areas were reported relative to their current extent and historic (pre-human arrival to New Zealand) extent. We also separated Stewardship Land from other types of PCL. Please note that some of the data may differ slightly from other reported figures, particularly those calculated using GIS.

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. Stewardship Land accounts for a significant amount of freshwater ecosystem protection. For example, Stewardship Land covers 18,300 ha of lakes and over 33,400 km of rivers.

Figure 2 reports on the percentage of different wetland types in protected areas. The marsh, fen and swamp wetland types have lower levels of protection across New Zealand. Relative to the historic extent of wetlands, marsh (3%) and swamp (3%) wetland types have the lowest proportion in protected areas, and bogs (20%) the highest. The higher percentage for bogs is partly due to the contribution of few large wetlands, such as the Kopuatai peat dome.

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 wetland ecosystems

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

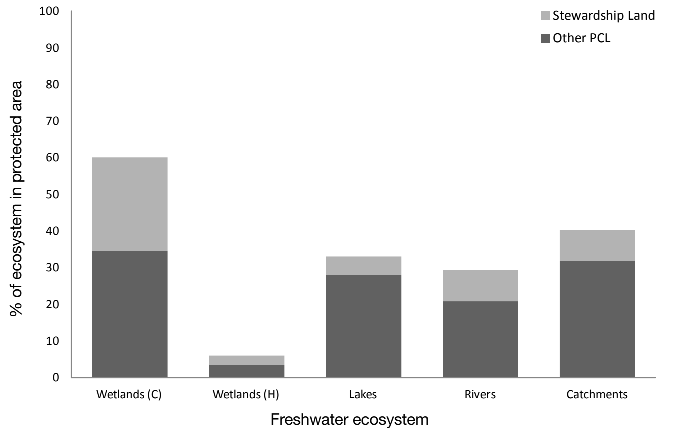

Figure 1. Percentage of lakes, wetlands, rivers and river catchments in protected areas. Note the percentage of wetlands in protected is reported relative the current (C) and historic (H) extent of wetlands (from Ausseil et al. 2008).

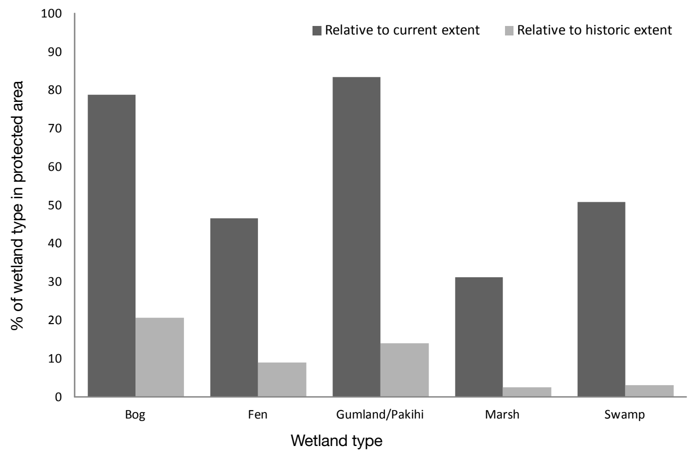

Figure 2. Percentage of different wetland types in protected areas.

indicates that swamps, fens and marshes are a priority for protection. Greater security and protection for freshwater ecosystems could be achieved through alternative land classification than that provided by the Stewardship Land class.

4. Size-class structure of canopy dominants

Refer to Landcare Research report 2012/13.

5. Representation of plant functional types

Refer to Landcare Research report 2013/14.

6. Demography of widespread animal species

Measure 5.1.2

Demography of widespread animal species—case study, South Island robin (*Petroica australis*).

Widespread indicator species are a component of the Tier 1 national monitoring programme. Changes in their populations or distributions can result from changes in environmental threats (such as weeds and pests), which also represents change in other similar species.

We have piloted monitoring designs for two widespread indicator species (mountain stone weta (*Hemideina maori*), scaup (*Aythya novaeseelandiae*)). We have completed drafts for another two species (New Zealand fur seal (*Arctocephalus forsteri*), grey-faced petrel (*Pterodroma* *macroptera*)) and three freshwater fish species also look promising. Three other species thought originally to be to good indicators have now been assessed more closely and have been classed as unsuitable (alpine scree weta (*Deinacrida connectens*), *Aciphylla traversii*, little blue penguin (*Eudyptula minor*)).

Note: This measure is also referenced in the Landcare Research Technical Report.

Definition

This measure assesses the number and distribution of widespread species, and selected indicator species (e.g. robins), and is used as an early warning of long-term changes in populations so that action can be taken before it is too late.

South Island robins have been identified as a useful indicator for measuring changes in demography of a widespread forest bird species which is vulnerable to predation by rats and stoats.

Five additional indicator species have been selected for reporting, and sampling programmes for them will be implemented in 2012/13. This number will incrementally increase to a total of 25 indicator species over the next 5 years.

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

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 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. Pest control at Walker Creek has clearly contributed to an increasing trend in robin numbers and we anticipate further increases in future years.

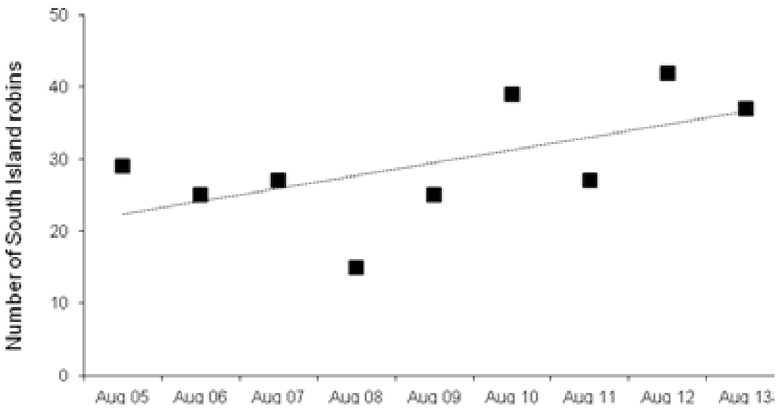

Figure 3. Estimate of number of robins derived from territory mapping at Walker Creek.

At Knobs Flat, where pest control was not initiated until 2011, the 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 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.

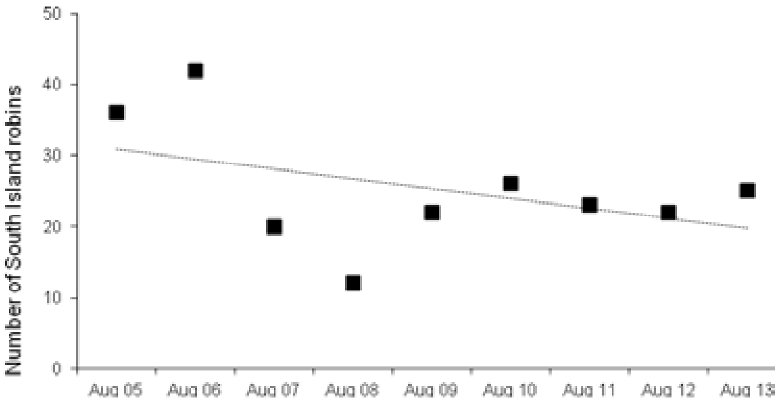

Figure 4. Estimate of the number of robins derived from territory mapping at Knobs Flat.

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 (*Rattus* spp.), mice (*Mus musculus*)) and mustelids (stoats (*Mustela erminea*), 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.

7. Representation of animal guilds

The first report on this indicator will be made in 2015/16 and annually thereafter.

8. 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 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 is an indicator of 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 to the sea causes significant changes in the hydrology and chemistry of the water in 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 quality 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 prescription site managed by the Department with comprehensive outcome monitoring. Lagoon water levels and chemistry parameters are compared with the results of repeated annual surveys (2009 to 2014) of 48 sites across the Lagoon 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, its salinity increases. When the Lagoon is closed, its water quality is degraded as a result of high nutrient (nitrogen and phosphorous) loads from the agriculturally intensified upstream catchment (Table 7).

The occurrence of *Ruppia* spp. declined from 2009 to 2011 and again between 2012 and 2014. After the lagoon closed in 2011, there was a substantial increase in the occurrence of *R. polycarpa* (Fig. 5). In 2014, less than 20% of monitored sites supported *Ruppia* spp. compared with >60% in 2009. The overall abundance of macrophytes appears to be directly related to the opening status of Waituna Lagoon.

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 system is also at risk of becoming less resilient. This is because it is increasingly algae-dominated as a result of increased nutrient enrichment from high loads of nitrogen and phosphorus flowing in from farmland further up the catchment.

Table 7. 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)		TOTOAL 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)	–

* Data courtesy of Environment Southland.

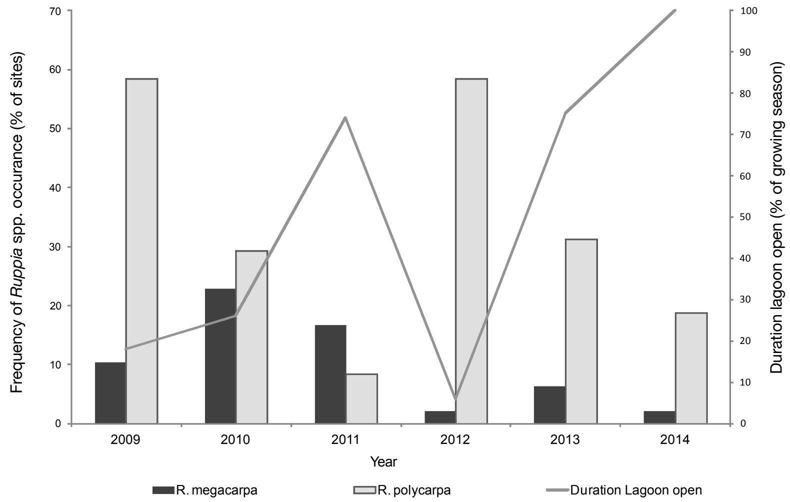

Figure 5. Frequency of occurrence of *Ruppia megacarpa* and *R. polycarpa* in Waituna Lagoon between 2009 and 2014.

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.

9. Number of extinctions

Measure

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

Information on extinct taxa is gathered over 3-year cycles. The assessment process for the 2012–2014 cycle is roughly halfway to completion. So far, one new species has been listed as 'Extinct'—a plant which became extinct many decades ago but has only recently been identified as a distinct species (during a taxonomic revision of the group it was realised that what had been considered one extinct species was actually two closely related extinct species). One bird has been removed from 'Extinct' to 'Data Deficient'; because, while it may indeed be extinct, there have been unconfirmed sightings which have raised some doubt about its status.

This indicator will be reported on again in 2015.

10. Number of 'Threatened' and 'At Risk' species

Measure

Improve status of 'Threatened' taxa and 'At Risk' taxa

Definition

'Threatened' taxa are those that are facing imminent extinction. 'At risk' taxa are those that, although either declining, or having small populations or small areas of occupancy, 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 three-year cycles. '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 relictual 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. See Townsend et al. for more information about the NZTCS and its catgories.

Results

Information on NZTCS status is gathered over three-year cycles. The assessment process for the 2012–14 cycle is roughly halfway to completion Completed reports are available here: http://www.doc.govt.nz/publications/science-and-technical/products/series/new-zealand-threat-classification-series/.

The conservation status of New Zealand's freshwater fish and freshwater invertebrates was assessed using these criteria (Townsend et al. 2008).

Goodman et al. (2014) list 77 freshwater fish taxa, of which 54 are resident natives. Of the 54 resident native fish, 74% are considered to be Threatened or At Risk, compared with 65% in the 2009 list (Allibone et al. 2010). Just over a quarter of the resident native fish (26%) had a higher threat classification in 2013 than in 2009, comprising 11% that changed because of observed declines in abundance and distribution and 15% that changed because of improved knowledge. Five taxa (9%) moved from Not Threatened to either At Risk or Threatened. Changes to the conservation status of these taxa are for one or more of the following reasons: a more accurate estimate of their population size and/or area of occupancy, loss and/or degradation of habitat due to land use intensification, competition and/or predation by introduced species or increased genetic knowledge.

Six hundred and forty-four freshwater invertebrates across five Phyla, 28 Orders and 75 Families were assessed by Grainger et al. (2014). Only native freshwater invertebrates were assessed and 25% of the 644 species were ranked as either Threatened or At Risk. This is the most comprehensive assessment of freshwater invertebrate threat rankings to date; previous assessments have been focused on taxa that are likely to be threatened. Many species listed have small natural ranges, restricted to specialist habitats so the loss and/or degradation of habitat is a key driver for the threat status of these species. The Department is planning to identify where it should focus its efforts for freshwater invertebrate conservation.

Reports for the remaining groups will be completed and published in 2014/15. Incomplete interim results suggest an ongoing deterioration in status in many species in all groups, with some notable exceptions where species which are being actively managed have improved in status as a result.

This indicator will be reported on again in 2015.

11. 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 two forest-dwelling species vulnerable to predation by stoats, rats and cats (*Felis cattus*):

- The long-tailed bat (*Chalinolobus tuberculatus*), one of only two forest-dwelling terrestrial mammals found in New Zealand and;
- Kākāpō (*Strigops habroptilus*), a flightless, ground-nesting parrot species.

Methods

Two methods are described:

- Predicted population from a population model (long-tailed bats)
- Complete census of number of individuals (kākāpō)

LONG-TAILED BATS

Predation, particularly by introduced rats, has been identified as the major cause of decline of the critically endangered 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 2014 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. 6). 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 variation of survival figures within each time period.

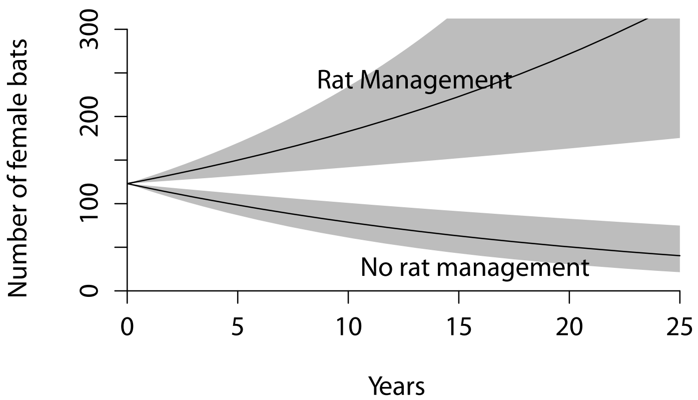

Figure 6. Predicted population trends in numbers of female long-tailed bats in the Eglinton Valley over 25 years with and without management of rats (shaded areas represent 95% confidence intervals).

Results: The modelling was based on the current data of 13 years with low rat numbers, 3 years with medium rat numbers and 4 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. Two more mast events have occurred since 2007, with rats having been controlled on both occasions. The intrinsic rate of increase for the time period with rat management is > 1.0 (λ =1.05), therefore the population increases (Fig. 6), 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 will be effective at reversing declines of long-tailed bats in the valley.

KĀKĀPŌ

Methods: Data on live individuals were estimated for the period 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 presented from 1990 onwards 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, Codfish (Whenuahou) and Te Hauturu-o-Toi / Little Barrier). 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 are good food and were enthusiastically hunted by Maori and their dogs and were in decline even in Maori times. Kākāpō research and management is now focused on overcoming the bird's low fertility, which is a consequence of inbreeding and very low genetic diversity. Matings between kākāpō are planned and manipulated to maximise the genetic diversity of offspring, and artificial insemination has been developed and used also to maximise genetic diversity. A few kākāpō bred during the 2013/14 financial year and 6 chicks were produced. Three kākāpō died—an old male and an old female of unknown age, and a three-year-old female. The population increased by 2.5% to 127 birds (Fig. 7).

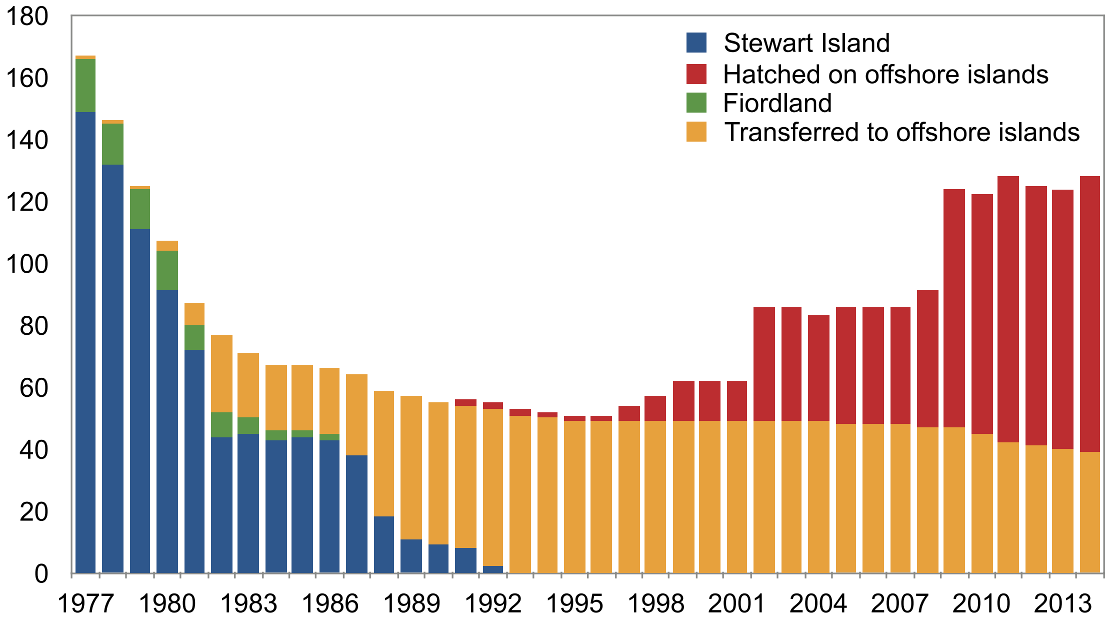

Figure 7. Estimated population of kākāpō.

12. Number, extent and control of fires

Measure 1.4.1

Number, extent and control of fires

Definition

This measure records the extent of areas burnt on public conservation land. Fire on DOC-managed land, or fire from DOC-managed land that affects other landowners (or vice versa), is crucial input to assessing risks, DOC management, and community relations.

Methods

Data were compiled from the Fire Occurrence Database maintained by DOC staff. A number of agencies are involved in fire control. Spatial extents of area burnt are maintained by DOC on behalf of the National Rural Fire Authority.

Results

There were an estimated 88 fires during 2013/14. The total area burnt was approximately 250 ha (Table 8). Over half of the area burnt (152 ha) was public conservation land. The rest of the area burnt was privately-owned land within the 1 kilometre fire safety margin (63 Fires, 98 ha).

The majority of fires occurred within the South Island (81, 92%), in eastern South Island (60, 68%) and southern South Island (21, 24%). The North Island accounted for 16% of the total area burnt.

Table 8. Number, area and cost of fires managed during 2013/14 by the Department of Conservation.

SERVICE REGION	AREA BURNT (ha)	NUMBER OF FIRES	PROPORTION OF FIRES (%)	PROPORTION OF COST (%)	COST ($)
Northern North Island	–	1	1	–	
Central North Island	40.10	6	7	0	60,500
Eastern South Island	107.33	60	68	0	80,800
Southern South Island	102.29	21	24	1	150,500
Total	**249.72**	**88**	**100**	**1**	**291,800**

Note: There have been a number of fires that have occurred on public conservation lands managed by Enlarged Rural Fire Authorities that have not been captured (the responsibility of fire management lies with the ERFD).

Interpretation and implications

During 2013/14, the total number of fires recorded (88) halved from the previous year (151). Responsibility for rural fire management on public conservation land is now shared between the department and the newly formed Enlarged Rural Fire Authorities (ERFAs). Sixty-three percent of the New Zealand land area now lies within the eleven currently gazetted Enlarged Rural Fire Districts (ERFDs). Fires, where they occur within these areas, are managed through the new entities and accordingly are not recorded as DOC fires. Table 8 shows the number of fires and area burned for those locations that have yet to be included in ERFDs.

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

Measure 6.1.4

Proportion of threatened naturally uncommon and significantly reduced habitats under protection[5]

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[6], 45 of which are threatened[7]. 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-five ecosystems have maps at a final draft stage; 22 of these represent threatened (i.e. critically endangered, endangered or vulnerable) ecosystems (Table 9)[8]. When ecosystems are mapped, the land tenure and protection status can be examined using GIS analysis. Land tenure classes evaluated included public conservation land[9], other forms of formal protection (i.e. Ngā Whenua Rāhui[10], privately owned land managed under the Reserves Act, covenants[11]) and lands that are not formally protected[12]. Within public conservation land, status can be examined. We evaluated the proportion of these lands designated as Stewardship land versus the remaining public conservation land. 'Stewardship' land is administered by the Department of Conservation but has yet to have its conservation status classified and can potentially be removed from the conservation estate. The remaining 37 ecosystems not yet to have draft maps prepared are at different stages of completion. They can be categorised into five groupings: two are now part of a wider mapping project, 23 are in progress, for three we are investigating a mosaic approach to resolve spatial and thematic resolution issues, four need to be drafted by experts in that ecosystem and for five the information base is currently too weak for them to be mapped.

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5 Report for this measure prepared jointly by Landcare Research (Susan Wiser) and the Department of Conservation (Derek Brown).

6 Williams, P.A.; Wiser, S.K.; Clarkson, B.; Stanley, M. 2007. New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. *New Zealand Journal of Ecology 31*: 119–128

7 Holdaway, R.J.; Wiser, S.K.; Williams, P.A. 2012. Status assessment of New Zealand's naturally uncommon ecosystems. *Conservation Biology 26*: 619–629.

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

9 Determined by Department of Conservation from assessment of all public conservation land and includes 11 ha known to be protected, but for which exact determination of tenure is unresolved.

10 Data extracted from NaPaLIS.

11 Covenants, including privately owned land managed under combinations of the Reserves Act and the Land Act, and QEII National Trust covenants; data extracted from NaPaLIS.

12 Other, defined as all other lands, including privately owned, as well as military and other Crown lands; data extracted from NaPaLIS.

Table 9. Threatened status of mapped ecosystems.

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)
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

Results

Four of the 22 mapped threatened ecosystems (shell barrier beaches, volcanic dunes, coastal turfs, and young tephra plains and hillslopes) have less than 20% of their total area under public conservation land; as such they are high priority for future protection efforts (Fig. 8). Of the 22 mapped threatened ecosystems that occur on Public Conservation Land, 13 ecosystems (Seabird burrowed soils, Inland 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[13]) have more than 20% of this classed as 'Stewardship Land' (Fig. 9).

Interpretation and implications

Naturally uncommon ecosystems have been included in national conservation policy[14] 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 and so inform conservation priority setting. Of the 45 threatened ecosystems, the four ecosystems that have so far been identified as having less than 20% of their total area under formal protection are of high priority for future protection efforts. The thirteen threatened ecosystems having more than 20% of their total extent on Public Conservation Land classed as 'Stewardship Land' are a high priority for determination of their conservation status to a category which offers greater protection from development.

[13] Calcareous tors (mapped as points) considered separately from calcareous cliffs and scarps (mapped as linear features).

[14] 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.

Figure 8. Proportion of the total extent of each of 35 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 reports as 'not formally protected'.

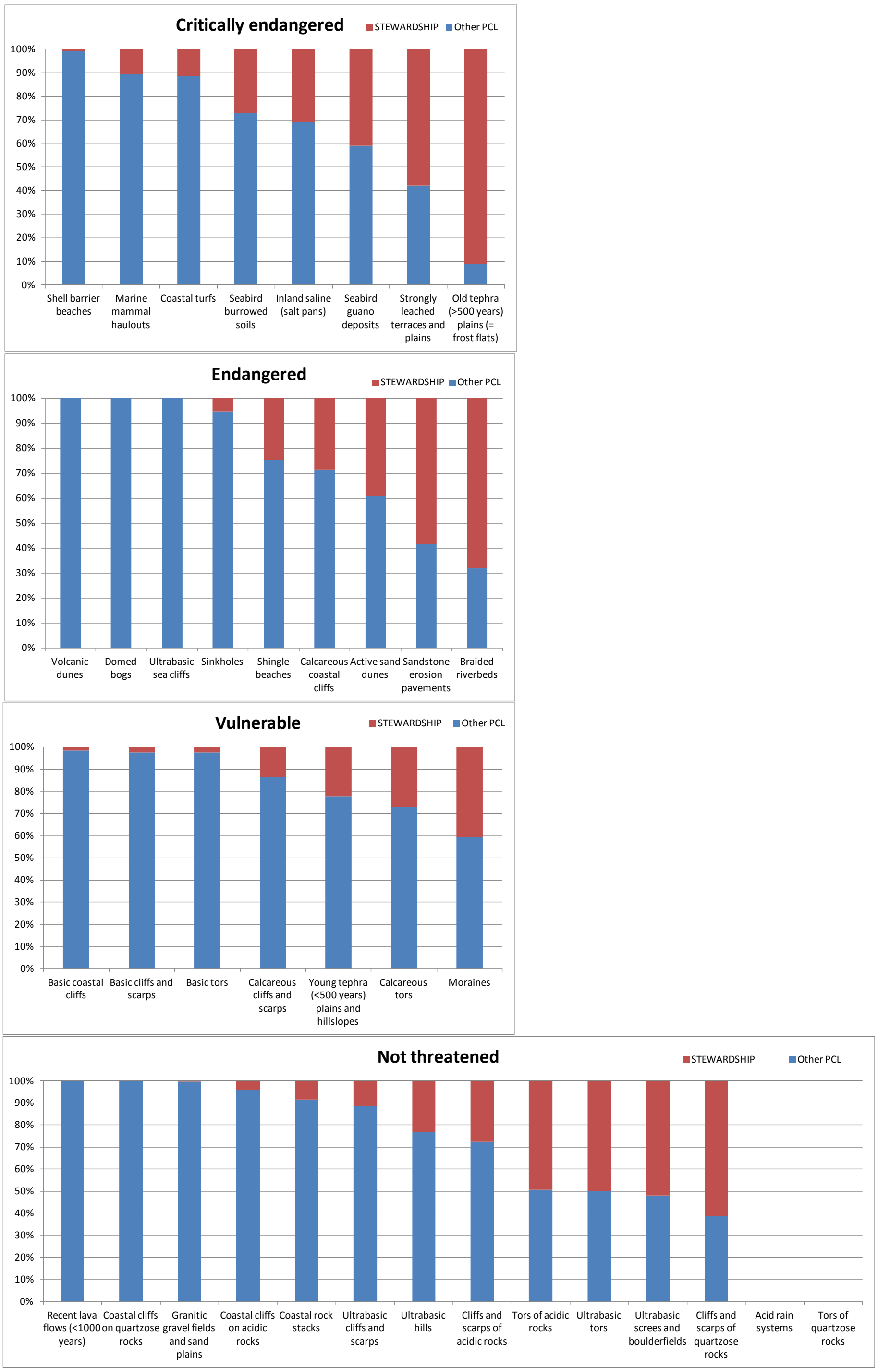

Figure 9. The proportion of the total extent on public conservation land of each of the 35 threatened naturally uncommon ecosystems as land classed as stewardship v. classified conservation land. Ecosystems are grouped by threat status.

14. 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

Eight years ago, as part of its National Monitoring Programme, the Department (in partnership with Landcare Research), invested in seedfall (seed rain) data collection using seed traps for a range of plant species across New Zealand (Fig. 10). Seeds are counted at regular intervals and assessed for viability. This work represents an extension of an existing network focused on South Island Beech Forests and one mixed forest where the data are used to predict the likelihood of predator irruptions. Rodent and mustelid monitoring regimes are run in parallel with seedfall

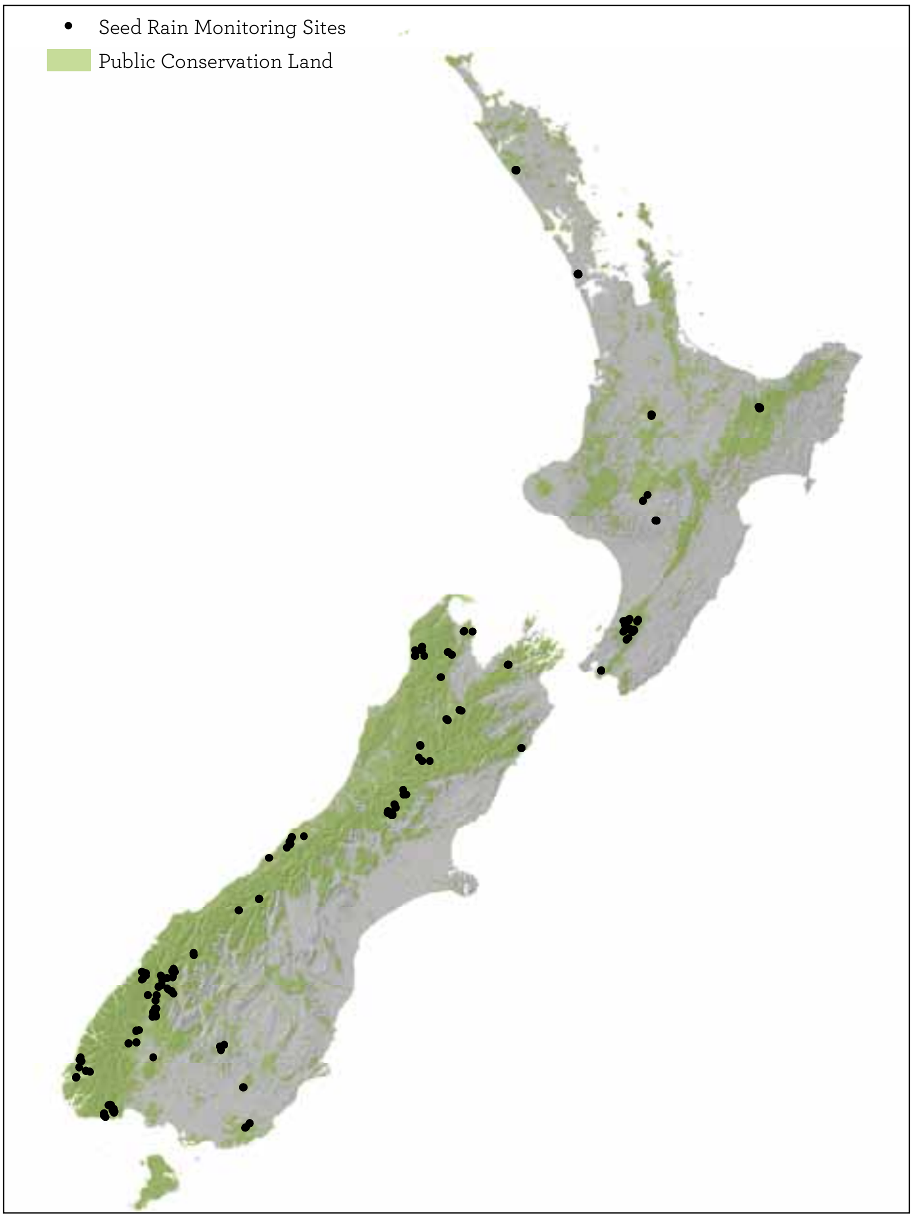

Figure 10. Location of seed rain network across New Zealand—a component of the DOC national monitoring and reporting programme.

monitoring to inform management on the need for intervention in response to mammal irruptions while also contributing to our general understanding of the relationship between seedfall and small mammal abundance.

Results

Periodic high seed production by a number of forest trees and tussocks (masting) has been shown to be an important driver of plant and animal dynamics. Seed production is highly variable in space and time for different species. Masting predictions provide the basis for Departmental pest control strategies aimed at protecting threatened native forest fauna from the impact of predator irruptions. Figure 11 shows beech seedfall (seeds/m^2) measured at selected sites across the South Island seedrain network from February and June 2014.

Interpretation and implications

Spatial and temporal variation in tree seed production is an important driver of the population dynamics of trees and of mammalian and avian seed consumers. Large irregular seed crops represent an important pulsed resource for birds, insects and mammals. In New Zealand, these high seedfall events result in a cascade of responses by both native birds and insects, and introduced mammals[15]. Recent evidence has highlighted the spatial and temporal variability

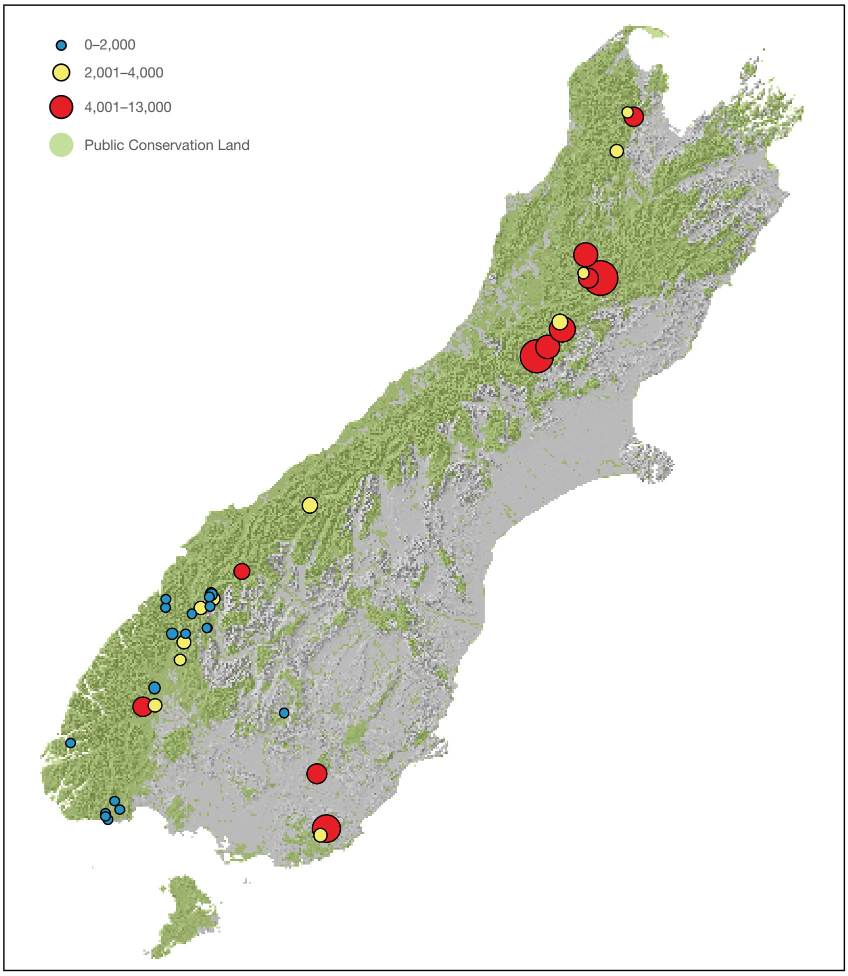

Figure 11. Beech seedfall (seeds/m^2) measured at selected sites across the seed rain network February–July 2014.

[15] Ruscoe, W.A.; Norbury, G.; Choquenot, D. 2005a. Trophic interactions among native and introduced animal species. Pp. 247–260 in Allen, R.B.; Lee, W.B. (Eds): Biological invasions in New Zealand. Springer-Verlag, Heidelberg.

in masting among and within species and in relation to soil fertility[16]. Numbers of introduced predators in temperate beech and mixed forests fluctuate dramatically in relation to food availability[17]. Beech trees mast at irregular intervals, dramatically increasing the food supply for introduced rodents. Irruptions in mouse and rat numbers that follow trigger the breeding of stoats and increase the predation pressure on native fauna[18]. Effective management of the predator irruptions is essential for improving the long-term viability of vulnerable native species in forests. Seedfall monitoring has confirmed widespread mast seeding by the South Island beech forests this year (Fig. 11). Although seed collection and counting is still underway, 15 of the 38 monitoring locations have already produced in excess of 2000 seeds/m², the approximate trigger level for concern about rodent numbers and predator irruptions. For example, the alpine Poulter and Hawdon valleys in Canterbury, home to the nationally endangered orange-fronted parakeet/kākāriki (*Cyanoramphus auriceps*), have produced more than 8000 seed/m², as have monitoring locations in the northwest of the South Island. More than 5000 seeds/m² have fallen in the Catlins, south Otago, home to the nationally vulnerable yellowhead/mohua (*Mohoua ochrocephala*)—this spells trouble for our vulnerable native bird species.

Data from monitoring of beech seedfall and rodent and stoat abundances is currently being used to plan for approximately 700,000 hectares of aerial 1080 operations in South Island beech forests—dubbed 'the Battle for Our Birds'. The objective of this operation is to ensure protection for native bird species during the spring nesting season and provide an opportunity for on-going maintenance and recovery of vulnerable populations. The outcomes of these interventions will be monitored and reported on next year.

15. Distribution and abundance of exotic weeds and animal pests considered a threat

Exotic pest and weed dominance is of more importance than actual numbers of exotic species present because of the potential impact their dominance can have on indigenous species persistence, ecosystem processes or aspects of ecosystems valued by society. Refer to the Landcare Research report 2013/14 and the freshwater ecosystem case study below.

Measure 2.2.1

Distribution and abundance of exotic weeds and pests considered a threat.

Definition

Distributions, abundances and eliminations recorded of important pests that threaten ecological integrity. To interpret changes in these distributions and their impact on dominance of indigenous species, additional explanatory measures are collected and presented. Information on how changes to soil chemistry (**Measure 1.1** Soil status) as an indicator of water quality) and hydrological regime (**Measure 1.4.3** Hydrological change) impact the ecological function of significant wetlands supports restoration programmes being undertaken by the Department[19]. Information on soil chemistry will identify the risk of eutrophication (high nutrients) at different wetland 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.

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[16] Canham, C.D.; Ruscoe, W.A.; Wright, E.F.; Wilson, D.J. April 30 2014. Spatial and temporal variation in tree seed production and dispersal in a New Zealand temperate rainforest. Ecosphere 5: art49.

[17] Ruscoe, W.A.; Wilson, D.; McElrea, L.; Richardson, S.J. 2004. A house mouse (*Mus musculus*) population eruption in response to a heavy rimu (*Dacrydium cupressinum*) seedfall in southern New Zealand. *New Zealand Journal of Ecology 28(2)*: 259–266.

[18] O'Donnell, C.J.F.; Phillipson, S.M. 1996. Predicting the incidence of mohua predation from seedfall, mouse and predator fluctuations in beech forests. *New Zealand Journal of Ecology 23*: 287–293.

[19] The Arawai Kākāriki Wetland Restoration Programme is a conservation initiative led by the Department of Conservation at three significant freshwater sites: Whangamarino Wetland, Ō Tū Wharekai (Ashburton Basin/upper Rangitata River) and Awarua-Waituna.

This measure provides a report on the effects of changes in soil chemistry and hydrological change for a high priority freshwater site, Whangamarino Wetland.

Methods: The hydrological regime of wetlands is known to have a strong influence on the distribution and composition of wetland vegetation. Changes in hydrology are frequently accompanied by changes in soil chemistry. The hydrology of Whangamarino Wetland has been altered due to the operation of the Lower Waikato Waipa flood control scheme (operational since 1982) that is predicted to have an impact on water levels, soil chemistry and water quality. Whangamarino Wetland is an ecosystem prescription site managed by the Department with comprehensive outcome monitoring. A network of 36 monitoring plots is used to record changes in soil chemistry and vegetation composition. Aerial photographs are used to map changes in the distribution of invasive weeds. Water level recorders and a hydrological model were used to examine hydrological change across the swamp, fen and bog wetland types.

Results: The operation of the Lower Waikato Waipa flood scheme has altered the frequency and extent of inundation within the wetland. The hydrological model for Whangamarino indicates annual flood events now inundate large areas of swamp and fen habitat and 10-year flood events can reach the raised bog. Flood waters have high loads of suspended sediment and high nutrient concentrations. Table 10 indicates the differences in soil phosphorus (TP) and soil nitrogen (TN) between the swamp, fen and bog habitats. Higher abundance of exotic plant species are recorded in the swamp habitats at present (Table 10). A negative relationship between soil TP and the abundance of native plants is observed (Fig. 12).

Table 10. Soil chemistry and exotic plant abundance across the three main wetland types in Whangamarino Wetland from 2013 outcome monitoring.

WETLAND TYPE	SOIL CHEMISTRY (MEAN)			DOMINANT SPECIES	EXOTIC PLANT ABUNDANCE (MEAN % COVER)
	TP (mg/cm^3)	TN (mg/cm^3)	N:P		
Bog (*n* = 9)	0.033	1.2	37.4	Wirerush	99.2
Fen (*n* = 12)	0.142	2.5	17.6	Mānuka	65.0
Swamp (*n* = 15)	0.195	2.8	14.3	Willow	42.0

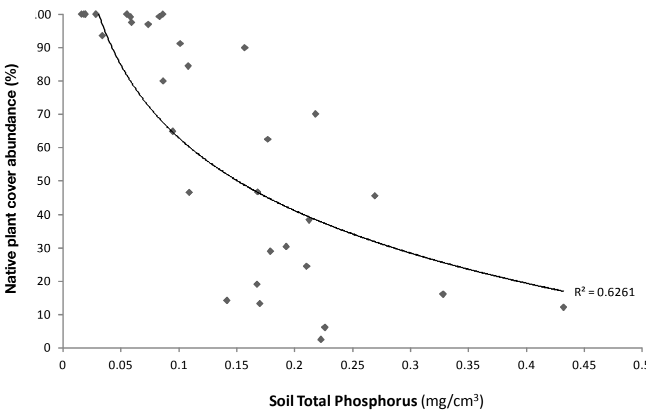

Figure 12. Relationship between native plant dominance and soil Total Phosphorus at Whangamarino Wetland. Data from 2013 outcome monitoring.

Between 1963[20] and 2007 changes in the distribution of exotic weeds (willow (*Salix* spp.)) and invasive native species (mānuka (*Leptospermum scoparium*)) have been mapped from aerial photographs (Fig. 13). Tall mānuka is spreading across fen and bog habitat that was previously characterised by sedge and wirerush vegetation. Willow now dominates the swamp habitat. The Department is currently preparing the 2014 vegetation map.

Interpretation and implications: Coordinated outcome monitoring using multiple indicators is critical to understanding complex ecosystems. Increased sediment and nutrient loads associated with altered patterns of flood inundation in Whangamarino Wetland appear to be encouraging mānuka invasion into the low-nutrient raised bog. This presents a significant threat to the integrity of the wetlands. The Department is working with other agencies to identify options to maintain and enhance the status of the Whangamarino site as part of the Arawai Kākāriki wetland restoration programme.

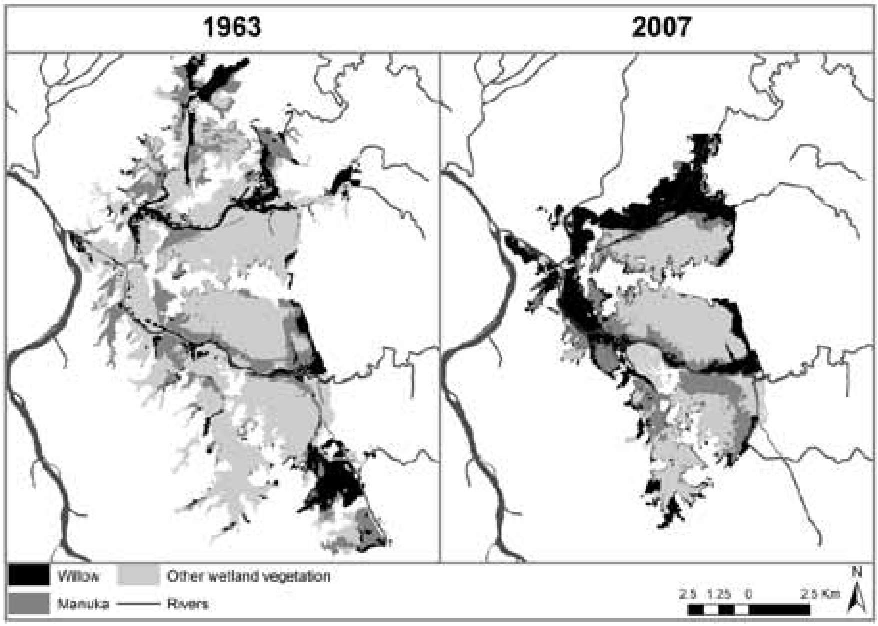

Figure 13. Vegetation map of Whangamarino Wetland (derived from aerial photography) showing the distribution of mānuka (*Leptospermum scoparium*), exotic willow (*Salix fragilis*, *S. cinerea*) and other wetland vegetation between 1963 and 2007.

[20] The 1963 vegetation map is based on Reeves (1994) MSc Thesis.

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