

STRATEGIC ANALYSIS OF OPTIONS TO IMPROVE MANAGEMENT OF ECOSYSTEMS AND BIODIVERSITY FOR OTAGO REGION



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Indigenous forest and grassland remnants in the North Branch Waikouaiti River.

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Project Team:

Kelvin Lloyd - Project management, Report author

Steve Rate - Report author

Nathan Baker (Beca) - Report author

Susan Jackson (Beca) - Report author

Corinne Marti (Beca) - Report author

Juliet O'Connell - GIS analyses

Roger Bawden - GIS analyses

William Shaw - Strategic advice

Prepared for:

Otago Regional Council

70 Stafford St

Dunedin

EXECUTIVE SUMMARY

Otago Regional Council (ORC) is reviewing the roles it plays with respect to ecosystems and biological diversity, in order to give better effect to its statutory functions and responsibilities under the Resource Management Act 1991 (RMA). Regional councils have a broad mandate for maintaining indigenous biological diversity, stemming from Section 30(1) of the RMA. A number of national goals and policy statements are also relevant.

Wildland Consultants and Beca were commissioned to analyse options to improve management of indigenous ecosystems and diversity for Otago. The scope of the project includes terrestrial, freshwater, and marine ecosystems within Otago. As part of the project, the statutory and non-statutory framework covering the project was assessed, current indigenous biodiversity values of Otago Region were summarised, ecosystem zones were delineated and described, organisations involved in protecting and enhancing indigenous biodiversity in Otago were identified and their activities summarised, and the aspirations of organisations with respect to roles for ORC were canvassed with a representative selection of organisation representatives. From this process, options were developed for ORC to better achieve the aspirations of the Otago community for indigenous ecosystems and biodiversity.

Otago Region is mostly based on the Clutha River catchment but broadens in the coastal area from the Waitaki River to the mid-Catlins. The Clutha River is the largest river by volume in New Zealand. Thirteen ecological regions and 39 ecological districts cover Otago Region, with 17 ecological districts occurring only in Otago. Eleven ecosystem zones were defined as part of this project, based on differences in landforms, indigenous forest, and non-forest cover. Inland basin floors, downlands, and lowland plains retain less than 10% of their original vegetation cover, but the zones in mountainous areas and in the Catlins have greater (46-86%) indigenous cover.

Key terrestrial Otago ecosystems include a variety of tussock grassland, wetland, and inland saline habitats on remnants of the Otago Peneplain, which support a large number of threatened plant, lizard, fish, and invertebrate populations; areas of indigenous forest, mainly in the east, south, and west of Otago Region, which provide habitat for threatened indigenous forest fauna; montane tall tussock grasslands, which are being cleared at an alarming rate; and naturally rare limestone, saline, and outwash plain ecosystems. Pressures on these ecosystems and species include clearance of habitat, mammalian predation, and invasion by exotic weeds.

The marine part of Otago Region can be divided into five coastal zones, and contains a number of key habitats, including river mouths, estuaries, intertidal and shallow subtidal habitats, biogenic habitats, deep sub-tidal habitats, and canyon heads. The Tautuku and Tahakopa estuaries are nationally significant due to their relatively unmodified character. Otago Region is rich in marine fauna including marine mammals (seals, sea lions, dolphins, whales) and seabirds (penguins, shags, albatross, gulls, petrels), marine algae, and benthic organisms.

At least 65 organisations are actively working on the protection and enhancement of indigenous biodiversity in Otago Region, including four government departments, five TLAs,

Otago Regional Council, and approximately 50 NGOs. Many NGO projects focus on coastal habitats, forests, and streams. Relatively fewer NGO projects are located in dryland habitats or involve lakes. Significant NGO projects include wilding conifer control in the Queenstown area and northern ranges, conservation of marine avifauna in coastal Otago, the burgeoning control of mammalian predators in the Dunedin area, and predator control projects in the Dart, Matukituki, and Makarora areas in the western mountains. Department of Conservation protects significant areas of forest and mountain lands, and an increasing amount of alpine grassland and herbfield following tenure review of pastoral leases, but there are large parts of Otago Region, especially in the eastern half of the Region, with little protection of indigenous biodiversity. There is little management of indigenous biodiversity in the marine area, but the South East Marine Protection Forum process should result in a variety of marine protected areas.

Representatives of organisations offered numerous suggestions for actions that Otago Regional Council could undertake, which fell in the categories of advocacy, biosecurity, capacity, direct action, funding, monitoring and reporting, partnerships, policy, and strategy. Regional councils in other parts of New Zealand are undertaking variety of actions to maintain and enhance indigenous ecosystems and biodiversity.

Options suggested for actions that Otago Regional Council could undertake include building capacity and relationships, development of a regional biodiversity strategy, development of a regional biodiversity accord, improve state of the environment monitoring, coordination of biodiversity enhancement actions, establishment of regional parks and reserves, protect montane tussock grasslands, support Predator-free Dunedin and other landscape scale pest animal control projects, establish a 'mountains to sea' biodiversity framework for the Clutha River, support catchment projects for the Waikouaiti, Kakanui, and Taieri Rivers, develop an Otago Biosecurity strategy, supporting the implementation of marine protected areas, and support research into inland lake and marine processes.

Methods provided under policies in the Proposed Otago Regional Policy Statement are broad and cover both regulatory and non-regulatory tools. All of the options suggested in this report for consideration are consistent with RPS policies because all options can help to achieve the policy outcomes sought.

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Reviewed and approved for release by:



W.B. Shaw
 Director/Principal Ecologist
 Wildland Consultants Ltd

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1. INTRODUCTION

Otago Regional Council (ORC) is reviewing its roles with respect to ecosystems and biological diversity, in order to give better effect to its statutory functions and responsibilities under the Resource Management Act 1991 (RMA). ORC completed an internal review of the biodiversity activities that it is involved with in 2015. ORC now wishes to look more closely at the activities being undertaken across Otago and, accordingly, where it is best placed to meet regional needs into the future.

Wildland Consultants and Beca were commissioned to evaluate options for improved management of Ecosystems and Biological Diversity for Otago. The scope of the project includes terrestrial, freshwater, and marine ecosystems within Otago. As part of the project, current indigenous biodiversity values of Otago Region were summarised, ecological zones were delineated and described, organisations involved in the protection and enhancement of indigenous biodiversity were identified and their activities summarised, and the aspirations of organisations with respect to roles for ORC were canvassed with a representative selection of organisation representatives. From this process, options were developed for ORC to better achieve the aspirations of the Otago community for indigenous ecosystems and biodiversity.

This report presents the findings of the above work, and the options identified will be considered by the Council. Selected options for strategic initiatives will then be developed further, along with more detailed prescriptions to assist implementation.

2. METHODOLOGY

The scope of this project is indigenous biodiversity. For this project we used the broad and inclusive definition of biodiversity from the New Zealand Biodiversity Strategy (2000):

The variety of all biological life - the different species, from micro-organisms to trees, animals, and fungi; the genes they comprise, and the ecosystems they collectively form. This includes diversity within species, between species, and of ecosystems”

An initial meeting was held with the Regional Council reference group to confirm the brief and to better understand Council requirements. Information on ecosystems and biodiversity within Otago Region was then compiled and summarised. This included delineation of broad ecological zones and generation of land cover and threatened land environment attributes for these zones through overlays and GIS analysis of those spatial layers.

Information on the marine part of the Region was compiled from existing sources of information, much of which was made available from the South East Marine Protection Forum process that is currently considering protection options for marine habitats and biodiversity.

Information on agencies, authorities, and organisations undertaking projects involving indigenous biological diversity in Otago was gained from Wildlands staff knowledge

of many of these organisations and from website searches. These sources of information were then used to generate standardised information on these agencies, authorities, and organisations, by assessment of organisation websites, undertaking phone and email communications, and undertaking interviews with organisation representatives.

Emphasis was placed on identification of existing projects involving indigenous biodiversity, and the actions that representatives of other organisations consider the Council could be undertaking, or undertaking better, to maintain and enhance indigenous biodiversity. Interviews with stakeholder representatives were particularly helpful in generating information on these aspects of the project.

3. STATUTORY AND NON-STATUTORY FRAMEWORK

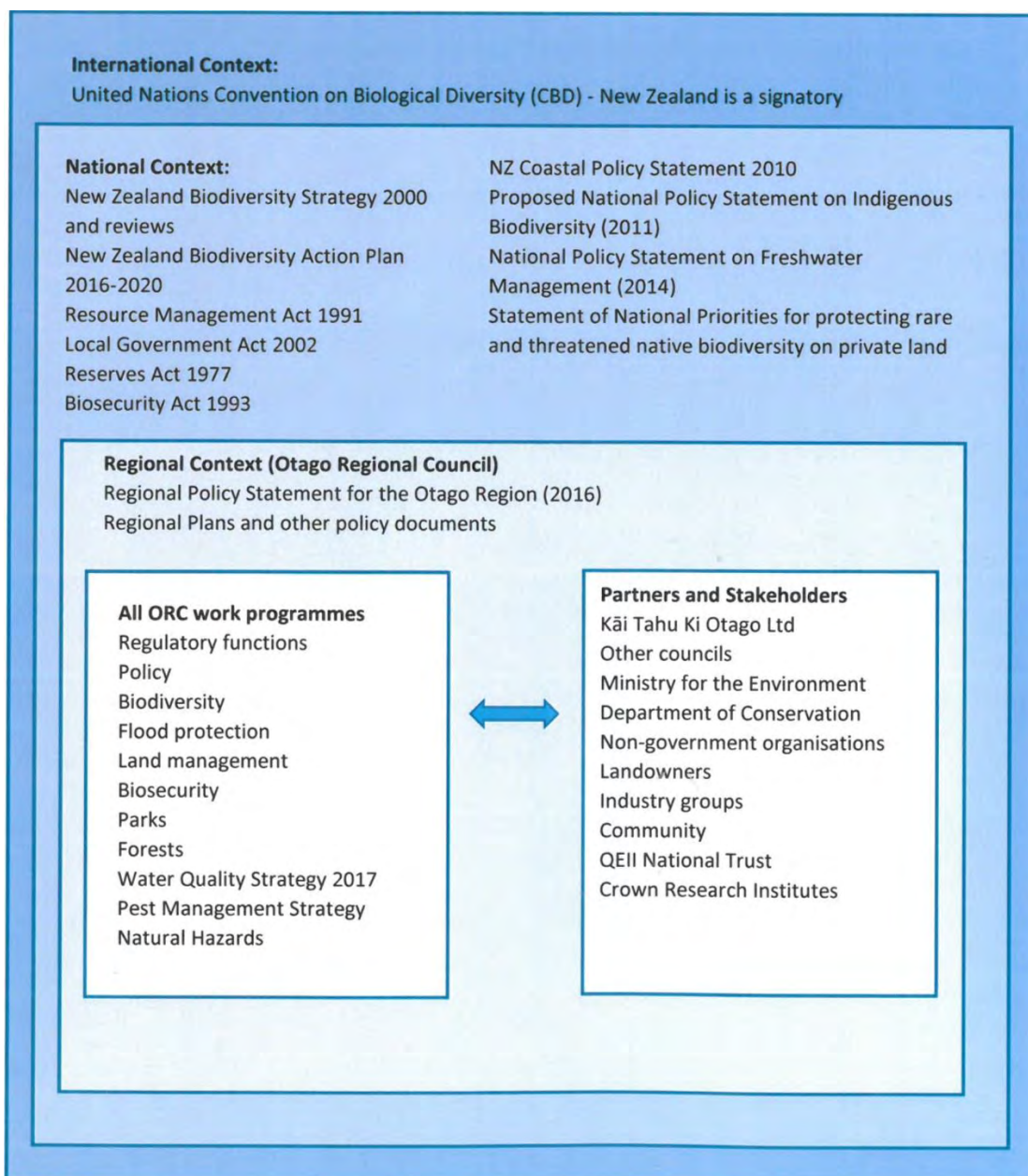
3.1 Overview

Management of biodiversity can be a relatively complex undertaking, with strategic directions potentially available at international, national, and regional scales. Most Regional Council work programmes have an influence on biodiversity at some level, either directly or indirectly. Given the broad and comprehensive nature of biodiversity management, there is also a range of partners and stakeholders with either a statutory responsibility or non-statutory interest for biodiversity management. The most relevant strategies and legislation are summarised below, setting the framework to help inform the roles and responsibilities of the Otago Regional Council in relation to biodiversity management.

3.2 The New Zealand Biodiversity Strategy 2000-2020

The New Zealand Strategy on Biodiversity was published in 2000 as a part of New Zealand's international responsibility under the Convention of Biological Diversity. This strategy establishes a framework to halt decline of biological biodiversity. As well as "biological diversity", the strategy aims to address:

- ***Genetic Diversity:*** The variability in the genetic make-up among individuals within a single species. In more technical terms, it is the genetic differences among populations of a single species and those among individuals within a population.
- ***Species Diversity:*** The variety of species - whether wild or domesticated - within a particular geographical area. A species is a group of organisms which have evolved distinct inheritable features and occupy a unique geographic area. Species are usually unable to interbreed naturally with other species due to such factors as genetic divergence, different behaviour and biological needs, and separate geographic location.
- ***Ecological (ecosystem) Diversity:*** The variety of ecosystem types (for example, forests, deserts, grasslands, streams, lakes, wetlands and oceans) and their biological communities that interact with one another and their non-living environments".



ORC's role in managing regional biodiversity in the context of international obligations, national drivers, and local partners and stakeholders.

The Strategy contains the following goals:

- To enhance community and individual understanding about biodiversity, and to inform, motivate and support community initiatives. Enable the community to equally share responsibility for and benefits from conserving New Zealand's biodiversity.
- Actively protect iwi and hapu interests in indigenous biodiversity, and build and strengthen partnerships between government agencies and iwi and hapu in conserving and sustainably using indigenous biodiversity.

- Halt the decline in New Zealand's biodiversity and to restore the remaining natural habitats.
- Maintain the genetic resources of introduced species that are important for economic, biological and cultural reasons by conserving their genetic diversity.

3.3 New Zealand Biodiversity Action Plan 2016-2020

The New Zealand Biodiversity Action Plan was released in October 2016 and sets out the national action plan for managing biodiversity for the next four years. It sets ambitious national targets toward greater protection and sustainable use of biodiversity. The targets put forward in this action plan aim to demonstrate New Zealand's progress towards achieving the goals of the New Zealand Biodiversity Strategy 2000-2020.

Other national-level plans that have come out of this plan include:

- Predator Free 2050: with an ambitious goal to rid New Zealand of introduced species
- War on weeds: with an aim to rid New Zealand of wilding conifers
- Battle for the Birds: this includes 1080 drops and self-setting traps to protect high risk populations of New Zealand's indigenous birds.

National Target 3 is to integrate biodiversity into national and local strategies, policies, plans and reporting. The key actions for achieving this target are:

- **BY 2020**, *we will fully implement a new national environmental reporting series, including the synthesis report Environment Aotearoa, in which biodiversity is a cross-domain theme.*
- **BY 2017**, *natural resources are recognised in New Zealand's Long Term Fiscal Statement underlining the importance of the natural resource base to New Zealanders' living standards.*
- **BY 2017**, *investigate the need and potential to produce New Zealand environmental-economic accounts.*

National Target 7 aims to promote the sustainable use and protection of biodiversity through improved national guidance, information and industry background. Key actions for achieving this target are:

- **BY 2020**, *a National Policy Statement on Indigenous Biodiversity will provide national direction to councils on managing biodiversity under the Resource Management Act 1991.*
- **New Zealand** *will continue work to improve the efficiency of agricultural production systems by improving decisions around land use, maintaining soil and water health, and enhancing flexibility in land management and farming practices.*

- **BY 2018**, a National Environmental Standard for Plantation Forestry will be implemented to improve consistency and reduce negative impacts in the management of plantation forestry.

3.4 Part 2 of the Resource Management Act

The Resource Management Act gives direction to Regional Councils and Territorial Authorities as to how they should managing their resources. Part 2 of the Act, encompassing Section 5, 6, 7 and 8 of the Act, outlines the purpose and principles. Section 5 of the RMA outlines the purpose of the Act which is to:

- “(1) The purpose of this Act 1991 (RMA) is to promote the sustainable management of natural and physical resources.*
- (2) In this Act, sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—*
- (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
 - (b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
 - (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.”*

The term “biodiversity” is not directly used in the RMA but it is managed indirectly through all matters listed in Section 5(2).

Section 6 of the RMA outlines matters of national importance.

“In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

- (a) the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:*
- (b) the protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development:*
- (c) the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:*
- (d) the maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers:*
- (e) the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga:*

- (f) *the protection of historic heritage from inappropriate subdivision, use, and development:*
- (g) *the protection of protected customary rights.”*

Section 7 outlines other matters that particular regard has to be given to:

- “(a) *kaitiakitanga:*
- (aa) *the ethic of stewardship:*
- (b) *the efficient use and development of natural and physical resources:*
- (ba) *the efficiency of the end use of energy:*
- (c) *the maintenance and enhancement of amenity values:*
- (d) *intrinsic values of ecosystems:*
- (e) *[Repealed]*
- (f) *maintenance and enhancement of the quality of the environment:*
- (g) *any finite characteristics of natural and physical resources:*
- (h) *the protection of the habitat of trout and salmon:*
- (i) *the effects of climate change:*
- (j) *the benefits to be derived from the use and development of renewable energy.”*

3.5 Functions of Regional Councils under RMA 1991

Section 30(1) of the RMA outlines the functions of regional councils for the purpose of giving effect to the Act in its region. Subsection (ga) states that:

“(1) Every regional council shall have the following functions for the purpose of giving effect to this Act in its region:

- (ga) *the establishment, implementation, and review of objectives, policies, and methods for maintaining indigenous biological diversity:”*

The RMA defines biological diversity as *“the variability among living organisms, and the ecological complexes of which they are a part, including diversity within species, between species, and of ecosystem”*.

3.6 Functions of Territorial Authorities under the RMA 1991

Section 31(1) of the RMA outlines the functions of Territorial Authorities when giving effect to the Act. Subsection (1)(b)(iii) states that:

“(1) Every territorial authority shall have the following functions for the purpose of giving effect to this Act in its district:

- (b) *the control of any actual or potential effects of the use, development, or protection of land, including for the purpose of—*
- (iii) *the maintenance of indigenous biological diversity.”*

In accordance with Section 31(1) of the RMA, a District Plan must contain rules to control any potential effects of development or use activities on the maintenance of biodiversity.

3.7 Proposed Regional Policy Statement for Otago

Otago's operative Regional Policy Statement is currently under review. The Proposed Regional Policy Statement (RPS) plans the direction for future management of Otago's natural and physical resources and provides the foundation for development of regional plans and district plans. This includes the development of objectives, policies and methods for managing biodiversity.

The proposed RPS was publicly notified on 23 May 2015. A total of 156 submissions and 42 further submissions were received. The hearing panel heard or received evidence from 88 submitters in late 2015, deliberated from December 2015 to September 2016, and the Council released its decisions in October 2016. The appeal period closed in December 2016 and 26 notices of appeals were received. ORC, appellants and Section 274 parties now have the opportunity to mediate on the issues raised in appeals. Any issues not resolved through mediation will become the subject of an Environment Court hearing.

The proposed RPS has a number of relevant objectives and policies that have either a direct or indirect influence on biodiversity. The most relevant are Policies 3.1.9 and 3.1.12, as presented below. There are a number of appeals on both these policies. In terms of relevance to this report, the proposed methods include a range of regulatory and non-regulatory tools.

Policy 3.1.9 Ecosystems and indigenous biological diversity

Manage ecosystems and indigenous biological diversity in terrestrial, freshwater and marine environments to achieve all of the following:

- a) Maintain or enhance ecosystem health and indigenous biological diversity;*
- b) Maintain or enhance biological diversity where the presence of exotic flora and fauna supports indigenous biological diversity;*
- c) Maintain or enhance areas of predominantly indigenous vegetation;*
- d) Recognise and provide for important hydrological services, including the services provided by tussock grassland;*
- e) Recognise and provide for natural resources and processes that support indigenous biological diversity;*
- f) Maintain or enhance habitats of indigenous species and the habitat of trout and salmon that are important for recreational, commercial, cultural or customary purposes;*
- g) Control the adverse effects of pest species, prevent their introduction and reduce their spread.*

Method 3: Regional Plans

Method 3.1

Method 4: City and District Plans

Method 4.1.3

Method 5: Research, Monitoring and Reporting

Method 5.2.1

Method 6: Non RMA Strategies and Plans

Method 6.4

Method 7: Education and Information

Method 7.1

Method 9: Advocacy and Facilitation

Method 9.2

Policy 3.1.12 Environmental enhancement

Encourage, facilitate and support activities which contribute to enhancing the natural environment, by one or more of the following:

- a) Improving water quality and quantity;*
- b) Protecting or restoring habitat for indigenous species;*
- c) Regenerating indigenous species;*
- d) Mitigating natural hazards;*
- e) Protecting or restoring wetlands;*
- f) Improving the health and resilience of:
 - i. Ecosystems supporting indigenous biological diversity;*
 - ii. Important ecosystem services, including pollination;**
- g) Improving access to rivers, lakes, wetlands and their margins, and the coast;*
- h) Buffering or linking ecosystems, habitats and areas of significance that contribute to ecological corridors;*
- i) Controlling pest species.*

Method 2: Regional, City and District Council Relationships

Method 2.1, Method 2.2

Method 3: Regional Plans

Method 3.1

Method 4: City and District Plans

Method 4.1

Method 6: Non RMA Strategies and Plans

Method 6.1 - Method 6.9

Method 7: Education and Information

Method 7.1

Method 8: Funding

Method 8.1

Method 9: Advocacy and Facilitation

Method 9.1, Method 9.2

4. OTAGO REGION

4.1 Geography

Otago Region extends from the Main Divide of the Southern Alps, where its highest point is Tititea/Mt Aspiring, to the east Otago coast between the Waitaki River mouth and the Catlins. Much of the Region is based on the catchment of the Clutha River but it also extends north and south of the Clutha catchment in coastal Otago.

4.2 Geology

Otago Schist landforms dominate much of Otago, but volcanic intrusions and Tertiary sedimentary rocks occur in coastal Otago, and landforms in the Catlins comprise Triassic and Jurassic sandstones, mudstones, and other sedimentary rocks.

4.3 Catchments, rivers, and streams

The Clutha River is the longest river in the South Island (and second only to the Waikato River in New Zealand) and is the highest volume river in New Zealand.

Outside the Clutha catchment the Taieri River is the only other major river within Otago Region, but the Region contains the Shag/Waihemo and Kakanui catchments in the north and various rivers and streams that flow to the coast in the eastern Catlins.

4.4 Ecological character

4.4.1 Ecological regions and districts

Thirteen ecological regions and 39 ecological districts occur within Otago Region (Table 1; Figure 1). Of these, the Otago Coast and Lammerlaw Ecological Regions are the only ecological regions that occur wholly within Otago Region, while 17 ecological districts occur only within Otago. These are primarily the districts from the central lakes, Central Otago, and coastal Otago areas. These areas are therefore the most unique to Otago Region.

Only very minor parts of the Landsborough Ecological District (Aspiring Ecological Region), Ahuriri Ecological District (Mackenzie Ecological Region), and Nokomai Ecological District (Waikaia Ecological Region) occur within Otago Region.

However the 36 ecological districts that are better represented in Otago Region is a large number of ecological districts given the size of the region, and reflects the very strong gradients in geology, landform, and vegetation cover that occur within Otago Region.

Table 1: Ecological regions and districts (ED) within Otago Region.

Ecological Region	Ecological District	Total ED Size (ha)	Area in Otago Region (ha)	Proportion (%) of ED in Otago Region
Aspiring	Arawata	197,944	77,814	39
	Dart	171,544	114,994	67
	Landsborough	56,039	306	0.5
	Okuru	135,915	42,890	32
Mackenzie	Ahuriri	75,246	467	0.6
Central Otago	Dunstan	90,254	90,254	100
	Lindis	109,817	108,383	99
	Maniototo	263,618	275,521	100
	Manorburn	194,961	194,961	100
	Old Man	149,693	111,557	75
	Pisa	82,312	82,312	100
	Rock and Pillar	60,380	60,380	100
Kakanui	Dansey	71,790	56,485	79
	Duntroon	67,964	42,405	62
	Waianakarua	50,685	50,685	100
Wainono	Glenavy	51,386	18,383	36
	Oamaru	44,824	44,824	100
Otago Coast	Dunedin	38,856	38,856	100
	Tokomairiro	162,670	162,670	100
	Waikouaiti	68,802	68,802	100
Waitaki	Hawkdun	90,698	19,627	22
	St Bathans	39,953	26,293	66
	St Mary	75,287	5,305	7
Lammerlaw	Lawrence	99,210	99,210	100

Ecological Region	Ecological District	Total ED Size (ha)	Area in Otago Region (ha)	Proportion (%) of ED in Otago Region
	Macraes	113,862	113,862	100
	Tapanui	29,974	29,974	100
	Waipori	191,420	191,420	100
Lakes	Huxley	114,644	79,907	70
	Remarkables	86,869	85,409	98
	Richardson	119,918	119,918	100
	Shotover	94,011	94,011	100
	Wanaka	209,313	209,313	100
Mavora	Eyre	197,830	68,711	35
	Livingstone	114,809	25,578	22
Gore	Gore	297,700	127,821	43
Waikaia	Nokomai	109,396	158	0.1
	Umbrella	148,010	96,081	65
Catlins	Tahakopo	240,203	113,618	47
	Waipahi	93,251	50,272	54
NA	[marine part of region]		660,452	

4.4.1 Ecosystem zones

Zones

Eleven broad zones covering terrestrial ecosystems and habitats within Otago Region were defined for this project based on topography, geology, and vegetation cover (Table 2; Figure 2). These zones differ significantly in their cover of indigenous forest and cover of indigenous vegetation generally, and thus comprise zones useful to generate strategic directions and priorities for indigenous biodiversity management, or state of the environment reporting on indigenous biodiversity.

The largely mountainous zones (Blue Mountains, Inland Block Mountains, Northern Ranges, Western Lakes and Mountains), and the Catlins zone, all retain more than 45 percent of their indigenous cover, predominantly comprising non-forest vegetation except for the Blue Mountains and Catlins zones where indigenous cover is dominated by forest (Table 2).

Zones based on basin floors, plains, and downlands - Inland Basin Floors, Southern and Northern Downlands, and Lowland Plains - retain less than 10 percent indigenous cover, primarily non-forest cover on the plains and basin floors, and indigenous forest cover in the downlands.

A more detailed summary of the features of these ecosystem zones is presented in Appendix 1, along with maps.



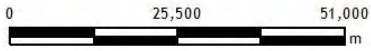
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- Otago Region
- Ecological Districts
- Ecological Regions

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Figure 1: Ecological districts within Otago Region



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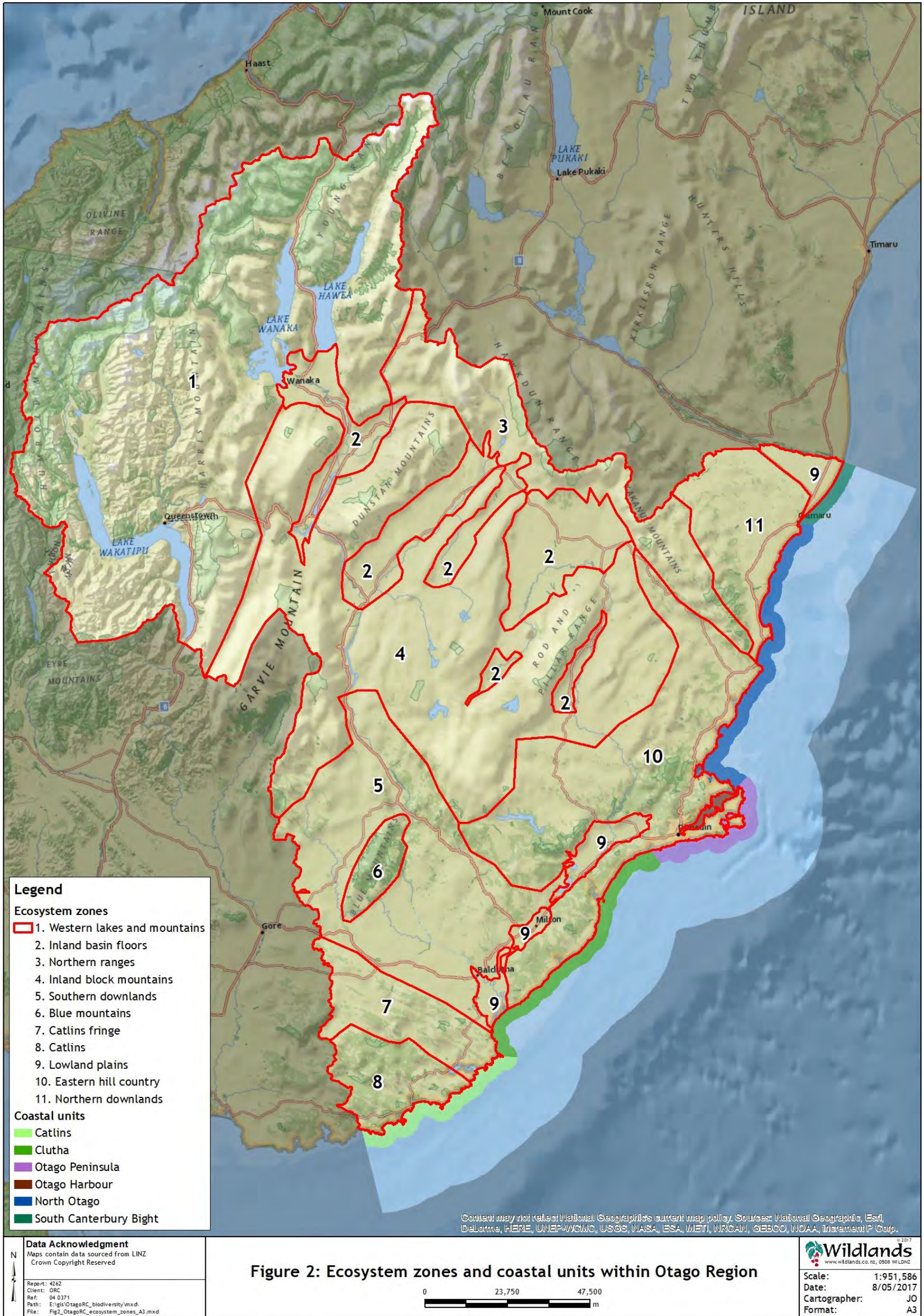


Table 2: Ecosystem zonation within Otago Region, ordered by least to greatest extent of indigenous cover remaining within each zone.

Land Use Zone	Area (ha)	Indigenous Forest (ha)	Indigenous Non-Forest (ha)	% Indigenous Cover Remaining
Inland basin floors	253,415	1,255	12,411	5
Southern downlands	328,486	11,811	5,306	5
Lowland plains	58,464	92	4,078	7
Northern downlands	120,232	8,624	911	8
Catlins fringe	89,650	7,934	3,804	13
Eastern hill country	355,040	33,816	16,100	14
Blue Mountains	30,505	11,120	2,882	46
Inland block mountains	757,409	6,995	346,038	47
Northern ranges	178,032	5,181	97,371	58
Catlins	70,594	43,570	1,728	64
Western lakes and mountains	948,572	134,832	676,366	86

Utility of Ecosystem Zonation

The 11 ecosystem zones described above have different combinations of elevation, landforms, indigenous and exotic vegetation cover, and land uses. These zones would be suitable, at a broad scale, for state of the environment reporting, for example reporting changes in the extent of indigenous cover classes. They also provide a basis for delivery of the most appropriate management actions to benefit biodiversity. For example, in the Inland Basin Floor, Lowland Plains, Northern Downlands, and Southern Downlands zones, the highest priority should be to protect all remaining indigenous vegetation, and increase the extent of indigenous cover through restoration projects that involve planting of indigenous plant species. Restoration of indigenous forest is particularly important in the Lowland Plains and Inland Basin Floors zones, as very little indigenous forest remains in these zones. In the zones with large amounts of indigenous cover remaining, the focus should be on large scale pest control projects to allow populations of indigenous fauna to expand and flourish within these extensive indigenous habitats. In the Catlins Fringe and Eastern Hill Country zones, the sizeable areas of gorse and/or broom provide an opportunity for restoration to indigenous forest if managed appropriately, and the larger areas of remaining indigenous forest in these zones could also be a focus for landscape-scale pest animal control activities.

5. KEY BIODIVERSITY FEATURES

Otago Region has significant ecological diversity, stretching from deepwater marine and coastal habitats through coastal forest to semi-arid inland basins and upland herbfield and grassland, and western lakes, rivers, and mountains. Otago is notable for its assemblages of endemic lizards, fish, plants, and invertebrates, and the marine mammals, penguins, and other shorebirds that occur along the Otago coast. Distinctive and special features of Otago's indigenous biodiversity are its coastal and marine habitats and fauna, tussock grassland uplands, inland saline habitats, lizards and fish, and rich plant and invertebrate diversity. These features are discussed in more detail below.

5.1 'Otago Peneplain'

The so-called Otago Peneplain (Forsyth 2001) is well-preserved in central Otago, especially in an area bounded by the Manuherikia River, Clutha River, Shag/Waihemo River, and the coastal Otago hills. This comprises the Maniototo, Manorburn, Waipori, Rock and Pillar, and Macraes Ecological Districts, and falls within the eastern part of the Inland Block Mountains land use zone.

Ecological features included within this area are:

- Extensive upland tussock grassland vegetation with high vascular plant diversity.
- Significant wetlands, including large upland peat bogs, and numerous ephemeral wetlands, an originally rare ecosystem (Williams *et al.* 2007) classified as Threatened-Critically Endangered (Holdaway *et al.* 2012). Ephemeral wetlands provide habitat for numerous Threatened and At Risk plant species.
- Nationally significant inland saline habitats, an originally rare ecosystem (Williams *et al.* 2007) classified as Threatened-Critically Endangered, with only 10-100 hectares remaining (Holdaway *et al.* 2012). These saline habitats support populations of Threatened indigenous halophytic plant species and include New Zealand's only salt lake, Sutton Salt Lake near Middlemarch.
- Nationally significant populations of Threatened and At Risk (Goodman *et al.* 2014) freshwater fish, including Clutha flathead galaxias (*Galaxias* 'species D'; Threatened-Nationally Critical) in the vicinity of Lawrence, Central Otago roundhead galaxias (*G. anomalus*; Threatened-Nationally Endangered) in the Maniototo, Teviot flathead galaxias (*G.* 'Teviot'; Threatened-Nationally Critical) in tributaries of Lake Onslow, and Eldon's galaxias (*G. eldonii*) and Dusky galaxias (*G. pullus*) in east Otago (both Threatened-Nationally Endangered).
- Nationally significant lizard populations, including those of grand skink (*Oligosoma grande*) and Otago skink (*Oligosoma otagense*), both classified as Threatened-Nationally Endangered (Hitchmough *et al.* 2016), and both unique to Otago Region.



Sphagnum bog in tussock grassland



Otago skink (*Oligosoma otagense*) is a nationally threatened lizard found only in Otago Region

- Numerous significant populations of Threatened and At Risk indigenous plant taxa, including nationally significant populations of the grass *Simplicia laxa* and undescribed native bidibid *Acaena* aff. *rorida*, both classified as Threatened-Nationally Critical (de Lange *et al.* 2013).



Habitat of *Acaena* aff. *rorida*, Ida Valley, Maniototo. This taxon is also currently known only from Otago.

Significant pressures on these biodiversity values include:

- Clearance of tussock grassland vegetation due to pastoral intensification and mining. This area experienced some of New Zealand's most rapid reductions in indigenous vegetation cover between 2002 and 2012, which resulted in a change in Threatened Environment Classification category from Chronically Threatened (10-20% cover remaining) to Acutely Threatened (<10% cover remaining) (Cieraad *et al.* 2015). Numerous Threatened and At Risk species are affected by such clearance.
- Clearance of inland saline habitats through pastoral intensification.
- Predation by feral cats, mustelids,



Wilding conifers and tussock grassland: Regenerating contorta pine (*Pinus contorta*) is visible in tussock grassland vegetation on the western slopes of Maungatua. If left uncontrolled, wilding conifers such as contorta pine can displace indigenous tussock grassland habitat.

and rodents on populations of lizards, including the Otago skink, in addition to loss of tussock grassland habitat.

- Significant predation by trout (*Salmo trutta*) on indigenous fish and invertebrates, in addition to background loss and modification of freshwater habitat and barriers to migration.

5.2 Indigenous forest

Indigenous forest is mostly restricted to the margins of Otago Region, but these areas contain important forest habitat, and many transitions between different forest types. Indigenous forest values include:

- Examples of cloud forest, an originally rare ecosystem type (Williams *et al.* 2007) at Dunedin and in the Catlins.
- Forest at Mt Watkin/Hikaroroa is present on volcanic boulderfields, an originally rare ecosystem type (Williams *et al.* 2007) classified as Nationally Endangered (Holdaway *et al.* 2012).
- Rare examples of matai-tōtara forest occur on productive landforms in scattered locations from near Balclutha to North Otago.
- Kānuka (*Kunzea serotina*) scrub is increasing in extent in Central Otago, and is providing more habitat for indigenous forest birds and invertebrates.
- Habitat for Threatened indigenous forest fauna. Beech forest in western Otago, the Blue Mountains, and mixed forest in the Catlins support populations of mohua (*Mohoua ochrocephala*; Threatened-Nationally Vulnerable; Robertson *et al.* 2013), and South Island long-tailed bat (*Chalinolobus turberculatus* (South Island); Threatened-Nationally Critical; O'Donnell *et al.* 2013). Both of these insectivorous species were formerly widespread but are now much reduced with populations that have been strongly reduced due to predation from exotic mammalian predators. Kea (*Nestor notabilis*) and rock wren (*Xenicus gilviventris*) (both classified as Threatened-Nationally Endangered) are present in the western mountains of Otago.



Kea (Nationally Endangered) on a road sign in the Matukituki Valley.

5.3 Montane tall tussock grassland

Tall tussock grassland on the montane ranges of Central Otago (e.g. Rough Ridge), the foothills of taller ranges, and in uplands of the the Macraes area and Eastern Hill Country zone has been significantly reduced in extent over the last few decades, with the rate of reduction increasing more recently (Cieraad *et al.* 2015). Many of the tussock grasslands in these areas are species-rich, and comprise a matrix in which other habitats such as rock outcrops, shrublands, and gully and ephemeral wetlands are prominent. These habitats in turn provide shelter and feeding habitat for a range of indigenous lizards, birds, and invertebrates. Montane tussock grassland is being adversely affected by a number of land use activities, including grazing by livestock, burning, cultivation, and mining.



Montane tussock grassland in the Logan Burn area. A variety of habitats are visible, including sunny tussock slopes, shady tussock slopes, and abundant rock outcrop habitat.

5.4 Limestone ecosystems

The Shag/Waihemo Valley and North Otago contain cliffs and scarps of calcareous rocks, an originally rare ecosystem type (Williams *et al.* 2007) classified as Nationally Vulnerable (Holdaway *et al.* 2012). Limestone outcrops are key habitats for Threatened and At Risk plant species, but are relatively poorly-known in Otago Region.

Limestone ecosystems generally have little indigenous cover remaining, and are subject to invasion of exotic weeds that threaten to overwhelm any rare plants remaining on these limestone habitats. Restoration of indigenous forest around limestone outcrops could potentially help to maintain partially shaded limestone habitats, with rare plant species.

5.5 Inland outwash plains

Inland outwash plains are restricted to the upper Clutha basin within the Inland Basin Floors land use zone. They comprise outwash gravels generated by the historic glaciers that occupied the Lake Hawea and Lake Wanaka basins. These dry gravel landforms are critical habitats for a number of threatened plant species and were also important breeding habitat for seasonally-migrating wading birds, such as banded dotterel (*Charadrius bicinctus bicinctus*). Advances in irrigation systems have resulted in recent losses of outwash gravel habitat to more intensive agricultural practices. Residential development has also occurred on some of these habitats.

5.6 Inland saline ecosystems

Otago Region contains nationally significant inland saline habitats, including areas of saline/sodic soils (salt pans) in the Maniototo and in the upper Clutha basin, and New Zealand's only confirmed inland salt lake at Sutton. A number of rare plant species are specialised to these habitats, including the rare indigenous cress *Lepidium kirkii* (Threatened-Nationally Critical) and the rare geometrid moth *Paranotoreas fulva* (At Risk-Relict; Stringer *et al.* 2012). Most salt pans are threatened by land use intensification involving cultivation and irrigation, and by invasion of exotic weeds (Wildland Consultants 2011).



Salt pan habitat of *Lepidium kirkii*, Central Otago

5.7 River and lake ecosystems

Otago Region contains rare lake and river systems, on a national basis. For example the Lake Waihola-Waipori complex is nationally rare, and the Tautuku River is the only example of an east coast South Island river that has a catchment with over 95% indigenous cover. Sutton salt lake near Middlemarch is New Zealand's only confirmed example of a salt lake, and its bed supports distinctive indigenous turf vegetation when dry. Many rivers and streams in Otago support diverse populations of indigenous fish and invertebrates. Thirteen of these indigenous fish species are classified as Threatened or At Risk (Table 3), which is the most of any region of New Zealand. Most of these Threatened and At Risk species are galaxiid fish of inland areas.

Table 3: Threatened and At Risk fish species found in Otago Region.

Common Name	Species	Threat Classification
Teviot flathead galaxias	<i>Galaxias</i> 'Teviot'	Threatened-Nationally Critical
Clutha flathead galaxias	<i>Galaxias</i> 'species D'	Threatened-Nationally Critical
Lowland longjaw galaxias	<i>Galaxias cobitinis</i>	Threatened-Nationally Critical
Central Otago roundhead galaxias	<i>Galaxias anomalus</i>	Threatened-Nationally Endangered
Dusky galaxias	<i>Galaxias pullus</i>	Threatened-Nationally Endangered
Eldon's galaxias	<i>Galaxias eldonii</i>	Threatened-Nationally Endangered
Giant kōkopu	<i>Galaxias argenteus</i>	At Risk-Declining
Manuherikia alpine galaxias	<i>Galaxias</i> aff. <i>paucispondylus</i> 'Manuherikia'	Threatened-Nationally Endangered
Nevis galaxias	<i>Galaxias</i> 'Nevis'	Threatened-Nationally Endangered
Pomahaka galaxias	<i>Galaxias</i> 'Pomahaka'	Threatened-Nationally Endangered
Gollum galaxias	<i>Galaxias gollumoides</i>	Threatened-Nationally Vulnerable
Taieri flathead galaxias	<i>Galaxias depressiceps</i>	Threatened-Nationally Vulnerable
Southern flathead galaxias	<i>Galaxias</i> 'southern'	At Risk-Declining

6. MARINE ECOSYSTEMS

6.1 Overview of marine habitats

The marine ecosystem extends from mean high water springs (MHWS) to the 12 nautical mile limit of Otago Region. It is part of the South-East Marine Protection Planning Forum (see below) area, extending from Wallace Beach in the south to the Waitaki river mouth in the north. The coastline can be broadly categorised into five distinct environments (Figure 2):

- Lower extent of the Canterbury Bight, a coastline dominated by mixed sand and gravel beaches and braided rivers with lagoons/hapua at their outlets to the sea.
- Northern Otago coast, a sedimentary rock coast with shallow subtidal reefs supporting forests of giant kelp.
- Otago Peninsula, a prominent volcanic landform that strongly influences coastal currents, bordered to the east by a narrow shelf and deep water canyons that are found relatively close inshore.
- Clutha coastline, strongly influenced by fresh water input and sediment from the Clutha River, the biggest river by volume in New Zealand, which has a major effect on the chemistry and productivity of the coastal shelf waters.
- The Catlins, a cliffed and embayed coastline with old erosion-resistant sedimentary rocks that is strongly influenced by tidal currents and the outflow from Foveaux Strait/Te Ara a Kewa.

This stretch of coastline is recognised as distinct due to the mixing of sub-Antarctic and sub-tropical waters along the coast. In particular, the Southland Current is a special and major influence on the marine ecology of the area. Where the current heads north past the Otago Peninsula, the headland and offshore deep canyons narrow the current, creating periods where nutrients from deeper waters are potentially pushed up and become available in coastal waters. Wave exposure also has a significant impact, with the main exposure from the south to northeast, creating different habitats in sheltered areas, such as north of the Otago Peninsula, as well as behind smaller headlands and within bays.

6.2 South-East Marine Protection Forum

The South-East Marine Protection Forum (Roopu Manaaki ki te Toka) is currently undergoing a consultation process on a draft proposal for Marine Protected Areas (MPAs) in the South East Bioregion, under the remit of protecting biodiversity to help safeguard long term viability of habitats and ecosystems through the development of a network of MPAs. Note: the South-East Marine Area extends further North and South than the jurisdiction of Otago Regional Council. Through this process, a number of key habitats have been identified as sites worthy of marine protection:

- *River Mouths*

The Waitaki River and Clutha River influence marine biodiversity, both in terms of freshwater input to the marine environment and the sediment that is transported to the sea. The area surrounding the Waitaki River is known to be an important foraging area for seabirds (including southern blue penguin - *Eudyptula minor minor*) and Hector's dolphin (*Cephalorhynchus hectori hectori*), classified as Threatened-Nationally Endangered (Baker *et al.* 2016). Rhodolith beds, often associated with high biodiversity value, are also likely to be associated with cobble habitat in this area, as well as known kelp beds that are important for juvenile fish species. In addition, some of the densest areas of squat lobster (*Munida gregaria*) have historically been found around the Waitaki River mouth.

- *Estuaries*

Large estuaries are concentrated at two locations in Otago Region: at northern group including the mouth of the Pleasant River, Karitane, Blueskin Bay, Purakaunui Bay, Aramoana, Papanui Inlet, Hoopers Inlet, and Kaikorai Stream, and another cluster in the Catlins, comprising estuarine systems at the mouths of the Catlins, Papatowai, Fleming, and Waipati Rivers. Smaller estuaries and coastal lagoons are associated with many smaller rivers and streams in coastal Otago.



**Hoopers Inlet and Papanui Inlet,
Otago Peninsula**

A number of estuarine tidal sandflats and mudflats supporting saltmarsh vegetation, seagrass beds, shellfish beds and aquatic birdlife provide significant habitat for biodiversity. Estuaries provide nursery habitat for many types of fish, particularly flatfish and galaxiids, and are an important part of the migration pathways for a range of species, such as wading birds (godwits, herons), seabirds, and diadromous fish.

Otago's estuaries are threatened by infilling and drainage to create pasture, invasion by exotic plants such as spartina (*Spartina ×anglica*), and effects on water quality due to upstream land uses.

- *Tahakopa Estuary*

The Tahakopa Estuary in the Catlins comprises modified mud flats with a small area of salt marsh turf and an extensive area of oioi (*Apodasmia similis*). This intricate area of wetland is of special significance for wading birds and galaxiid breeding; flatfish are also a feature of the estuary's biodiversity. This relatively pristine estuary has significant ecological values.

- *Tautuku Estuary*

Also in the Catlins, the Tautuku Estuary is a largely unmodified estuary with a catchment largely comprising indigenous forest and protected wetlands. The estuary contains pristine saltmarsh and estuarine communities, and is an important breeding ground for black flounder (*Rhombosolea retiaria*) and yellow-belly flounder (*Rhombosolea leporina*). The estuary is also an important habitat for South Island fernbird (*Bowdleria punctata punctata*).

- *Intertidal and Shallow Subtidal Habitats*

The extent of these habitats across the Region varies at a local scale. They consist of subtidal forests of giant bladder kelp (*Macrocystis pyrifera*) and bull kelp (*Durvillaea antarctica*), with other dominant brown kelp species below depths of three metres. Giant bladder kelp is a habitat-forming indigenous kelp that provides important habitat for fisheries, and is long-lived but recovers slowly after damage. It forms the base of complex food webs which provide for both coastal and pelagic species, such as rock lobster (*Jasus edwardsii*). Kelp understoreys also consist of a diverse assemblage of small red seaweeds, and a variety of sponges, bryozoans and solitary ascidians.

Beaches and subtidal sediments across the Region contain shellfish species - such as cockle/tuaki (*Austrovenus stutchburyi*), tuatua (*Paphies subtriangulata*), and horse mussel (*Atrina zelandica*) - that create extensive shellfish beds, as well as containing marine worms and crustacea.

- *Biogenic Habitats*

Biogenic habitats are formed by living organisms or their remains, including deeper habitats (bryozoan beds, rhodolith beds, shellfish beds, sponge gardens, cold water corals and tube worms) and shallow estuarine habitats (shellfish beds, seagrass beds and saltmarshes). Biogenic reefs are found throughout the Otago marine environment. Bryozoan beds enhance local biodiversity by providing attachment surfaces for invertebrates such as anemones, and places for other animals to hide from predators. Juvenile tarakihi (*Nemadactylus macropterus*) are associated with tube worm habitats along the East Coast of the South Island, while blue cod (*Parapercis colias*) are associated with biogenic habitats in Foveaux Strait, as well as with the Otago bryozoan beds.

Seagrass beds have been identified in the Otago Harbour, Papanui Inlet, Blueskin Bay, Waikouaiti River and at Moeraki. New Zealand has only one species of seagrass, *Zostera muelleri*, which provides a range of ecosystem services, including provision of habitat, refuge, shelter and nursery grounds; they are identified as “hotspots” of biodiversity and productivity, involving macroinvertebrate and fish assemblages.

A local example of biogenic habitat in Otago Region includes dense assemblages of sponges, tulips and tubeworms which occur offshore from north of Oamaru to the Waianakarua River; these habitats provide for a multitude of invertebrate species, and nurseries for fish including blue cod, rock lobster and tarakihi.

- *Deep Sub-Tidal Habitats (greater than 30 metres depth)*

There is relatively little known regarding the biology of the deep subtidal shelf area; the main research focus has been on an extensive area of bryozoan beds on the mid and outer shelf directly east of Otago Peninsula. The heads of several canyons (Karitane Canyon, Papanui Canyon, and Saunders Canyon) are located within the 12 nautical mile limit of the Otago marine area. These habitats are important deep slope environments, with diverse fauna including brittle stars, sea stars, gastropods, bivalves, shrimps, hermit crabs, bryozoans, sponges and quill worms. They are known hotspots for whales and seabird activity. Shephard's beaked whale (*Tasmacetus shepherdi*), one of the world's least known cetaceans, was recently sighted for the first time in New Zealand waters in the vicinity of the Saunders and Taiaroa Canyons. Deep offshore reefs and gravels (such as Akatore Offshore, with areas of ice-age relict shoreline gravel) are likely suitable habitat for bryozoans. These areas are also an offshore foraging area for yellow-eyed penguins (*Megadyptes antipoda*) from Otago Peninsula. Also likely in the area are New Zealand fur seal (*Arctocephalus forsteri*), sooty shearwater (*Puffinus griseus*), Buller's albatross (*Thalassarche bulleri*), and white-capped albatross (*Thalassarche cauta*).

6.3 Marine fauna

The Otago marine environment is an important foraging area for marine mammals and seabirds, including those protected under the Wildlife Act 1953 and the Marine Mammals Protection Act 1978. There are a number of Important Bird Areas (IBAs) located within the Otago marine environment; these are sites that are recognised as internationally important for bird conservation, and are known to support key bird species and other biodiversity. Many of these bird species are found only in New Zealand, such as the yellow-eyed penguin, the northern royal albatross (*Diomedea sandordii*), spotted shag (*Stictocarbo punctatus*) and Otago shags (*Leucocarbo chalconotus*); these species and others use the offshore marine environment for foraging, passage and maintenance behaviours.

The endangered great white shark (*Carcharodon carcharias*) and basking shark (*Cetorhinus maximus*) occur seasonally off the Otago coast but there is currently limited data available on their movement and habitat requirements.

The Otago Region was previously an important calving ground for southern right whale (*Eubalaena australis*) in New Zealand; this recovering population is now frequently sighted off the Otago coast, particularly during the winter months.

Female New Zealand sea lion (*Phocarctos hookeri*) are known to use the Otago coast for resting and giving birth to pups. New Zealand sea lion have a conservation status of Threatened-Nationally Critical (Baker *et al.* 2010) and there has been a rapid decline in numbers observed in their main population at the Auckland Islands. A small breeding population established around Otago Peninsula following the arrival of a female sea lion to this area in the early 1990s and individuals in this population regularly forage along coast within the project area as far north as Shag Point. Sea lions have a preference for coming ashore to rest on sandy beaches, and so, while they

are very rare, it is a common occurrence for them to be encountered on the coast. Females often travel a remarkable distance inland in search of private places to rest and have shown a preference for resting sites in stands of radiata pine forest adjacent to the coast. Unfortunately their travel to resting habitats such as these can expose them to risks from hazards such as roads and railway tracks.

Hector's dolphin inhabits coastal waters around Otago peninsula, north of Moeraki, and the southern Catlins near Waikawa Harbour.

New Zealand fur seal are also present in coastal Otago with an established breeding rookery at Heyward Point. Fur seals prefer to haul out on rocky shore lines, so while they are common they are less regularly encountered by beach walkers. The end of the Aramoana Mole is a regular haul out for fur seals, which can be viewed with minimal disturbance to them at this site. Fur seals are afraid of people and will return to the sea if they feel threatened.

Leopard seals (*Hydrurga leptonyx*) are a regular seasonal occurrence in winter. Sightings of leopard seals between Aramoana and Karitane have been reported to or observed by the Department of Conservation in most years since 1999.

Southern elephant seal (*Mirounga leonina*; Threatened-Nationally Critical) are less frequently seen, although dead seals are often washed ashore by the Otago Peninsula eddy. During one year there was a yearling present on Warrington Beach for a week or so.

A summary of seabirds and marine mammals found in the Otago marine environment is included in Table 4. Nine of these species are classified as Threatened and eight as At Risk.

Table 4: Summary of seabirds and marine mammals found in Otago Region.

Common Name	Species	Threat Classification
Southern blue penguin	<i>Eudyptula minor minor</i>	At Risk-Declining
Yellow-eyed penguin	<i>Megadyptes antipodes</i>	Threatened-Nationally Vulnerable
Black-backed gull	<i>Larus dominicanus</i>	Not Threatened
Red-billed gull	<i>Larus novaehollandiae scopulinus</i>	Threatened-Nationally Vulnerable
White-fronted tern	<i>Sterna striata striata</i>	At Risk-Declining
Otago shag	<i>Leucocarbo chalconotus</i>	Threatened-Nationally Vulnerable
Spotted shag	<i>Stictocarbo punctatus punctatus</i>	Not Threatened
Little shag	<i>Phalacrocorax melanoleucos brevirostris</i>	Not Threatened
Pied shag	<i>Phalacrocorax varius varius</i>	Threatened-Nationally Vulnerable
Australasian gannet	<i>Morus serrator</i>	Not Threatened
Northern royal albatross	<i>Diomedea sanfordi</i>	At Risk-Naturally Uncommon
Sooty shearwater	<i>Puffinus griseus</i>	At Risk-Declining
Fairy prion	<i>Pachyptila turtur</i>	At Risk-Relict
Broad-billed prion	<i>Pachyptila vittata</i>	At Risk-Relict
White-faced storm petrel	<i>Pelagodroma marina maoriana</i>	At Risk-Relict
Common diving petrel	<i>Pelecanoides urinatrix chathamensis</i>	At Risk-Relict

Common Name	Species	Threat Classification
Bottlenose dolphin	<i>Tursiops truncatus</i>	Threatened-Nationally Endangered
Common dolphin	<i>Delphinus delphis</i>	Not Threatened
Hector's dolphin	<i>Cephalorhynchus hectori hectori</i>	Threatened-Nationally Endangered
Dusky dolphin	<i>Lagenorhynchus obscurus</i>	Not Threatened
New Zealand fur seal	<i>Arctocephalus forsteri</i>	Not Threatened
New Zealand sea lion	<i>Phocarctos hookeri</i>	Threatened-Nationally Critical
Leopard seal	<i>Hydrurga leptonyx</i>	Vagrant
Southern elephant seal	<i>Mirounga leonine</i>	Threatened-Nationally Critical
Humpback whale	<i>Megaptera novaeangliae</i>	Migrant
Minke whale	<i>Balaenoptera bonaerensis</i>	Not Threatened
Pilot whale	<i>Globicephala melas</i>	Not Threatened
Southern right whale	<i>Eubalaena australis</i>	Threatened-Nationally Vulnerable
Sperm whale	<i>Physeter microcephalus</i>	Not Threatened
Shepherd's beaked whale	<i>Tasmacetus shepherdii</i>	Data Deficient

6.4 Research

Current research in the Otago marine environment includes the following:

The University of Otago and the associated Marine Laboratory is currently involved with a number of research projects in Otago Region, including:

- Benthic structure and function of the Otago shelf and upper slope
- Fisheries ecosystems in coastal kelp forests
- Role of omnivores in kelp forest community structure
- Biology and ecology of inlet and estuarine macrobenthos
- Impact of the Subtropical Frontal Zone on bacterio-plankton carbon cycling
- Paua fisheries ecosystems



The Proposed Marine Protected Areas for New Zealand's South Island South-East Coast also highlights that with the implementation of a network of MPA, these provide a foundation for research and education that will provide benefits for our understanding of marine ecology, the impact of pressures on the marine environment, conservation efforts and biodiversity in general.

Conservation biology of Hector's dolphin: Otago University has been involved in a long-term research programme (1984-present), providing much of the data informing current conservation measures for this endemic species of dolphin; current work is focussed on survival rates and reproduction.

6.5 Threats to marine biodiversity

Threats to biodiversity in the Otago marine environment are comparable to those elsewhere in New Zealand, including sedimentation and excessive nutrients from land run-off, wastewater discharge, dumping of dredge spoil and rising sea temperatures. Suspended sediment in the water column also reduces the amount of light energy

reaching plant communities (such as kelp and seagrass), drastically reducing their productivity.

Invasive species, such as *Undaria pinnatifida*, have been shown to out-compete indigenous kelp and macroalgal species, reducing species diversity. Likewise, harvest of kelp for fertilisers, fish food and human consumption has the ability to significantly reduce kelp biomass and alter food web dynamics.

“Anecdotal evidence from local commercial fishers in Otago indicate that the extent of kelp-forests has reduced compared to twenty years ago, and attribute the decline to the negative impacts of sedimentation on juvenile kelp. In areas where M. pyrifera has disappeared completely (e.g. Taieri Mouth) fishers report a downturn of local fisheries for crayfish and finfish.” - South-East Marine Protection Forum.

Fishing methods have the potential to impact on marine biodiversity, particularly where mobile bottom impacting methods (i.e. trawling and dredging) directly impact biogenic habitats, including bryozoan beds, which are sufficiently delicate and slow growing that even a single pass by a trawl or dredge can cause damage that may take decades to recover.

7. CURRENT ORGANISATIONAL ACTIVITIES

7.1 Overview

At least 71 stakeholder organisations are working on activities aimed at the protection and enhancement of indigenous biodiversity in Otago Region See Figures 3 and 3a-3c. These include four government departments (Department of Conservation, Department of Land Information, Ministries for Primary Industries, and the Ministry for the Environment), five territorial authorities, the regional council itself, two research organisations, approximately fifty NGOs, and numerous schools (Appendix 1). Dunedin City District has a greater number of NGOs involved in the protection and enhancement of indigenous biodiversity than do the other TLAs.

All of the NGOs have projects involving the enhancement and/or restoration of areas of indigenous biodiversity, with many projects centred on coastal habitats, forests, and streams. Relatively fewer NGO projects are located in dryland habitats or involve lakes. Most NGO projects include planting of indigenous plant species and weed control (including significant areas of recently-funded wilding conifer control), while many also include pest animal control. Relatively fewer NGOs (11) are involved in the legal protection of areas of indigenous vegetation and habitat, but the Department of Conservation and Queen Elizabeth the Second National Trust (QEII) provide considerable protection of indigenous vegetation and habitats in Otago. The Dunedin City Council also administers several Scenic Reserves, protected under the Reserves Act 1977.

Many primary schools are involved in biodiversity projects. These often involve planting, but also projects such as creation of lizard habitat and trapping predators. Schools typically partner with NGOs or external technical experts to resource and implement these projects.

In the sections below, roles and/or activities are summarised for the Department of Conservation, the Otago Regional Council, and the five territorial local authorities within Otago Region.

7.2 Department of Conservation roles and activities

The Department of Conservation administers a number of acts of parliament, the key one being the Conservation Act 1987. The Department runs programmes to protect and restore species, places, and heritage, and provide opportunities for people to engage with these features. It also manages the single largest historic heritage portfolio in New Zealand, with some 12,000 archaeological and historic heritage sites. Other acts administered by the Department include the Marine Mammals Protection Act 1978 and the Wildlife Act 1953. The protection and conservation of seabirds, marine mammals, and other protected marine species is the Department's responsibility, and it undertakes research relating to the effects of fishing on these species, and how these effects could be mitigated. It also develops population management plans for protected species under the Wildlife Act 1953 and the Marine Mammals Protected Act 1978. Some biodiversity programmes of relevance to Otago Region are described below.

7.2.1 Biodiversity programmes relevant to Otago

Battle for the Birds

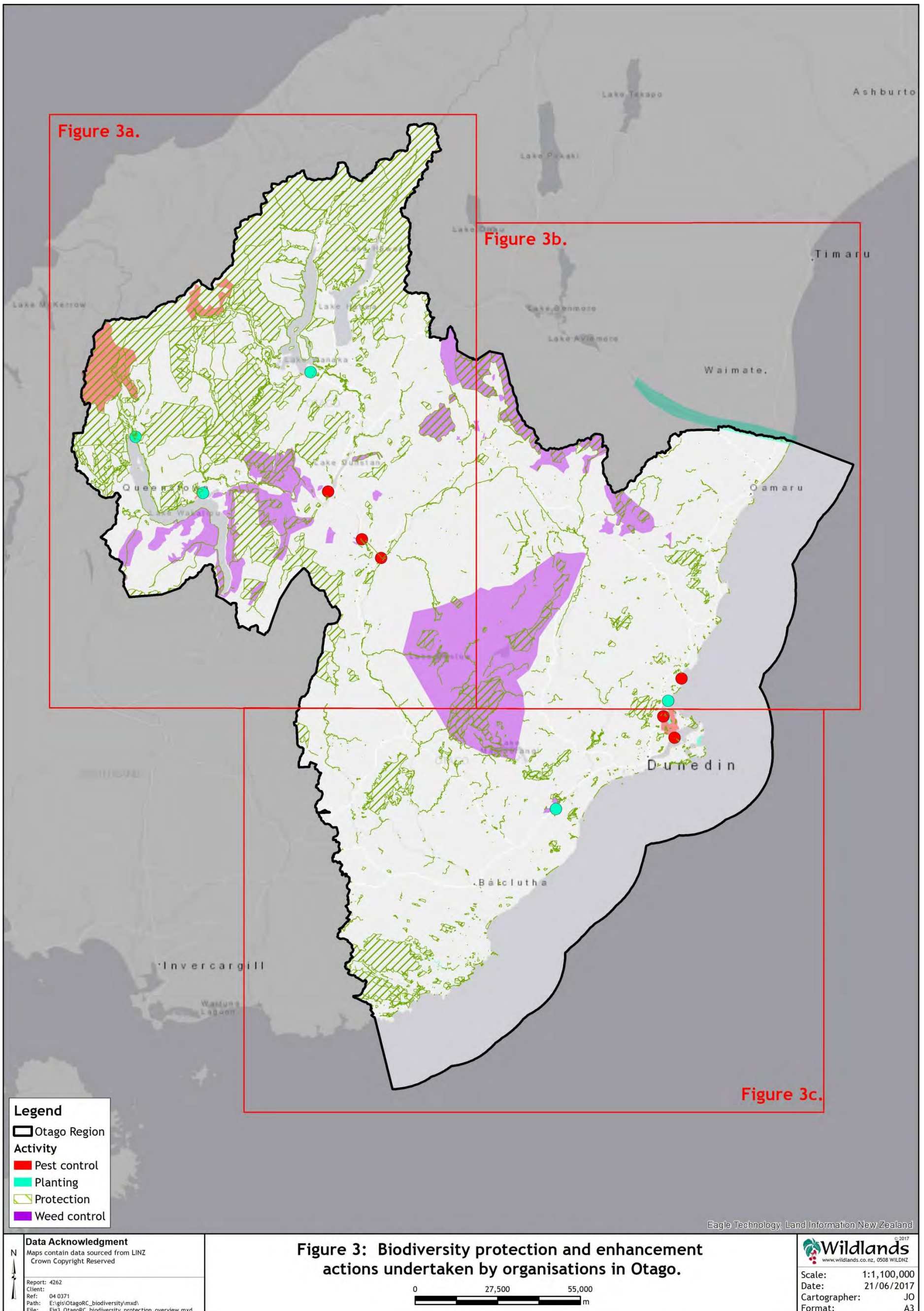
Battle for the birds is a national-scale predator control programme that protects vulnerable indigenous fauna including kea, South Island kākā, mohua, and long-tailed bat, all of which have populations in Otago. The programme uses aerially-spread 1080 over areas of often rugged terrain to knock down rats, stoats, and possums. Trapping and other ground-based predator control methods are also used where appropriate. The location of treated sites varies, as previous control, weather, beech mast events, and pest animal indices all play a part in determining where future control is undertaken. In 2016, Battle for the Birds sites in Otago included Makarora, Dart/Routeburn/Caples, and Waikaia.

Routeburn and upper Hollyford stoat control

Donations from trampers on the Routeburn Track have enabled the setting up of 188 stoat traps in boxes along the Routeburn Track, and the goal is to expand the area to join up with other pest animal control projects in the wider area.

Goat control

Goat control is undertaken on the margins of Mt Aspiring National Park, and at Bendigo, Ardgour, Cairnmuir, Lauder Basin, Long Gully, and Waikerikeri in Central Otago.



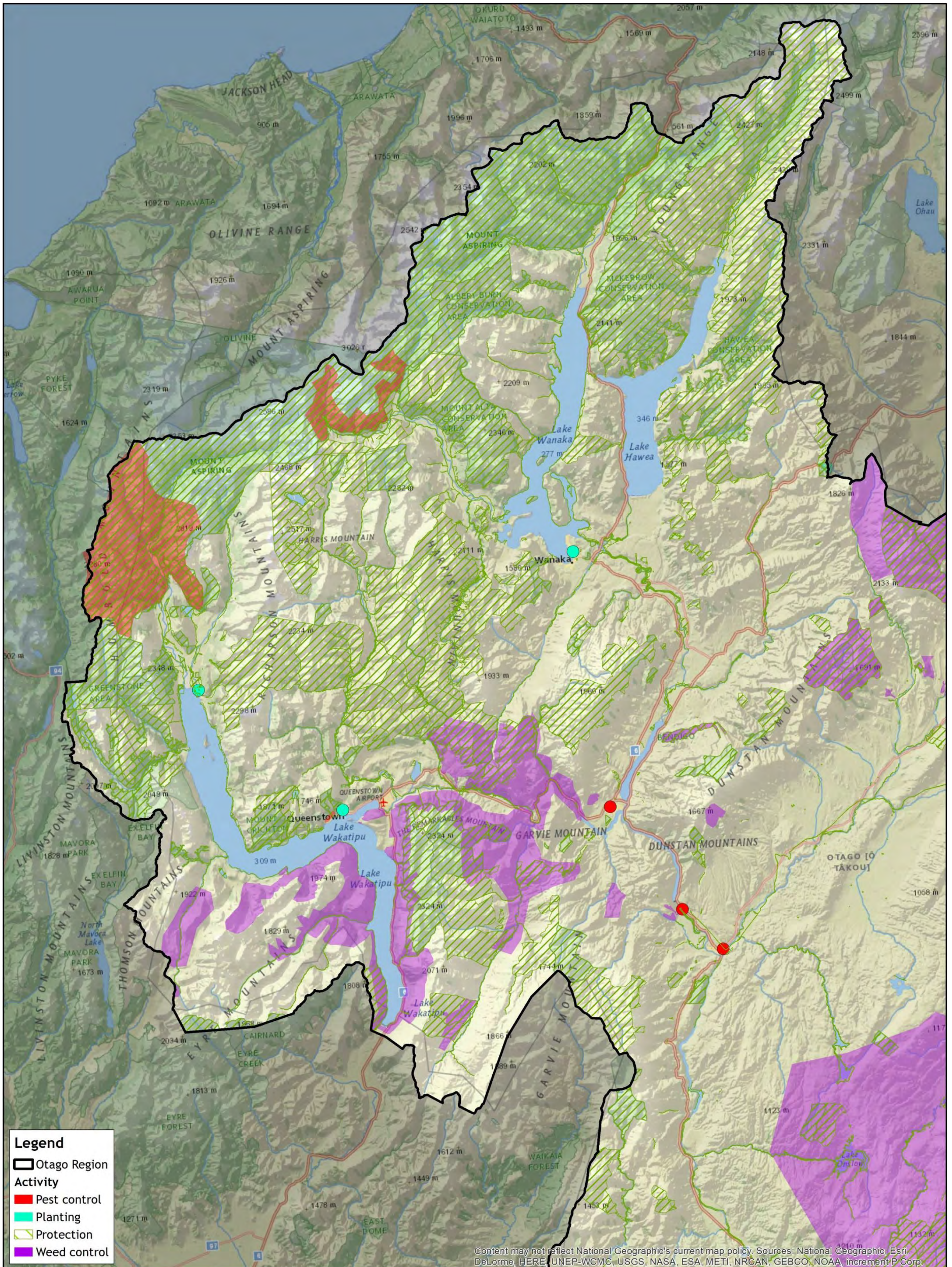


Figure 3a: Biodiversity protection and enhancement actions undertaken by organisations in Otago.

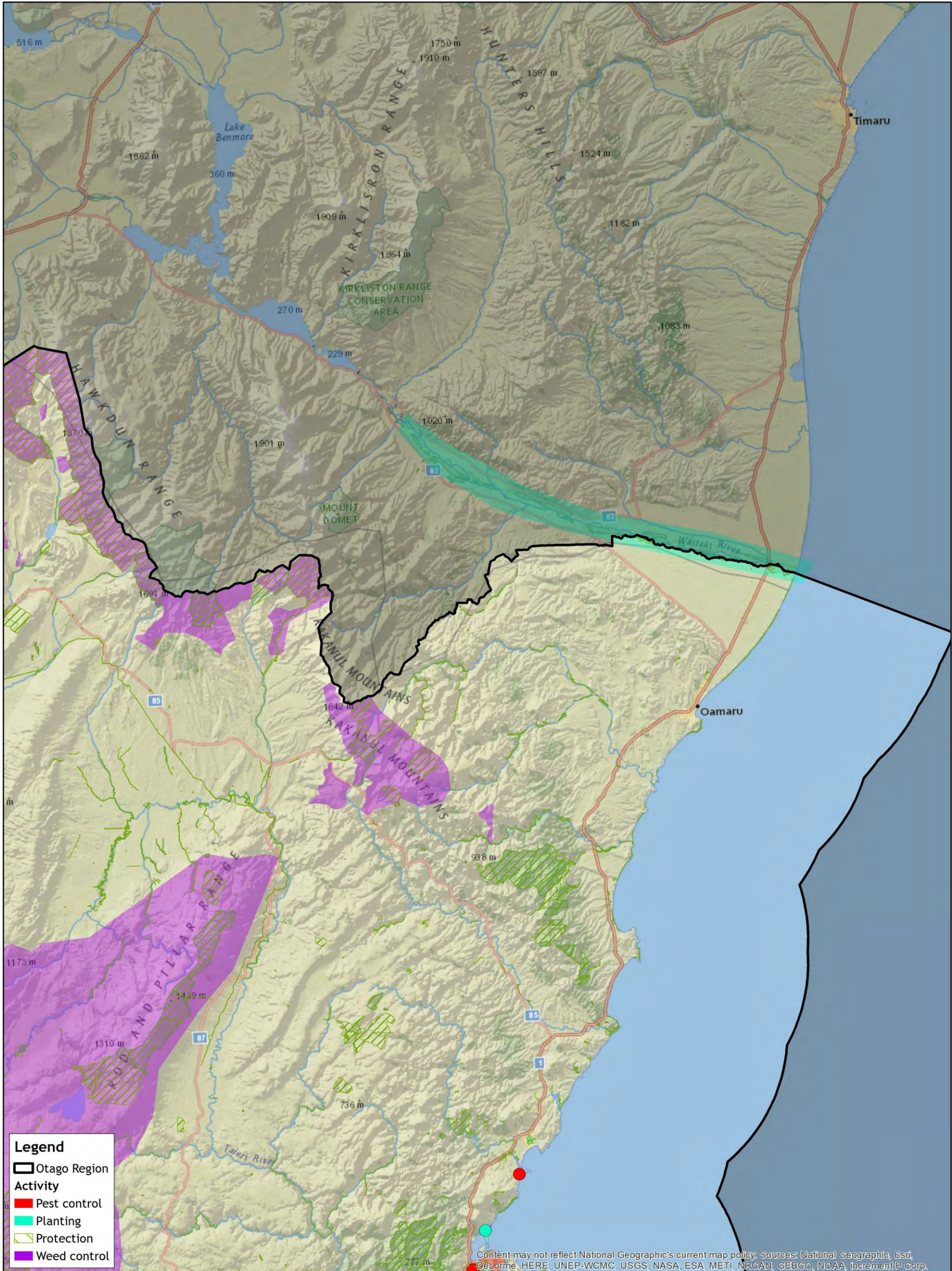
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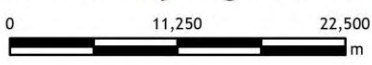
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- Otago Region
- Activity**
- Pest control
- Planting
- Protection
- Weed control

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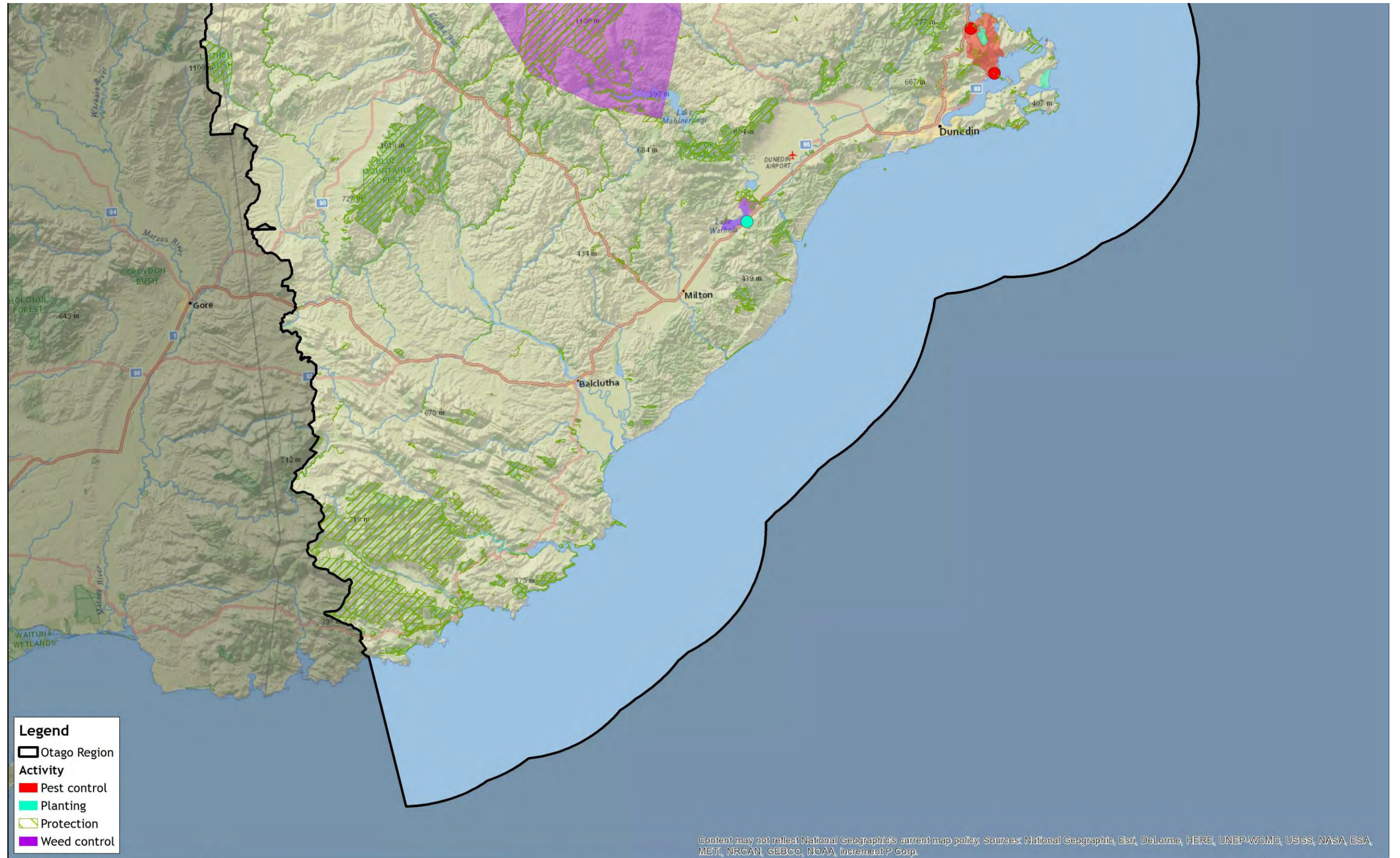
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Figure 3b: Biodiversity protection and enhancement actions undertaken by organisations in Otago.



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Scale: 1:450,000
 Date: 21/06/2017
 Cartographer: JO
 Format: A3



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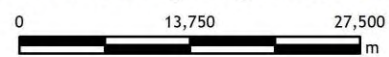
Legend

- Otago Region
- Activity**
- Pest control
- Planting
- Protection
- Weed control

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Figure 3c: Biodiversity protection and enhancement actions undertaken by organisations in Otago.



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Scale: 1:550,000
 Date: 21/06/2017
 Cartographer: JO
 Format: A3

Project Gold

Project Gold was initiated by the Department to protect and enhance kowhai trees in Otago. The project aims to encourage Otago people to grow and look after kowhai, and strengthen community enthusiasm for dryland forest restoration. The Department is working with landholders, community groups, and schools, and a key project will be the widespread planting of kowhai along the length of the Otago Central Rail Trail.

Monitoring programmes

The Department undertakes national scale monitoring of biodiversity in some 1440 sites as part of its Tier 1 biodiversity monitoring programme. This includes scattered monitoring sites in eastern Otago - Papanui Conservation Park, Catlins, Waikaia, Umbrella Range, Remarkables, Shotover - but a higher density of sites in the western ranges of Otago. Additional plots have been established for vegetation alone. A number of indicators are reported from the Tier 1 data, including bird and plant species richness and various indices of pest animal abundance.

The Department undertakes a number of local monitoring programmes in Otago, including monitoring of rabbit abundance in reserves at Flat Top Hill, Bendigo, Taiaroa Head, and Otago Peninsula, and seed rain monitoring in the Catlins and Dart and Caples Valleys. Possums are monitored by the Department in the Wanaka area to assess their effects on mountain cedar dieback.

Conservation services programme

The Conservation Services Programme focusses on protected marine species, including all marine mammals, all seabirds, and nine fish.

7.3 Otago Regional Council activities

Otago Regional Council activities that relate to indigenous biodiversity were summarised by Becher (2015), and this section draws on information from this summary. Most of the Otago Regional Council activities relating to indigenous biodiversity are mandatory (required by legislation), but also include various discretionary activities. Most mandatory activities occur in the freshwater environment, and spanned the entire planning cycle from policy development to monitoring and reporting. Biosecurity activities were the main component of Otago Regional Council action in the terrestrial environment.

Policy

As relevant policies of the Otago RPS are described above in Section 3.6, the activities discussed in this section do not include RPS policy. The Regional Council also administers a water plan, which has provisions that address habitat quality, and contains a schedule of regionally significant wetlands. A coastal plan addresses aspects of coastal biodiversity. It includes a schedule of coastal protection areas that include many important beaches, coastal platforms, and intertidal and estuarine habitats that are important habitats for indigenous birds, fish, marine mammals, and marine invertebrates. The plan gives priority to avoiding adverse effects on the values

that these habitats hold. The coastal plan also includes a schedule of important indigenous marine mammal and bird habitats adjacent to the coastal marine area, which are to be taken account of in decision-making on adjacent activities within the coastal marine area.

Water

Policy is implemented through resource consent decision making that enables conditions to address riparian planting, sedimentation, discharges to water, fish passage. Establishment of minimum flows also helps to maintain in-stream values, and in-stream works must avoid bird nesting and fish-spawning seasons. Indigenous fish populations are considered in resource-consent decision-making relating to in-stream effects. Water conservation orders are emplaced on the Kawarau and Nevis Rivers.

Protecting, enhancing, and restoring indigenous biodiversity

Council owned land near Lake Tuakitoto was restored through realignment of rivers and restoration of wetland hydrology. Otago Regional Council has also purchased land in the Pleasant River estuary to protect an extensive and important area of indigenous saltmarsh vegetation and habitat.

Biosecurity

Fourteen pest plant species that affected indigenous biodiversity are listed in the Pest Management Plan (RPMP) for Otago. One of the most important of these for open environments is contorta pine (*Pinus contorta*), while other important ecological weeds are old man's beard (*Clematis vitalba*), which threatens indigenous forest ecosystems, and spartina (*Spartina* spp.) which affects estuarine habitats. Of the pest animals addressed by policy in the RPMS, Bennett's wallaby (*Macropus rufogriseus rufogriseus*) is a significant threat to indigenous vegetation in Otago. Otago Regional Council takes a leadership role in biosecurity at a national level, and in implementation of both national and regional biosecurity programmes.

Research and monitoring

The Waikouaiti and Kakanui estuaries have been mapped, and some monitoring of beach water quality is undertaken. Reporting on estuaries and coastal water is undertaken. State of the environment monitoring is undertaken for fish at thirty sites within Otago. GIS databases are maintained for significant wetlands, estuaries, and galaxiid populations.

Facilitation and funding

Regional Council staff meet with NGOs, key stakeholders, and community groups, and the Council facilitates pest control undertaken by community groups and landholders by providing funding for purchase of traps and by making mustelid traps available for a minimal fee. Council staff have also facilitated community groups working on biodiversity projects by commissioning biodiversity surveys and providing technical advice.

Otago Regional Council has provided significant capital funding for Orokonui Ecosanctuary developments and operational funding wilding conifer control in Otago. The Council also administers the Honda Tree Fund which provides funding for community groups and individuals to purchase indigenous trees for planting projects. The Regional Council also employs a regional coordinator for the Otago Enviroschools programme, and provides part-funding for a researcher employed by the Yellow-eyed Penguin Trust.

7.4 Territorial Local Authorities

Biodiversity-related policies and activities of the five territorial authorities within Otago Region are summarised in Table 5. Dunedin City Council has the greatest range of biodiversity-related activity, including a biodiversity strategy, biodiversity coordinator, active management of biodiversity in Council-owned reserves, and a project to monitor the state of indigenous biodiversity. However, it has not proposed a comprehensive schedule of significant natural areas.

Waitaki District Council also has a biodiversity strategy, coordinator, and biodiversity fund, and is actively assessing potentially significant habitats.

Clutha District Council has only a biodiversity fund, and a limited schedule of significant indigenous vegetation and habitats.

Neither Central Otago District Council nor Queenstown Lakes District Council have biodiversity strategy, coordinator or fund, but these Councils differ in other respects.

Queenstown Lakes District Council has a reasonably comprehensive list of significant natural areas and is a significant partner in wilding tree control in the district, while Central Otago District Council has a limited schedule of significant natural areas and does not appear to undertake any biodiversity activities.

The activities of these Councils are described in more detail below.

Table 5: Summary of District Council biodiversity activities in Otago Region.

TLA	Biodiversity Strategy	Biodiversity Coordinator	Biodiversity Fund	Schedules of Sites ¹ Include	Vegetation Clearance Rules
Waitaki	Yes	Yes	Yes	RAP, SSWI, DOC, RSW, other sites	Yes
Dunedin	Yes	Yes	Yes	DOC, RSW, QEII, WERI, DCC	Yes
Clutha	No	No	Yes	DOC, fauna habitats, wetlands	Yes
Central Otago	No	No	No	DOC, RSW, other wetlands	Yes
Queenstown Lakes	No	No	No	Woody vegetation, WERI, RSW, SSWI	Yes

¹ RAP = recommended area for protection under the PNAP programme; SSWI = site of specific wildlife interest; DOC = public conservation land; RSW = regionally significant wetlands, WERI = wetlands of ecological and representative importance; DCC = Dunedin City Council reserves.

Waitaki District Council

Waitaki District Council is one of two local authorities with a biodiversity strategy, which was adopted in 2014. The Council maintains a contestable \$30,000 biodiversity fund aimed to help fund physical and legal protection of indigenous biodiversity, and management of threats to indigenous biodiversity on private land. To be eligible, sites should be legally protected, recognised as an SNA, or meet SNA criteria. The fund is available on a 50:50 proviso, funding up to half the total costs of a project. The Waitaki District Plan contains a schedule of significant sites addressed by district plan policies. The schedule comprises a selection of recommended areas for protection (RAP) under the PNAP programme, sites of specific wildlife interest (SSWI), areas of conservation land, and regionally significant wetlands. Some other sites of conservation merit are listed in another schedule, but are not addressed by district plan policy. The Council is currently undertaking a programme of ecological surveys to identify additional areas of significant indigenous vegetation and habitats of significant indigenous fauna on private land within Waitaki District. This should result in a much more comprehensive schedule of significant sites when the Waitaki District Plan is next reviewed. Waitaki District Council employs a part-time biodiversity coordinator whose role includes liaison with landholders.

Dunedin City District Council

Dunedin City Council approved a biodiversity strategy for Dunedin in 2007, and maintains a contestable biodiversity fund of \$60,000 that is also provided on a 50:50 cost share basis. The Council owns reserves under the Reserves Act 1977 including large scenic reserves, and other large *de facto* reserves where indigenous vegetation is maintained to protect water quality. The operative Dunedin City District Plan contains a schedule of significant areas of indigenous vegetation and habitats, which includes areas of conservation land, QEII covenants, regionally significant wetlands, wetlands of ecological and representative importance, and DCC-owned sites. While ecological assessments of potentially significant sites on private land have since been undertaken, the proposed second generation plan has not scheduled the majority of these areas. The plan also contains schedules of important indigenous tree species and Threatened, At Risk, and locally uncommon plant species in Dunedin City District, with rules relating to the protection of these values. The proposed second generation district plan has more protective indigenous vegetation clearance standards than the operative plan. The Council undertakes pest and weed control within the substantial areas of indigenous vegetation and habitat it owns. The Council has implemented a trial project to control sycamore (*Acer pseudoplatanus*) in the west harbour area. The Council is also establishing indicators to assess and monitor the state and trend of indigenous biodiversity within the District. A biodiversity officer is employed by the Council with a key role in management of the extensive areas of indigenous vegetation and habitat owned by the Council, but currently with no landholder liaison role

Clutha District Council

Clutha District does not have a biodiversity strategy, but maintains a biodiversity fund with similar criteria to those operated in Dunedin City and Waitaki Districts. It has a schedule that contains conservation land and local purpose reserves, not all of which

are likely to contain indigenous vegetation and habitats, and district plan tables of significant wetlands and significant habitats of indigenous fauna with associated rules. Clutha District Council has been consulting recently on landscape issues, which have occupied a lot of its

Central Otago District Council

Central Otago District is not covered by a biodiversity strategy and does not operate a biodiversity fund. It has no current biodiversity projects. The Central Otago District Plan contains schedules of conservation land, regionally significant wetlands, and other wetlands. The Council is largely relying on the tenure review process to identify and protect additional areas of indigenous vegetation within Central Otago District. This process only operates on pastoral leasehold land, and is voluntary, thus will not fully identify areas of significant indigenous vegetation and habitats on freehold land within Central Otago District.

Queenstown Lakes District Council

Queenstown Lakes District does not have a biodiversity strategy, but does have a wilding conifer strategy, and is represented on the Wakatipu Wilding Conifer Group, which funds wilding conifer control on the Queenstown hills. The Council has also pledged \$130,000 annually to wilding tree control. Its Indigenous Vegetation Policy includes establishment of a contestable biodiversity fund, but this does not seem to have been implemented. The proposed Queenstown Lakes District Plan contains a list of threatened plants, and an operative list of numerous recently-assessed significant natural areas that capture mostly woody indigenous vegetation, wetlands, and sites of specific wildlife interest. Both threatened plant species and significant natural areas are protected by indigenous vegetation clearance rules

7.5 Effectiveness of activities

Effectiveness of current activities varies, but is general poorly coordinated (Table 6). This is slowly changing, with wilding conifers now receiving prioritised and coordinated control in Otago, and NGO efforts achieving considerable success in some areas. There are also burgeoning efforts in the Dunedin area to coordinate pest control over larger landscapes, and to undertake citizen science projects to better understand local ecological patterns, e.g. Wildland Consultants (2016). There are many examples of riparian planting in Otago, but these are typically very small scale and cover only a tiny fraction of riparian stream length. The Catlins area supports significant areas of indigenous forest that provides habitat for Threatened indigenous fauna, and populations of these and other indigenous fauna would benefit from integrated control of pest animals. Control of possums, stoats, and rodents occurs in the Dart River catchment, West Matukituki Valley, and at Makarora. These projects are coordinated and implemented by the Department of Conservation in partnership with NGOs, and are sustaining populations of threatened indigenous fauna locally, but require ongoing pest control. Department of Conservation-led exclusion of pest animals and control of them in the surrounding landscape has been a key factor enabling the persistence of threatened lizards in the Macraes area. Some of Otago's most rare and distinctive terrestrial ecosystems, such as limestone and saline ecosystems, occur mostly on private land and receive relatively little conservation

management. Marine habitats receive local monitoring but almost no management for biodiversity values, however the SEMP process should result in better protection of marine habitats in some areas. Marine fauna are generally well-managed and a focus of several organisations where their life cycles bring them onto land.

Table 6: Summary of management activities in key Otago ecosystems.

Key Biodiversity Feature	Broad Overview of Management Activities
Otago Peneplain	Department of Conservation has significant tussock grassland reserves in Macraes Ecological District, and Waitaki District Council is undertaking ecological significance assessments which should ultimately result in better protection for significant indigenous vegetation and habitats. There is little protection of tussock grassland habitat in Central Otago District. Many threatened plant species occur on private land and are unmanaged. Threatened and At Risk lizards and invertebrates also occur on private land where they are not managed. Wilding conifer control reduces one threat, but many others remain.
Indigenous forest	The extent of indigenous forest appears stable in most zones. However relatively little of it is being actively managed, and many indigenous forest fragments on rural land are grazed and will be declining in condition. In northern coastal Otago, indigenous treelands are suffering ongoing attrition and will disappear without appropriate management. Furthermore, pest animal control in indigenous forests is fragmented and un-coordinated. Possums are controlled in TB vector control areas, local pest exclusion and halo control occurs at the Orokonui Ecosanctuary, Dunedin City Council controls pest animals in some reserves, NGO's control suites of predators at Makarora and in the West Matukituki, and Department of Conservation/NGO controls rats and stoats in the Dart River catchment. While these projects may sustain populations of indigenous fauna locally, most of Otago lacks integrated control of mammalian pest animals.
Montane tall tussock grassland	Some areas protected as conservation land, but most of the montane tussock grassland habitat is unprotected and un-managed. Tall tussock stature and the condition of tall tussock grassland vegetation will be declining in the majority of unprotected areas of tall tussock grassland habitat. Wilding conifer control will benefit these habitats by reducing one significant pressure, but the other pressures remain.
Limestone ecosystems	Very few limestone ecosystems in Otago region are protected and most have significantly modified vegetation and require ecological restoration.
Inland outwash plains	There are some protected areas on the inland outwash plains, but most are unprotected. Intensification of land use driven by irrigation, vineyard development, and residential development continues to reduce the extent of the inland outwash plain habitat.
Inland saline ecosystems	Inland saline ecosystems are rare and scattered, and most occur on private land where they remain vulnerable to weed invasion and cultivation. They receive some monitoring by the Department of Conservation. Sutton Salt lake is now contained within a protected area.
River and lake ecosystems	Otago Region has some high quality rivers, and most are in reasonably good condition. However Otago's streams are mostly accessible to trout with consequent adverse effects on indigenous fish. Most of these streams occur on private land. The Department of Conservation has an interest in managing indigenous fish, but generally depends on landholder goodwill to achieve effective conservation. Lakes receive little management apart from some control of aquatic weeds. Monitoring of lake water is rotational, rather than annual, meaning some events may be missed.
Marine Ecosystems	Marine ecosystems and indigenous biodiversity are not managed for their indigenous biodiversity values. Marine fauna that use terrestrial habitats during their life cycles receive better conservation management. Marine mammals are monitored by the Department of Conservation who also advocates on their behalf. Penguins are managed by NGOs and nature-based tourism operators. Smaller sea birds such as fairy prion and sooty shearwater are managed primarily by NGOs and have tenuous hold on the mainland. Estuaries receive little management and are not monitored, apart from regular seasonal counts of wading birds undertaken by NGOs.

8. STAKEHOLDER VIEWS ON POTENTIAL REGIONAL COUNCIL ACTIONS

Feedback from representatives of stakeholder organisations was valuable for the generation of ideas on actions that Otago Regional Council could take to better address the management requirements of indigenous biodiversity in Otago. These ideas fell into the following categories (Table 7):

- Advocacy.
- Biosecurity.
- Capacity.
- Direct action.
- Funding.
- Monitoring and reporting.
- Partnerships
- Policy.
- Strategy.

Ideas within these categories are set out below.

8.1 Advocacy

Stakeholders suggested a number of advocacy actions that the Regional Council could undertake, including.

- Ensuring better compliance with rules relating to water.
- Proposing marine reserves.
- Writing submissions on national strategies and plans relating to indigenous biodiversity, especially where the relevant biodiversity is present in Otago.
- Advocating for better management of indigenous biodiversity generally.
- Advocating to help prevent loss of tussock grassland habitats.
- Help to promote issues with weeds of inland environments, for example by sponsoring an inland Otago version of the ‘plant me instead’ booklet.
- Celebrating the biodiversity values of Otago Harbour, and using the well-known marine fossil record of North Otago in advocacy relating to marine issues in this part of the region.

8.2 Biosecurity

Ecological weeds were a concern for many organisations. Undertaking surveillance to enable early detection of weeds, of terrestrial, freshwater, and marine habitats, was considered crucial especially for lakes, where weed control is often intractable. Strong biosecurity programmes with rapid response capacity to deal with new weed incursions are generally cost-effective. Gorse (*Ulex europaeus*), sycamore (*Acer pseudoplatanus*), and lagarosiphon (*Lagarosiphon major*) were commonly-mentioned weeds. Maintaining weed-free catchments and trout-free streams as such was also considered important, and a greater focus on ecological weeds compared to what was perceived as a current focus on agricultural weeds. Goats in the Dunedin area are having significant adverse effects on the indigenous forest that cloaks the Dunedin

hills and their local eradication would require leadership from an agency such as ORC. Goats are also a significant issue in the Wakatipu-Skippers area.

8.3 Capacity

A common capacity action suggested by stakeholders was for the Regional Council to employ a biodiversity coordinator. This has significant merit if more engagement with landholders on biodiversity issues is proposed, as Council-employed biodiversity coordinators are often very effective at landholder liaison. There are almost always benefits for indigenous biodiversity when council staff engage with private landholders on a one-to-one basis on landholder properties. Biodiversity coordinator roles could include working to achieve protection and better management of indigenous biodiversity on private land, and helping to coordinate NGO projects, which often involve private land. A key requirement of biodiversity coordinators is to facilitate communication and flow of information between local people, landholders, and technical experts, as the input of all three groups is often necessary to obtain successful biodiversity outcomes.

Organisations dealing with marine issues felt that it was also important for the Regional Council to have staff with marine expertise.

Environmental compliance was also raised as an issue that could benefit from increased resourcing. As described above, maintaining a rapid response capacity to deal with new pest incursions was also considered important.

Many organisations felt that it was difficult to establish relationships with the Regional Council due to the lack of biodiversity and land resources staff. In addition, information on what the Council is doing for indigenous biodiversity was deficient. It would be valuable to build Council capacity to engage with the public on biodiversity issues, and for the Council to help connect and facilitate other organisations working to protect and enhance indigenous biodiversity.

8.4 Direct action

Stakeholders also suggested many areas where the Regional Council could take direct action to maintain, enhance, or restore indigenous biodiversity values, including:

- Regional parks.
- Regional reserves.
- Processing of coastal permits.

Each of these topics is discussed further below.

8.4.1 Regional parks

A key theme was that the Regional Council could follow the model that other regional councils have used, and create regional parks or reserves for both public use and recreation, and maintenance and enhancement of indigenous biodiversity. Regional parks tend to be well-used by the public, including for family recreation, and have proven to be excellent sites for advocacy of the need to maintain, enhance, and restore

indigenous biodiversity. Farming land uses often continue within regional parks. Most regional parks in New Zealand are in coastal locations, but in Otago there would be considerable potential for a regional park in Central Otago based, for example, on the upper Clutha River. A regional park in this location would be close to population centres, have high amenity and recreational values, have important existing biodiversity values, and have opportunities for ecological restoration projects. Similarly, a coastal regional park would also have a range of important values, and also be likely to provide important habitat for indigenous marine mammals and seabirds. Regional parks could also complement adjacent conservation land. To obtain land for a regional park, the Regional Council would need to create and advertise a process by which rural landholders may be willing to sell or donate the appropriate land.

8.4.2 Regional reserves

Regional reserves differ from regional parks in that they are primarily for the conservation of indigenous biodiversity. Coastal areas, especially estuarine margins, were a commonly-suggested site for regional reserves, and would provide capacity for estuaries to move inland in response to predicted sea level rise. Coastal reserves could also be established on the outer coast of the Otago Peninsula and on the Catlins coast. Regional reserves to protect montane tussock grassland habitats would also have merit, as would protecting and enhancing riparian vegetation to establish wildlife corridors along major Otago rivers.

8.4.3 Processing of coastal permits

Another direct action that stakeholders thought could be improved, was the processing of coastal permit applications. Stakeholders had a sense that indigenous wildlife values, for example marine mammals and seabirds, were not being fully addressed when permits for coastal activities are granted.

8.5 Funding

Various NGO stakeholders indicated that increased funding, particularly for pest control, would be useful. Ideas included increasing the level of contestable funding under the ORC Biodiversity Fund, establishing clear criteria with which to assess funding applications, establishing a targeted rate for pest control and/or biodiversity projects, using the proceeds to establish a contestable fund that NGOs could access, and increasing funding for pest control and fencing projects.

Funding is also critical for primary schools wishing to incorporate environmental projects into learning outcomes, especially for ecological restoration projects which require ongoing resourcing. Most schools need to partner with NGOs, the Department of Conservation, or other experts and funders to gain the resources required for biodiversity projects.

Increased funding is always likely to be popular with NGO stakeholders, which are often at least partially dependent on grants and sponsorship, and also for landholder projects such as fencing, planting, and pest control. This is particularly so since the demise of the Biodiversity Advice and Condition Funds formerly operated by the

Department of Conservation, which were available for simple one-off landholder projects, many of which were undertaken in Otago Region. These funds were replaced with the Community Conservation Partnerships Fund, which aimed to fund ‘transformative’ projects, and which has now been rebranded as the Department of Conservation Community Fund, which has variable priorities in a given year, and is significantly over-subscribed. As a result, Departmental funding is now spread more thinly across New Zealand. Four Otago-based indigenous biodiversity projects were funded by the Department’s Community Fund in 2016.

With less funding available from the Department of Conservation, biodiversity funds operated by TLAs and Otago Regional Council have become more important. With the Government launching the Predator Free 2050 goal to eradicate rats, stoats, and possums by 2050, local groups are striving to help achieve it, and recently 19 local groups, including Otago Regional Council, signed a Predator Free Dunedin memorandum. Funding will be critical if this vision is to be achieved, either locally or nationally. The Predator Free 2050 goal is associated with annual funding of \$6M that aims to leverage additional external funding to assist predator control projects.

8.6 Monitoring and reporting

Monitoring was suggested as being a key requirement to gain better information on the state and trend of not only indigenous biodiversity in Otago, but of TLA performance in biodiversity-related issues. Understanding the condition and trends of biodiversity values has obvious strategic value as it would help to prioritise where actions should be directed. Monitoring design requires significant thinking if it is to be efficient and effective. A range of biodiversity indicators for state of the environment monitoring were recently provided to Dunedin City Council (Wildland Consultants 2016). One organisation made a suggestion to adopt the Department of Conservation Tier 1 monitoring methodology, currently only carried out on public conservation land, and extend it to areas of indigenous habitat on private land. Establishing a regional framework for monitoring of indigenous biodiversity, which TLAs, organisations, landholders, and individuals could provide information for, would have considerable value. Surveillance for new and existing pest plants was also highlighted, and linking of biodiversity monitoring to water and soil monitoring.

State of the environment monitoring was raised numerous times by stakeholders, for terrestrial, freshwater, and marine ecosystems, and presents an obvious gap that is not being filled by any other agency. Many stakeholders felt that the Council already held considerable data that could be used in state of the environment monitoring. Organisations consider it important to establish robust baseline environmental monitoring and report on the outcomes. Monitoring should be designed to reveal information that is helpful to management of biodiversity, land, and water. The frequency and intensity of monitoring is important in this context.

Estuaries, wetlands, lakes, rivers, streams, and marine ecosystems were identified specifically as a focus for monitoring.

8.7 Partnerships

Building partnerships and broadening key relationships was another aspect that was repeatedly highlighted by stakeholders. Many stakeholders wanted the Council to be a leader and facilitator for programmes such as landscape-scale pest control, state of the environment monitoring, coordinating and facilitating community and NGO projects, and providing a framework and support for citizen science projects. In expressing these wishes, organisations made it clear that they did not expect the Council to do everything, and were very willing to play roles in maintaining indigenous biodiversity. What they hoped for was increased Regional Council support so as to achieve significantly greater outcomes.

Analysis of organisational activities showed that many organisations are dealing with coastal issues. Particularly striking was that management and monitoring of seabirds in Otago is almost entirely being carried out by the NGO, community, and commercial ecotourism sectors. There is however some funding support for this work from local and national agencies, including Otago Regional Council. As nature-based tourism provides an important economic contribution to Otago, more support for this NGO and community work could be justified on economic grounds.

Interviews with organisation representatives drew overwhelmingly positive and constructive responses, however many organisations found it difficult to maintain relationships with the Regional Council due to staff turnover and disestablishment of Council roles, for example land resources officers. In addition, many organisations were not very aware of what Otago Regional Council was doing with respect to indigenous biodiversity management, and found it difficult to obtain environmental information (such as monitoring data, or information on what other organisations were doing) from the Council. This suggests that Council investment to build and strengthen relationships with and support for the environmental community would generate significant positive results, increasing the capacity of the Otago community to maintain and enhance indigenous ecosystems and biodiversity within the Region.

8.8 Policy

A number of issues identified by stakeholders were potentially suitable for policy development in regional plans or in non-statutory policy.

These issues included:

- Considering inland weeds for RPMP or non-statutory weed control policy.
- Take lead in planning for projected sea level rise.
- Create RPS policy requiring TLAs to employ biodiversity coordinators.
- Providing better protection for estuaries and coastal wetlands.
- Improving the quality of the upper Taieri River, and better controlling stock, especially cattle, around waterways.
- Assessing whether there is an ORC role for regulating the marine environment.
- Preparation of a land plan to better control land uses that affect freshwater, including lakes.
- Ensuring that the RPS contains sufficient scope to address terrestrial indigenous biodiversity issues.

- Control the clearance of indigenous vegetation from riparian sites and from gullies.
- Control tussock grassland clearance to maintain its role of increasing water yield, in addition to better protection of the intrinsic values of tussock grassland vegetation.

8.9 Research

Additional research was highlighted in particular as a need for marine and lacustrine habitats. The marine processes that result in toxic effects on yellow-eyed penguin are poorly understood, for example. Also highlighted was the fact that New Zealand's largest river discharges into the Otago marine environment, yet the effects of this significant plume of freshwater on marine ecosystems, process, and biota are poorly known. It was felt that collation and interpretation of existing information would be a good start, and help to identify additional research and monitoring needs.

In inland Otago, more research was sought to better understand the effects of urbanisation and intensification of agriculture in the central lake catchments.

It was also pointed out that supporting citizen-science projects, and other scientific research projects, can be a cost-effective way of gaining relevant information to assist management.

8.10 Strategy directions

Strategic ideas from organisations fell into several areas:

- Prioritising particular habitats for protection and enhancement, for example tussock grassland, estuaries, dryland ecosystems, headwater catchments, inland basins, originally rare ecosystems, and where the most threatened biodiversity occurs.
- Increasing leadership in environmental strategy, building on work undertaken by TLAs.
- Helping to coordinate and facilitate various groups undertaking weed and pest control.
- Reviewing how other councils address biodiversity issues

Table 7: Biodiversity actions that Otago Regional Council could potentially undertake, as suggested by stakeholders.

Type	Action
Advocacy	Ensure better compliance around water.
	Propose marine reserves.
	Submit on national strategies and plans relating to indigenous biodiversity.
	More advocacy of indigenous biodiversity to landholders.
	Build biodiversity projects around tourism sites.
	Help to prevent loss of tussock grassland habitat.
	Use the well-known marine fossil record of North Otago to help advocate the marine ecological values of North Otago.
	Celebrate and advocate the biodiversity values of Otago Harbour .
	Educate the public on issues relating to New Zealand sea lion activity.

Type	Action
	Advocacy on weeds in inland areas, driven by increasing urbanisation and introduction of garden plants. Produce a 'plant me instead' booklet for inland areas, and undertake other advocacy about weeds in inland areas.
Biosecurity	<p>Undertake surveillance for new pests to enable early detection.</p> <p>Maintain these catchments as weed-free areas.</p> <p>Maintain trout-free streams as such.</p> <p>Focus on ecological weeds in addition to agricultural weeds.</p> <p>Prevent further spread of lagarosiphon in Lake Wakatipu.</p> <p>Add additional ecological pests such as goats and sycamore to the RPMS, or develop non-statutory policy addressing these pests.</p> <p>Ensure control of broadleaved wilding trees as well as wilding conifers.</p>
Capacity	<p>Ensure ORC has staff with marine expertise.</p> <p>Increase capacity to better resource the compliance regime concerning environmental matters.</p> <p>Increase capacity to respond to public interest in biodiversity.</p> <p>Employ a regional biodiversity coordinator.</p> <p>Maintain capacity for rapid response to new biosecurity issues.</p>
Direct action	<p>Establish a network of Regional Parks, establish pathway for farmers to transition land with high public value into public ownership.</p> <p>Make ORC land available for ecological restoration by community groups.</p> <p>Create coastal parks on the Otago Peninsula and Catlins coasts.</p> <p>Create regional biodiversity reserves, including in coastal areas subject to sea level rise, for example on estuary margins.</p> <p>Create wildlife corridors along major Otago rivers.</p> <p>Fully address effects on coastal wildlife when processing coastal permits.</p> <p>Create small islands in Otago harbour to establish high tide bird roosts and increase the extent of intertidal habitat.</p>
Funding	<p>Increase the contestable ORC Biodiversity Fund to \$500k per year.</p> <p>Fund elements of DCC's Te Ao Turoa implementation plan, or elements of the pending Predator-free Dunedin pest management plan.</p> <p>Develop criteria for the contestable ORC Biodiversity Fund and ensure that only excellent projects are funded.</p> <p>Increase funding for NGO biodiversity projects.</p> <p>Support fencing and pest control projects.</p> <p>Establish a targeted rate for pest control and/or biodiversity projects, providing some operational funding for NGO's working on these projects.</p>
Monitoring and reporting	<p>Monitor TLA performance, and remove delegations if TLAs are not performing.</p> <p>Undertake surveillance for existing and new pest plants.</p> <p>Consider how public databases can be used for monitoring by the community.</p> <p>Support monitoring by the community.</p> <p>Monitor environmental quality.</p> <p>Develop a comprehensive freshwater monitoring plan and encourage individuals to assist with monitoring</p> <p>Use Department of Conservation Tier 1 monitoring on private land, to align with national scale monitoring on public land.</p> <p>Monitor the biodiversity values of estuaries.</p> <p>Regularly monitor lakes, rather than the rotational monitoring that is currently undertaken.</p> <p>Establish baseline monitoring and report on biodiversity baselines, or create a framework to which TLAs or the community could report. This should lead to regular 'state of the regional environment' reporting.</p> <p>Monitor physical and biological attributes of the marine environment for state of the environment reporting and to better understand the ecological services that marine processes provide.</p> <p>Monitor biodiversity indicators linked to water quality and quantity.</p>

Type	Action
Partnerships	Form a regional biodiversity group jointly funded by TLAs and ORC.
	Establish and support community catchment groups.
	Partner with local communities to improve the condition of urban streams.
	Partner with other organisations, e.g. the Landcare Trust, on biodiversity advocacy and enhancement projects.
	Coordinate and facilitate NGO projects.
	Continue to attend predator-free Dunedin meetings.
	Partner with national themes, e.g. freshwater, predator-free NZ.
	Support citizen science projects involving monitoring and biodiversity.
Policy	Consider inland weeds for RPMS or non-statutory weed control policy.
	Lake foreshores are subject to invasion by many different weeds.
	ORC should lead in planning for the effects of sea level rise.
	Require TLAs to employ biodiversity coordinators.
	Protect coastal wetlands and estuaries from adverse effects, and plan for their expansion in the event of sea level rise.
	Improve the quality of the upper Taieri River.
	Assess ORC role for regulating the marine environment.
	Address the effects of agricultural intensification on lakes.
	Take indigenous biodiversity into account when establishing limits on water takes and discharges.
	Prepare a Land Plan to better control land uses that affect freshwater, or clearly devolve responsibility for this to TLAs.
	Ensure Otago RPS has scope to address terrestrial and marine biodiversity issues, for example having scope to develop regional plans addressing biodiversity issues.
	Better control of stock, particularly cattle, around waterways.
	Control the clearance of indigenous vegetation from gullies and along the margins of water bodies.
Control tussock grassland clearance to ensure maintenance of stream water yields.	
Research	Research on effects of urbanisation and other land uses central lake processes.
	Promote or fund research to better understand marine ecological processes.
	Support research projects as cost-effective way of obtaining information for management.
	Promote or fund research to better understand marine processes that result in toxic effects on indigenous marine fauna.
	Promote or fund research to better understand the effects of the Clutha River freshwater plume on marine processes.
	Collate existing information on the marine environment to develop a more holistic understanding of marine processes that affect indigenous biodiversity.
Strategy	Increase leadership in environmental strategy, which is currently being led by TLAs, who are none the less dealing with regional issues.
	Develop a regional biodiversity accord or strategy.
	Assess where tussock grassland connectivity should be prioritised and maintained.
	Implement actions within a 5-10 year time frame, but have a long term (200 year) vision that short term actions are consistent with.
	Facilitate development of a pest-free Dunedin plan.
	Put a regional focus on dryland indigenous biodiversity in addition to the current focus on wetlands and streams.
	Focus protection on unprotected headwater catchments.
	Develop catchment management plans, especially for the inland lakes.
Assess how the remaining indigenous biodiversity in inland basins can be pest protected.	

Type	Action
	Identify originally rare ecosystems within the Region that retain indigenous cover.
	Identify place-based opportunities for weed control at a landscape or catchment scale.
	Review how other regional councils are operating in the biodiversity sphere.
	Identify where the most threatened biodiversity is.
	Identify catchments that are free of significant weeds.
	Work with Fish & Game to identify priority streams for indigenous biodiversity.
	Prioritise work in the most threatened areas.
	Use catchments, at any scale, as the unit for management.
	Align biodiversity initiatives with water and soil initiatives.

9. ANALYSIS OF OPTIONS FOR REGIONAL COUNCIL ACTIONS

9.1 Other regional councils

As a preface to this section, a review is provided of what other regional councils are doing. Regional councils across the country are tasked with managing indigenous biological diversity. Broadly, regional councils have adopted a mixture of regulatory (for example objectives; policy and rules in plans) and non-regulatory (for example monitoring; incentives/funding; research and database; advocacy and education; management plans) to manage biodiversity.

In terms of regulatory documents, such as Regional Policy Statements and Regional Plans, there is great variability in regional council approaches to biodiversity planning and management across objectives; policies and regulatory and non-regulatory methods. Each region has developed their approach over time to respond to specific environmental, social, economic, cultural, and political issues in their regions.

Equally, there is great variability across the district plans that sit under regional policy, particularly in terms of terminology and regulatory approach. Variation in terminology across plans is partly a result of the different functions and focus of regional and district plans in relation to land use management and different jurisdictional environments across the coastal marine area, land and water. District plans, for example, may not use the encompassing term 'biodiversity' as they do not aim to address freshwater and marine biodiversity. Rather, it appears that District Plans much more commonly use terms such as 'indigenous vegetation protection' which seeks to achieve terrestrial biodiversity outcomes.

With that national inconsistency of approach in mind, the proposed National Policy Statement on Indigenous Biodiversity (NPS) seeks to more clearly set out the objectives and policies about managing natural and physical resources to maintain indigenous biodiversity under the RMA 1991. It is intended to provide clearer direction to local authorities on their responsibilities for managing indigenous biodiversity outside the public conservation estate. The NPS remains in a development and consultation phase at this stage.

To provide a brief overview of how other regional councils are approaching biodiversity management, Table 8 below provides a summary of some relevant initiatives and strategies.

Table 8: A brief overview of regional council¹ approaches to biodiversity actions and initiatives.

Regional Council	Broad Overview of Biodiversity Actions and Initiatives
Southland	<p>Fiordland Marine Regional Pathway Management Plan - This plan aims to greatly reduce the risk of marine pests being carried in on local and visiting vessels. It has been developed and will be implemented by a partnership group including Environment Southland, Fiordland Marine Guardians, Ministry for Primary Industries, Department of Conservation, and Ngai Tahu.</p> <p>High Value Areas - The High Value Area (HVA) programme utilises ecological surveys undertaken by local ecologists, and provides valuable information to landowners that can assist with overall land management.</p>
Canterbury	<p>Canterbury Biodiversity Strategy - The purpose of the Strategy is to provide guidance and a common focus for policy and decision making, resource allocation, voluntary effort, and on-the-ground projects and initiatives relating to biodiversity management in the Region.</p> <p>Canterbury Regional Pest Management Strategy - The purpose of the Strategy is to provide a framework for efficient and effective management or eradication of specified plants and animals in the Canterbury Region.</p>
West Coast	<p>Pest Plant Management Strategy for the West Coast - The Strategy identifies pests and provides a strategy to manage pests under the Biosecurity Act.</p>
Greater Wellington	<p>Biodiversity Strategy - This Strategy sets a framework that guides how GWRC protects and manages biodiversity in the Wellington Region. The Strategy also communicates to the public our mandate, role and functions for protecting and managing biodiversity. The Strategy sets out a vision for the Region which is underpinned by four operating principles and three strategic goals.</p>
Horizons	<p>Proposed Combined Pest Management Plan and Strategy 2015 - 2035 - The purpose of the RPMP is to outline the regulatory framework for efficient and effective management or eradication of specified animal and plant organisms in the Manawatu-Wanganui Region taking a regionally coordinated approach.</p> <p>Preventing Freshwater Weed Invasions - The CHECK, CLEAN, DRY programme to raise awareness of freshwater pests and works, to ensure that pests are not spread throughout the Region.</p>
Taranaki	<p>Biodiversity Strategy - The primary purpose of this Strategy is to pull together all the Council's biodiversity-related programmes under one operational document, develop a co-ordinated and focused programme of action for indigenous biodiversity work, and set out a road map for the future. The maintenance of indigenous biodiversity is work that spans across all sections of the Council and thus requires a 'whole of council approach'. The Strategy spells out actions the Council proposes to undertake in order to implement the biodiversity objective, policies and methods of the Proposed Regional Policy Statement for Taranaki ('PRPS') (Appendix 1) and where appropriate, provide detailed information (criteria, priorities) to assist with annual work planning of the Council's programmes.</p> <p>Taranaki Biodiversity Forum Accord 2012 -The purpose of this Accord is to set out a statement of intent as to an agreed vision, desired outcomes, priorities and actions for Accord partners and, in so doing:</p> <ul style="list-style-type: none"> (a) Raise the profile of biodiversity generally and increase awareness and understanding of the issues (b) Provide a vehicle for dialogue, including information sharing, between like-minded but diverse interests

¹ Regional councils assessed exclude the larger unitary councils (Marlborough and Auckland)

Regional Council	Broad Overview of Biodiversity Actions and Initiatives
	(c) Identify common ground and establish a publicly-agreed policy position and partnerships (d) Make a commitment to positive action (e) Establish a collaborative framework to better work together and identify opportunities for obtaining the best results from finite resources.
Hawkes Bay	Regional Biodiversity Strategy - a guide to inform the community in their biodiversity efforts. Voluntary participation with organisations to promote biodiversity. Biodiversity Accord - A living document to support the Strategy that details the stakeholders of in the strategy. Includes 'Accountable Partners', 'Supporting Partners', and 'Friends of the Accord'.
Gisborne District (Unitary)	Regional Pest Management Strategy - The purpose of this Strategy is to provide for the efficient and effective assessment, management and/or eradication of pest plants and animals in the Gisborne District.
Bay of Plenty	Biodiversity Programme - a voluntary programme to empower landowners and community groups to protect valuable sites.
Waikato	Waipa Catchment Plan - The Waipā Catchment Plan (WCP) is intended to guide Waikato Regional Council, Waipā river iwi, communities and other stakeholders in the implementation of integrated catchment management activities within the Waipā River catchment. The plan includes: <ul style="list-style-type: none"> • The 20-year goals for the catchment. • Strategies to achieve the goals. • Implementation actions for the strategies, focusing on priority catchments for action. • The funding strategy for implementation activities.
Northland	Biodiversity Section of the Council Regional Website (no formal document) - statement of 'What is biodiversity', 'Lakes', 'Wetlands', 'Bring back natives', 'Action you can take'.

We first focus on general options that several other councils have implemented, and which Otago organisations also seek in this Region, then suggest more Otago-specific options to address the particular biodiversity needs of Otago Region.

9.2 Building capacity and relationships

Based on feedback from organisations, Otago Regional Council is likely to need to build capacity and strengthen relationships if it is to make a more effective and coordinated contribution to management of indigenous ecosystems and biodiversity. A biodiversity coordinator or other staff working with landholders and community organisations is probably essential for the relationship building that is required for effective biodiversity protection and enhancement work. Regional Council staff working with the community should be able to repay the required investment by enabling the community to help fulfil the Council's responsibilities. Having staff with marine biodiversity expertise would also be important to the development of appropriate policy for marine ecosystems and species. Marine expertise would also be useful for promoting appropriate marine research objectives and building relationships with NGOs working on marine biodiversity issues.

9.3 Regional biodiversity strategy

Many organisations called for more environmental leadership from ORC, and this could be expressed most clearly by a regional biodiversity strategy. A number of weaknesses in the Council's biodiversity-related actions have been identified because of this lack of strategic planning (Becher 2015). The strategy should:

- Have a vision for the long term.
- Summarise current biodiversity values in Otago.
- Summarise the activities of organisations that are currently undertaking biodiversity work.
- Identify threats to these biodiversity values.
- Identify where the most threatened indigenous biodiversity occurs, for example the locations of trout-free streams that support populations of inland galaxiid fish.
- Identify the priorities for short term action within the lifetime of the strategy.
- Clearly specify the actions Otago Regional Council would undertake, and the roles that TLAs and other organisations can play.

Actions undertaken by Otago Regional Council should ideally be specified by SMART objectives, being Specific, Measurable, Achievable, Realistic, and Time-bound objectives that allow achievement of objectives to be measured.

9.4 Regional biodiversity accord

A regional biodiversity accord would be useful for setting out how the different agencies and organisations will work together to achieve successful biodiversity outcomes. Key stakeholders in such an accord would be the TLAs within Otago Region, the Department of Conservation, Kai Tahu and its Otago runaka, Land Information New Zealand, farming representatives, and significant NGOs such as those that are implementing wilding conifer control in Otago and those undertaking long-standing or landscape scale pest control and ecological restoration projects. The recent Predator-free Dunedin initiative is an example of such an accord.

9.5 State of the environment monitoring

Patchy and poorly-coordinated state of the environment monitoring, and relatively little monitoring of trends in indigenous biodiversity values, is a clear example of a gap that needs to be addressed in Otago, and was identified as such by numerous organisations. Dunedin City Council has begun the process of state of the environment monitoring and would likely welcome this being further developed for use across the wider Otago Region. Otago Regional Council, which already collects information that is used to monitor the state of water and air, would be the ideal organisation to lead development of a framework for more comprehensive regional state of the environment monitoring addressing indigenous biodiversity values, share implementation of monitoring with TLAs and the community, and regularly interpret and report on the monitoring indicators.

Declines in indigenous biodiversity in Otago Region are clearly occurring, most evidently with tussock grassland habitat, indigenous fish populations, and increasingly threatened indigenous fauna, such as kea, mohua, long-tailed bat, and rock wren, in the western mountains and/or extensively forested parts of Otago.

Significant declines may also be occurring in the marine environment. None of this is reported on consistently due to the patchy and poorly-coordinated state of environment monitoring. If Otago is to be able to report on the difference made by its management of indigenous ecosystems and biodiversity, then robust and comprehensively sampled state of the environment indicators will be needed.

9.6 Coordinate biodiversity enhancement actions

Pests and weeds do not respect property boundaries and thus their effective control almost always requires coordination of effort from different agencies and landholders. Coordination of effort is a particular issue for NGOs, which often lack the resources for effective co-ordination, and generally concentrate on local sites rather than large landscapes. Coordination was thus commonly identified by NGO organisations as a key issue that the Council could help with. In coordinating effort, the Council is also likely to identify strategic gaps in effort, which it could then potentially address through engaging with relevant landholders and provision of funding for pest control in these areas. Otago Regional Council would also be the logical organisation to monitor the effectiveness of pest control and determine where future control effort is best directed.

9.7 Regional parks and reserves

Establishment of regional parks or regional reserves can give a very public face to Otago Regional Council's biodiversity programme. Regional parks have been established in several other regions, including Auckland, Wellington, and Canterbury, and tend to be well used by the general public and thus provide an excellent basis for delivering advocacy on biodiversity issues. They are also places where members of the public and NGOs can be directly involved in biodiversity enhancement, through activities such as planting, pest control, and weed control.

A key consideration is that regional parks and reserves should not duplicate the functions of public conservation land. Thus they could be located in areas where there is a scarcity of public conservation land or where they would complement adjacent or nearby public conservation land.

To achieve the public advocacy and involvement functions of regional parks, consideration should also be given to suitable public access, recreational opportunities, and proximity to population centres.

Regional reserves, which are primarily for the protection of indigenous biodiversity, do not necessarily have to be located in proximity to population centres, but for visibility and advocacy, would ideally also be well suited to public recreation.

9.8 Protection of tussock grassland habitats

Many stakeholders, both from coastal Otago and inland Otago, were concerned about loss of tussock grassland habitat. Protection of tussock grassland habitat is a key strategy, because there are no practical methods of restoring tussock grassland vegetation once it has been cleared. While alpine tussock grassland in Otago Region is generally well-protected, tussock grassland in montane habitats, which often forms

a matrix within which other indigenous habitat types (typically rock outcrops, shrublands, and wetlands) are present, is poorly-protected and diminishing rapidly. Options for improving the protection of tussock grassland vegetation include:

- Mapping the remaining extent of dense montane narrow-leaved snow tussock (*Chionochla rigida* subsp. *rigida*) and copper tussock (*Chionochloa rubra* subsp. *cuprea*) grassland outside existing protected areas. This could be done as a desktop exercise, using existing imperfect layers such as the ‘tall tussock’ unit in LCDB4.1, and refining or adding to these where necessary. A minimum polygon size should be used because the aim should be to capture the relatively large areas of remaining tussock grassland.
- Identification of areas where protection of montane tussock grassland is needed most, taking into account the needs of plant and animal species requiring tussock grassland (and other embedded) habitats, where there is a need for ecological services such as maintenance of water yield, and providing representation of tussock grassland habitat in different parts of the Region.
- Creation of new policy to provide better protection of tussock grassland habitat in these priority areas, for example in Regional Plans.
- Engagement with landholders on whose properties these priority areas lie.
- If necessary, contribute to the purchase and protection of such areas.

9.9 Predator-free Dunedin

Fund a pest control/eradication plan for the Dunedin area, and coordinate and help fund Dunedin groups undertaking pest control. Features that make Dunedin suitable as a strategic pest control/eradication area are:

- Extensive indigenous forest and plantation forest habitat, which would allow expansion of indigenous forest fauna populations once freed from the constraints of predation.
- Populations of coastal indigenous fauna that are vulnerable to mammalian predation, and which form the base of an economically valuable nature-based tourism activity
- Dunedin City Council administers extensive and highly significant areas of indigenous forest habitat, is already undertaking pest and weed control in some of these areas, and would welcome integrated control of pest animals.
- A supportive local community and many NGOs that have a long history of supporting indigenous biodiversity and undertaking pest control. Recently, significant landscape scale pest control projects have been developed by NGOs on Otago Peninsula and around the Orokonui Ecosanctuary.
- The Orokonui Ecosanctuary which provides a source from which predation-sensitive indigenous fauna can expand into areas where pest animals are held at sufficiently low densities.

9.10 Landscape-scale pest control in other areas

Landscape-scale integrated pest control is most needed where populations of vulnerable indigenous fauna persist or can be reintroduced. These factors align where there are significant tracts of indigenous forest, often incorporating significant rivers and streams, such as in the Catlins and in the Western Lakes and Mountains zone. Other sites where seasonal control of pest animals could be beneficial include sites such as the upper Manuherikia River adjacent to Falls Dam, which provides spring breeding habitat for vulnerable threatened braided river birds. This level of pest control generally requires strong design and coordination from an agency, but is very commonly supported by NGOs. A review could be undertaken to determine where the best options for landscape scale control of pest animals are present in Otago Region.

9.11 Mountains to the Sea Corridor

The Clutha River, on which Otago Region is largely based, traverses five of the 11 ecosystem zones during its passage from Otago's western mountains to the lowland plains, and exerts a profound, if poorly-understood, effect on marine ecosystems and species off the Otago Coast. As part of a long term, strategic vision, the Clutha River could be used promote indigenous ecosystem and biodiversity protection and enhancement throughout the Clutha catchment. An advantage of the Clutha River is the population centres that occur along it and the roads and cycle trails that occur along its margins. In addition, by cutting a deep channel through many parts of its course, the Clutha River is accompanied by broad, steep, valley sides that have had some resistance to agricultural intensification and often support existing stands of indigenous vegetation and habitat.

A mountains to the sea framework, which is being promoted in other parts of New Zealand, would also potentially encompass most of the kinds of ecosystem and biodiversity protection and enhancement that are required to maintain Otago's indigenous biodiversity. For example the western mountains support threatened indigenous fauna which require large scale pest control, while the upper Clutha basin supports high indigenous dryland biodiversity values that are vulnerable to the pressures of agricultural intensification. In the lowland part of the catchment, the Clutha River traverses the Southern Downlands and Lowland Plains ecosystem zones, which have little indigenous habitat remaining, thus require ecological restoration projects to increase the extent of indigenous habitat.

9.12 Other corridors and catchments

The Waikouaiti River catchment has experienced successful NGO, landholder, and iwi partnerships for activities such as riparian planting and water quality monitoring. The catchment also contains large farming landholders who have proved sympathetic to biodiversity enhancement, in both the North and South Branches of the Waikouaiti River. The Waikouaiti Estuary was the focus of comment from several organisations, and a site where planning for the effects of sea level rise on indigenous biodiversity would be valuable.

The Kakanui catchment has also benefited from Landcare Trust programmes and community partnerships. Rural landholders in this part of Otago are likely to be willing partners in any future programmes involving restoration and enhancement of indigenous biodiversity.

The Taieri River has experienced declines in water quality since approximately 2012, which extend from the upper to the lower catchment. Relatively little of the Taieri River catchment occurs on protected land, and increases in dairy farming activity are most likely to be the cause of the decline in Taieri River water quality. Developing a catchment project for the upper Taieri River, including retiring farmland in headwater catchments and fencing and riparian planting in areas where intensive land use is occurring, could help to improve water quality.

9.13 Biosecurity

Development of an Otago Biosecurity Strategy would identify likely threats, the policies that could be put in place to help avoid new incursions, how surveillance should be undertaken, and what the appropriate contingency responses would be in the event of invasion. Robust biosecurity is likely to be cost-effective compared to the ongoing need to control significant pests that do manage to get established. ‘Easy wins’ should be exploited first, for example a protocol to ensure that badly-fouled ships are not able to dock in Otago Harbour could be effective. Biosecurity is also very relevant to the inland lakes, as demonstrated by the apparently intractable problem with lagarosiphon and the recent incursion of ‘lake snow’. Each of these organisms has resulted in significant disruption to local residents and visitors, and to indigenous habitats.

9.14 Marine protected areas

Support for the implementation of a representative and publicly accessible network of marine protected areas would be a worthy objective. The South East Marine Protection Forum process may not result in adequate representation of marine ecosystems and habitats in protected areas, thus there may be scope following the process for further marine protection or regulation. For example, the marine protected area options so far identified would be difficult for general public access, as none adjoin public beaches. In addition, ongoing research is likely to generate new information, which may justify additional protection of marine habitats. The Regional Council could potentially have a role in enhancing fisheries, for example by establishing no-take zones to enable effective paua recruitment.

9.15 Research

Two significant habitats in Otago Region, both aquatic, warrant further research and monitoring, these being the inland lakes and the marine environment. Otago Regional Council is already working in this area, having supported a recent research bid from the University of Otago, to investigate the sensitivity or resilience of the inland lakes. In addition, the Regional Council is part-funding a science-liaison officer undertaking work for the Yellow-eyed Penguin Trust. Ongoing support of this kind is important.

10. PRIORITISING OF SUGGESTED ACTIONS

The actions identified above were categorised and prioritised using the following criteria:

- Actions that are easily-implemented in the short term.
- Relative urgency of preventing loss of biodiversity.
- Important planning actions.
- Actions that will harness significant community support.
- Actions that will provide a vision for others to follow.

Table 9 illustrates how these actions could be prioritised.

Table 9: Short-term prioritisation for suggested actions to improve protection and enhancement of indigenous ecosystems and biodiversity in Otago Region.

Action	Short Term Priority	Timescale/Notes
Process Actions		
Regional biodiversity strategy	High	Should be started immediately.
Regional biodiversity accord	High	Needed to implement regional biodiversity strategy.
Building capacity and relationships	Moderate	Important to maintain in long term.
Coordinate biodiversity enhancement actions	Moderate	Will depend on outcomes of biodiversity strategy.
Protection/Restoration Actions		
Mountains to Sea corridor	High	Important to establish vision/goals.
Establish regional parks/reserves	High	Important to establish vision/goals.
Other river corridors	High	Important to establish vision/goals.
Assist Predator-free Dunedin	High	Planning is happening now, and the Regional Council should be a strong partner.
Bioresecurity	High	Maintain current high level of action.
Protect tussock grassland habitats	Moderate	Identify opportunities, initiate them as they arise.
Assist other pest control projects	Moderate	Depends on cost-effectiveness.
Marine Protected Areas	Low	Evaluate once current MPA outcomes are known.
Research/Monitoring Actions		
State of the environment monitoring	High	Evaluate potential regional biodiversity indicators.
Research	Moderate	As opportunities arise.

11. CONCLUSIONS

Otago Region contains strong ecological and land use gradients and supports nationally significant ecosystems, habitats, and populations of birds, marine mammals, lizards, fish, plants, and invertebrates. Otago's key ecosystems include upland tussock grasslands, indigenous forests, significant rivers and lakes, diverse marine ecosystems, and distinctive limestone, saline, and outwash plain habitats.

There is strong community and NGO support for indigenous biodiversity especially in the eastern and western parts of Otago, and this community would welcome greater interest in the management of indigenous biodiversity from the Otago Regional Council. In particular, many communities would welcome better coordination of and

assistance with pest animal control projects. It is clear that the Council will not have to do all the necessary work alone, as there are a number of already active partners and stakeholders. Options identified for Regional Council action cover a range of ecosystems and kinds of action, and vary from short term actions to those that would be undertaken with very long goals under a long term vision.

Regional outcomes from improved management of indigenous biodiversity will include greater community pride for and care for Otago's biodiversity, and indigenous biodiversity providing ecosystem services that help the prosperity and long-term sustainability of Otago communities.

The Regional Council should consider the above (and any other) options and for each option, identify whether it wants to be a leader, a partner, a funder, a facilitator, or not be involved.

The first logical step is preparation of an Otago Biodiversity Strategy which outlines a vision for Otago's biodiversity, the current state of Otago biodiversity, the actions Otago Regional Council will take to maintain and enhance indigenous biodiversity, how it will integrate its work with that of other stakeholders, and how biodiversity outcomes will be monitored. Within the strategy, a vision for Otago's indigenous biodiversity can be presented at an overall level, but also at the level of individual projects, such as a mountains-to-sea corridor, establishment of regional parks, and for advanced landscape-scale pest control projects, such as predator-free Dunedin. The Otago Biodiversity Strategy should fit under a regional biodiversity accord which will set out how the larger stakeholders - such as takata whenua, Regional Council, District Councils, Department of Conservation, LINZ, and MPI - will work together.

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Many people from various institutions, organisations, and the public provided constructive and positive discussion that greatly informed this report, in particular, provision of numerous ideas from this community on strategic actions that Otago Regional Council could potentially undertake. We are grateful for provision of ideas and information provided by Chris Baillie (Orokonui Ecosanctuary), John Barkla (Department of Conservation), Michael Bathgate (Dunedin City Council), David Campbell (Clutha District Council), Colin Campbell-Hunt (Otago Natural History Trust), Helen Clarke (Te Kāhano Aotearoa Trust), Francesca Cunninghame (Forest & Bird), Jim Fyffe (Department of Conservation), Mark Hanger (Forest & Bird), Peter Johnson (Landcare Research), Peter Kloosterman (Waitaki District Council), Garreth Kyle (Dunedin City Council), Janet Ledingham (Forest & Bird), Beatrice Lee (Forest & Bird), Bill Lee (Landcare Research), Graeme Loh, Dave Macfarlane (Yellow-eyed Penguin Trust), Jinty MacTavish (Landscape Connections Trust), Sue Murray (Yellow-eyed Penguin Trust), Andrew Penniket (Te Kāhano Aotearoa Trust), Aalbert Rebergen (Dunedin City Council), Marc Schallenberg (University of Otago), Junichi Sugishita (Dunedin City Council), Patti and Joel Vanderburg (River-Estuary Care Waikouaiti-Karitane), Trudi Webster (Yellow-eyed Penguin Trust), Cilla Wehi (Landcare Research), Megan Williams (Te Kāhano Aotearoa Trust), and Robyn Zink (Otago Regional Council).

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SUMMARY OF CONTENT FOR
PROPOSED OTAGO
BIODIVERSITY STRATEGY

Key Elements of a Biodiversity Strategy for Otago Region

- Executive summary
- Introduction
- Summary of Otago's Biodiversity
 - Key biodiversity features
 - Key threats
 - Key opportunities
- Otago Regional Council role in biodiversity management
 - Statutory context (International, RMA, Biosecurity Act)
 - Regional policy - relevant to indigenous biodiversity
 - Core Otago Regional Council functions that support indigenous biodiversity
 - Who Otago Regional Council works with to achieve these functions
- A strategic approach for Otago
 - Regional vision
 - Principles - that Otago Regional Council biodiversity work will be guided by.
 - Goals; for example three major goals addressing key areas with multiple disciplines under each:
 - Biodiversity values*
 - Terrestrial
 - Wetlands
 - Rivers and streams
 - Lakes
 - Coast
 - Marine
 - Ecosystem functions*
 - Water yield
 - Water storage
 - Carbon storage
 - Mahika kai
 - Natural character
 - Amenity values
 - Communities*
 - Advocacy
 - Support
 - Information
 - Private land
 - Monitoring and reporting
- Objectives for each goal
- Implementing the strategy
 - Actions to be undertaken within each Objective
- Appendices
 - More detailed context information
 - Role of agencies in biodiversity management
 - NGO and community groups involved in biodiversity management

The strategy should be concise and include images covering the range of Otago biodiversity, and that help to promote the strategy vision. It should clearly identify what the Otago Regional Council will do, and how it will work with other stakeholders. Potential projects should not be included in the strategy, but should be outcomes of the strategy.

SUMMARY OF ORGANISATIONS
WORKING ON INDIGENOUS
BIODIVERSITY

The summary does not include regional and district councils

Organisation Type	Organisation	Mandate/Aim	Organisations Activities	Funding Sources
Research	University of Otago	Research that makes a difference to our lives, economy, society, and environment	Research, including on terrestrial, freshwater, and marine ecosystems and biodiversity	Government and commercial funding, donations
Research	Landcare Research	To drive innovation in the management of terrestrial biodiversity and land resources	Research on terrestrial ecosystems and species	Government and commercial funding
NGO	Kai Tahu and its local runaka	To honour the deeds and values of past generations and create an inheritance for future generations. To be a responsible steward.	Kati Huirapa Runaka ki Puketeraki hosts volunteers for Estuary-River Care Waikouaiti-Karitane, is undertaking mahika kai and Waikouaiti River projects, and is a partner in several other projects including Orokonui Ecosanctuary and Beyond Orokonui projects. Korako Karetai Trust is in partnership with Otago Peninsula Trust for the protection of blue penguins at Takiharuru Pilots Beach at Pukekura Taiaroa Heads.	Government, Kai Tahu, grants
Govt organisation	Department of Conservation (DOC)	The government agency charged with conserving New Zealand's natural and historic heritage	Advocacy, protection, pest animal control, weed control	Government, sponsorship
Govt organisation	Ministry for Environment (MfE)	Principal government advisor on the environment	National policy for indigenous biodiversity	Government
Govt organisation	Ministry for Primary Industries (MPI)	Protecting New Zealand from biological risk.	Biosecurity including wilding conifer control	Government
Govt organisation	Land Information New Zealand (LINZ)	Managing Crown property well to benefit future generations.	Biosecurity including lake weed control	Government
NGO	Queen Elizabeth the Second National Trust (QEII)	Partnering to protect special places on private land for the benefit of future generations.	QEII covenants throughout Otago, provision of advice to landholders	Government, grants, donations
NGO	South-east Marine Protection Forum	Recommend to Government a network of marine protected areas that will maintain and regenerate biodiversity and build resilience.	Compiling marine information, identifying representative habitats, consulting with public, identifying a potential MPA network for the south-east South Island coast.	Government

Organisation Type	Organisation	Mandate/Aim	Organisations Activities	Funding Sources
NGO	New Zealand Fish and Game Council (Fish & Game)	To manage, maintain and enhance sports fish and game birds and their habitats in the best long-term interests of present and future generations of anglers and hunters.	Protecting and enhancing lakes, rivers, streams and wetlands; RMA issues and advocating against consents which impact on valued habitats and providing 'national park' status to our important rivers through Water Conservation Orders. Habitat Enhancement Fund (HEF) programme	Government, licencing fees, membership.
NGO	New Zealand Landcare Trust	Undertake and support sustainable land and water management practices	Field days, workshops, community liaison, project management	Grants, donations
NGO	Yellow-eyed Penguin Trust	Committed to creating natural environments where threatened yellow-eyed penguins can thrive	Habitat restoration, including predator control, weed control, growing and planting indigenous plant species, and fencing. Education, advocacy.	Membership, sales of merchandise, grants, donations, sponsorship.
NGO	Royal Forest and Bird Protection Society	Protecting our indigenous plants, animals and wild places, on land and in our oceans.	St Clair cliffs seabird project Wilding pine control Working bees for local reserves	Membership, donations, grants, bequests.
NGO	Otago Natural History Trust	To restore the ecological integrity of the Orokonui Valley by providing a pest-free environment where existing indigenous species can thrive and into which absent indigenous species can be safely introduced.	Operation of Orokonui Ecosanctuary, advocacy, education	Visitor income, membership, donations, grants, bequests.
NGO	Hawksbury Lagoon Inc.	To enhance, protect and conserve the habitats of the wildlife and plant life within the environs of the Hawksbury Lagoon.	Planting, weed control.	Sales of cards and tea towels. Grants and donations.
NGO	Landscape Connections Trust	Protect and restore indigenous biodiversity.	How safe is my cat? Predator control for blue penguins Halo Project Habitat relations of forest birds Coastal forest enhancement	Grants, sponsorship
NGO	Estuary-River Care Waikouaiti-Karitane	Maintaining a healthy river and estuary ecosystem through community participation - monitoring, revegetation, advocacy,	Planting.	Grants, sponsorship

Organisation Type	Organisation	Mandate/Aim	Organisations Activities	Funding Sources
NGO	Otago Peninsula Trust	bird-watching The preservation of the natural attractions of the area and the protection of the flora and fauna of the area.	Administration and practical support for other small groups, education, management, weeding, planting	Air New Zealand Environmental Trust, membership, grants, donations
NGO	Save the Otago Peninsula	To protect and enhance the natural environment of the Otago Peninsula	The protection of bush remnants on the Otago Peninsula. The re-vegetation and enhancement of habitat for indigenous bird, reptile, invertebrate and freshwater life. Plant and animal pest control. Producing publications and displays to encourage public education and awareness of issues on the Otago Peninsula. Working with three Enviro-schools on the Peninsula.	Sales of postcards, grants and donations.
NGO	Central Otago Wilding Conifer Control Group	Provide guidance and co-ordination to achieve control of wilding conifers in Central Otago Identify the extent of wilding conifer spread within Central Otago Establish priorities for control work on wilding conifers Establish a strategy for implementing wilding conifer control over the next five years including identifying control methods Establish the projected costs for implementing the strategy Identify potential funding sources	Provide guidance and co-ordination to achieve control of wilding conifers in Central Otago Identify the extent of wilding conifer spread within Central Otago Establish priorities for control work on wilding conifers Establish a strategy for implementing wilding conifer control over the next five years including identifying control methods Establish the projected costs for implementing the strategy Identify potential funding sources	Ministry of Primary Industries
NGO	Speights Environment Fund	To preserve and protect Otago's natural environment	Provides grant income to groups and individuals within Otago	Lion
NGO	Otago Peninsula Biodiversity Group	To facilitate the eradication of animal pests on the Otago Peninsula and thereby protect the area's biodiversity values	Possum control, vegetation monitoring, education	Donations, grants
NGO	Hereweka	To maintain the working landscape	Planting	Dunedin City Council,

Organisation Type	Organisation	Mandate/Aim	Organisations Activities	Funding Sources
	Harbour Cone Trust	and enhance landscape, ecological, recreation, cultural and heritage values of the Hereweka/Harbour Cone property		grants
NGO	Richdale Trust		Partner in protecting blue penguin	
NGO	Aramoana Otago Conservation Charitable Trust	To preserve the unique wildlife and flora of the Aramoana area	Clearing, planting and maintaining public areas around Aramoana	Grants, sponsorship
NGO	Glenore-Manuka Trust	Restoration of public reserve area on the banks of Tokomairiro River (near Manuka Gorge/Milton)	Regular workdays	Grants, sponsorship
NGO	Herbert Heritage Group	Enhancing the lower Waianakarua River through habitat restoration and revegetation of indigenous plants	Working bees to plant and release indigenous species	Grants, sponsorship
NGO	Healthy Harbour Watchers (Otago University, Dept of Chemistry)	Monitoring the health of the waters of Otago Harbour	Monitoring the health of the waters of Otago Harbour	Otago University
NGO	Our Seas Our Future	Protecting New Zealand's coastal and marine ecosystems through advocacy, education and environmental stewardship	Adopt-a-Coast and coastal clean-up events	
NGO	Te Rūnanga o Ngāi Tahu (Sinclair Wetlands)	To protect and enhance the wetland system of Te Nohoaka o Tukiauau/ Sinclair Wetlands, with emphasis on restoring vegetation condition and healthy habitat, maintaining water quality, while enhancing mahinga kai, and reconnecting people back to the land via education and hands-on experience	Plant propagation, pest animal and plant control, planting	Grants, donations
NGO	Te Rūnanga o		Support Sinclair Wetlands	

Organisation Type	Organisation	Mandate/Aim	Organisations Activities	Funding Sources
NGO	Ōtākou Lake Waihola Waipori Wetlands Society	To sustainably manage the wetlands by increasing understanding about the area; providing safe recreational, cultural and educational opportunities and promoting suitable commercial/tourism activities within the wetlands	Weed control, planting, walking tracks	Grants
NGO	Quarantine Island/Kamau Taurua Community	Environmental and historic restoration, sustainability and spirituality	Planting, weed control	Grants, donations
NGO	Tomahawk- Smalls Beachcare Trust	Coastal ecology, restoration and community education	Nursery. Planting and maintenance in dunes	Grants, sponsorship, donations
NGO	Warrington Reserve Group		Planting and plant maintenance on Warrington Reserve	Grants, donations
NGO	Te Kākano Aotearoa Trust	To maintain a successful community-based nursery which services indigenous habitat restoration projects in the Upper Clutha Basin; to inspire and assist other communities through education, demonstration and hands-on participation.	Nursey for propagating plants, advocacy, planting projects, citizen science projects	Sponsorship, grants, in-kind products and services from individuals and businesses
NGO	Lindis Pass Conservation Group	Tall tussock restoration	Weed control, seed collection, growing of tussocks, planting	Grants, donations
NGO	Longview Environmental Trust		Indigenous revegetation and restoration, pest plant and animal control, education and sustainable building.	
NGO	Wakatipu Reforestation Trust	To grow and plant indigenous species in the Wakatipu basin.		Sponsorship

Organisation Type	Organisation	Mandate/Aim	Organisations Activities	Funding Sources
NGO	Matukituki Charitable Trust	Ensure the natural values of the Matukituki Valley are protected and enhanced	Pest animal control and outcome monitoring	Sponsorship
NGO	Wakatipu Wilding Conifer Control Group(WCG)	Protecting biodiversity and the remarkable landscape of the Wakatipu for the benefit of residents, users, tourists and particularly, future generations	Control of wilding trees	Sponsorship, grants
NGO	Alpine Bird Song (ABS)		4 GoodNature possum traps in the Fernhill area and 10 DOC 200 Traps along the Arawata Track	Sponsorship
NGO	Routeburn Dart Wildlife Trust	To bring back indigenous birdsong to the Routeburn and Dart Valleys and their immediate tributaries	Intensive pest control and species re-introductions	Sponsorship, donations
NGO	Lower Waitaki River Management Society	To protect and enhance, in a sustainable way, the Lower Waitaki River system	Canterbury mudfish protection project, wetland and riparian planting	
NGO	Sustainable Coastlines Charitable Trust	Enabling people to look after the coastlines and waterways they love	Coordinate and support large-scale coastal clean-up events, educational programs, public awareness campaigns and riparian planting projects. Help groups run their own events. E.g. Kaikorai Stream planting, Otago presentation workshops, East Taieri School planting.	Sponsorship, donations, grants, events, fundraising, merchandise
NGO	Ngāi Tahu Mahinga Kai Enhancement Fund	Improving mahika kai resources	Improving inaka spawning sites	Kai Tahu
NGO	Mahinerangi Catchment Environmental Enhancement Fund			
NGO	WWF Habitat Protection Fund	Support communities to run projects that conserve and restore New Zealand's natural environment		Tindall Foundation, WWF
NGO	Central Otago	A project to reintroduce the Otago	Mokomoko Otago skink and grand skink sanctuary	Donation, grants,

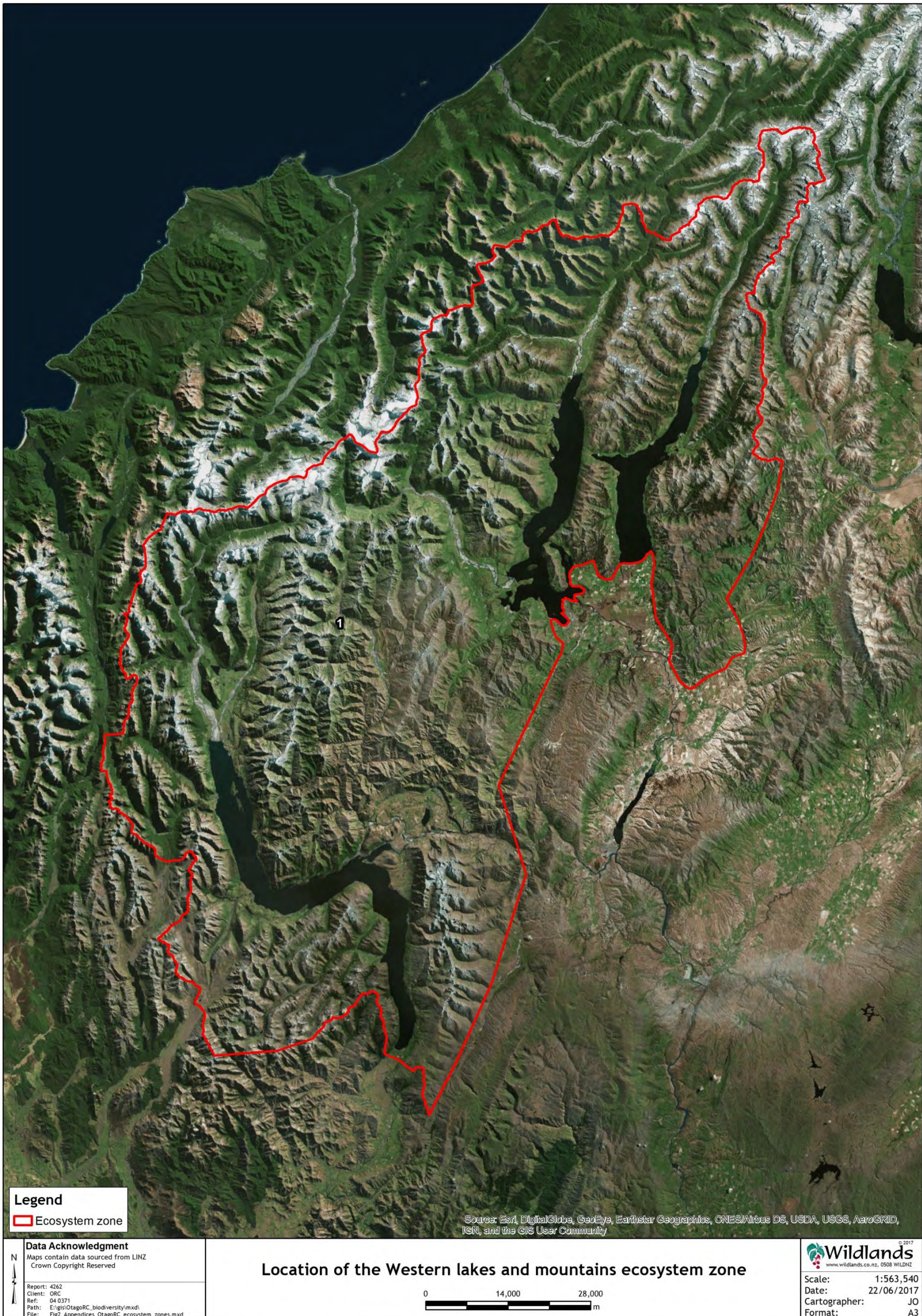
Organisation Type	Organisation	Mandate/Aim	Organisations Activities	Funding Sources
	Ecological Trust	skink to the Alexandra Basin		membership subscription, fundraising Grants, donations
NGO	Herbert Heritage Group	Key objectives for the Waianakarua river mouth enhancement and protection include: <ul style="list-style-type: none"> • Protecting whitebait habitat in the lower river • Improving recreational, aesthetic and wildlife values • Discouraging driving on and around the northern banks of the river mouth • Some degree of monitoring success (bird counts, whitebait spawning, habitat) • Focussing on the lower reaches of the river. 	Indigenous plantings and weed control	
NGO	Dunedin Environment Centre Trust	Environmental and community projects	Riparian projects Dunedin restoration plan	Grants
NGO	Environmental Education for Resource Sustainability Trust		Paper4trees, Watiaki - provides indigenous trees to schools in return for recycling efforts	Grants
School	Queenstown Primary School	Education	wetland planting project	Donations, working with NGOs, DOC, or community
School	Glenorchy Primary School	Education	planting project	Donations, working with NGOs, DOC, or community
School	Wanaka Primary School	Education	Native garden and nursery	Donations, working with NGOs, DOC, or community
School	St Gerards	Education	Working with Grant Norbury to develop safe lizard	Donations, working with

Organisation Type	Organisation	Mandate/Aim	Organisations Activities	Funding Sources
	Primary School		habitat on school grounds	NGOs, DOC, or community
School	Clyde Primary School	Education	Working with Grant Norbury to develop safe lizard habitat on school grounds	Donations, working with NGOs, DOC, or community
School	Goldfields Primary School	Education	Working with Grant Norbury to develop safe lizard habitat on school grounds	Donations, working with NGOs, DOC, or community
School	Waitati Primary School	Education	How safe is my cat? Halo pest control project. Riparian planting project	Donations, working with NGOs, DOC, or community
School	Purakaunui Primary School	Education	How safe is my cat?	Donations, working with NGOs, DOC, or community
School	Port Chalmers Primary School	Education	How safe is my cat?	Donations, working with NGOs, DOC, or community
School	Karitane Primary School	Education	How safe is my cat?	Donations, working with NGOs, DOC, or community
School	Warrington Primary School	Education	Riparian planting project	Donations, working with NGOs, DOC, or community
School	Waihola Primary School	Education	Riparian planting project	Donations, working with NGOs, DOC, or community

SUMMARY INFORMATION ON
ECOSYSTEM ZONES IN OTAGO

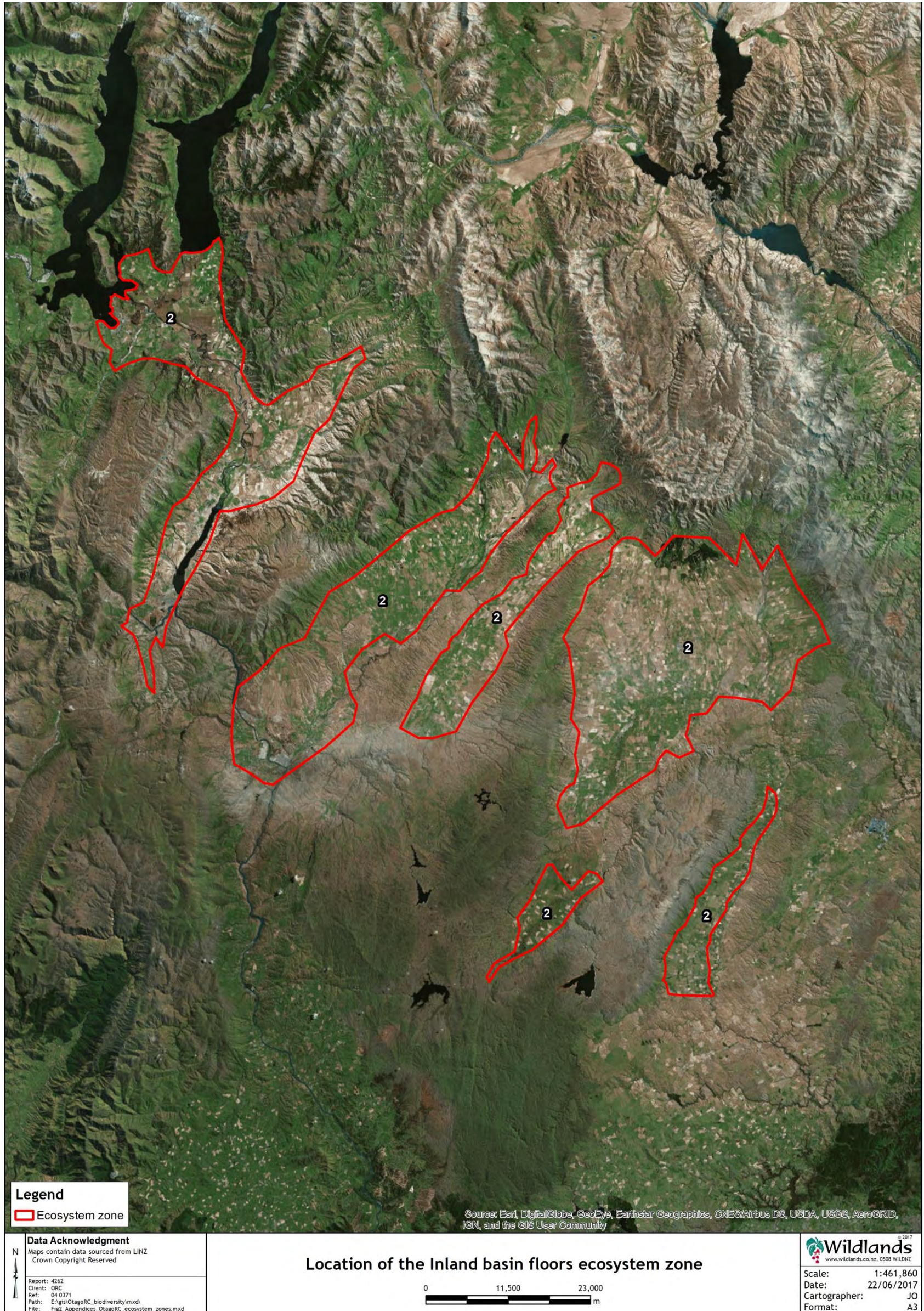
WESTERN LAKES AND MOUNTAINS

The Western Lakes and Mountains zone covers the western part of Otago Region and is the largest of the eleven zones at 948,572 ha. The zone has the highest cover (86%) of indigenous vegetation, primarily tall tussock grassland (43%) and indigenous forest (12%), with significant expanses of gravel or rock (9%), extensive lakes and ponds (7%), and less extensive subalpine shrubland (4%), fernland (3%), alpine grass/herbfield (2%), mānuka and/or kānuka (2%), and permanent snow and ice (2%). Exotic cover types are mainly low producing grassland (9%) and high producing exotic grassland (4%).



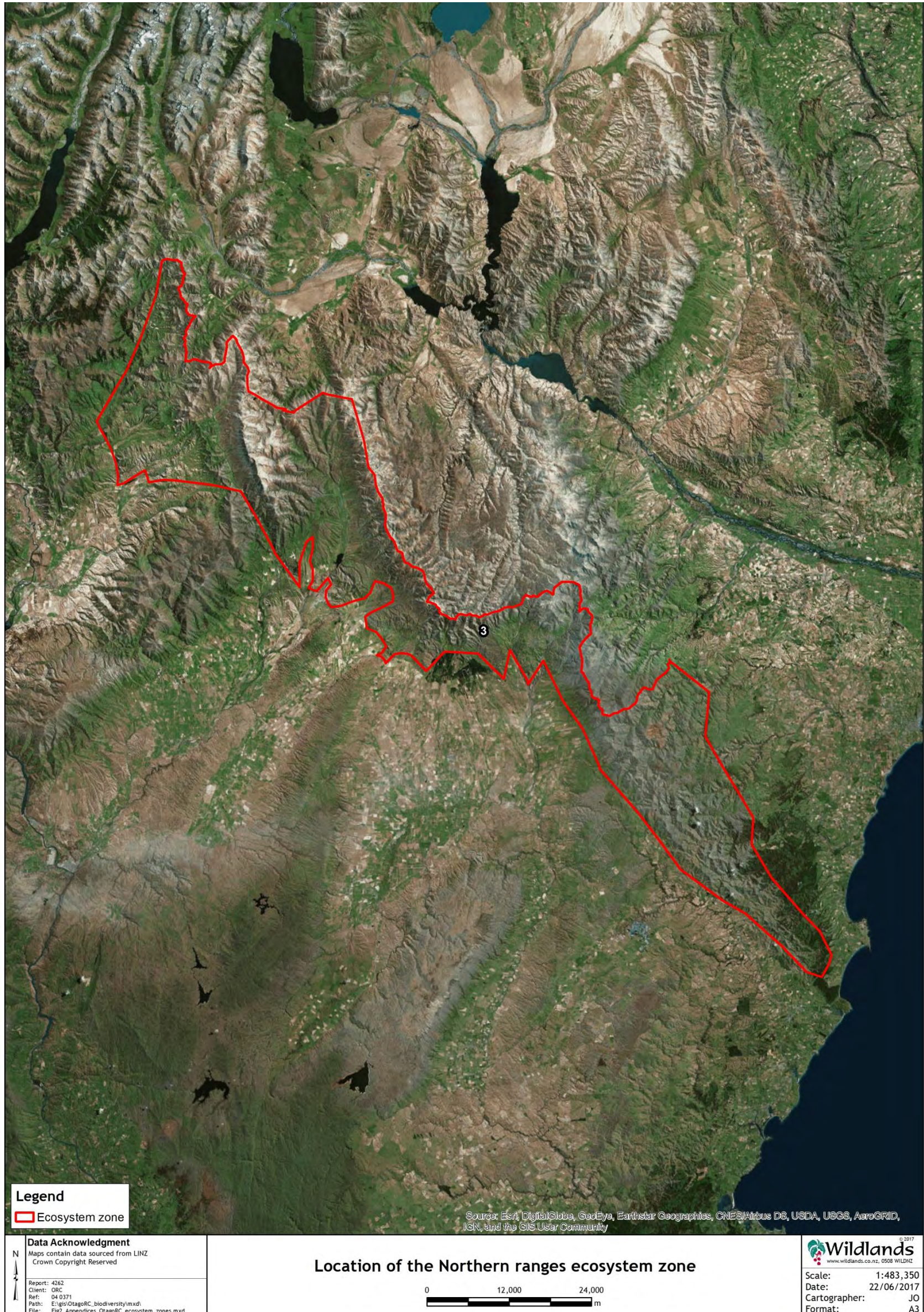
INLAND BASIN FLOORS

The Inland Basin Floors zone is made up of several discrete inland basins that lie between the inland block ranges. Like the Lowland Plains zone, only 5% of the original indigenous vegetation cover remains within the Inland Basin Floors zone, which is again dominated (71% of the zone) by high producing exotic grassland, but also has significant areas (14% of the zone) of low producing grassland. Also similarly to the Lowland Plains zone, there is practically no indigenous forest remaining in the Inland Basin Floors zone, and the non-forest indigenous cover on inland basin floors includes c.5,400 ha of herbaceous freshwater wetland vegetation and lakes and ponds, but also c.2,300 ha of tall tussock grassland and c.1,870 of depleted grassland.



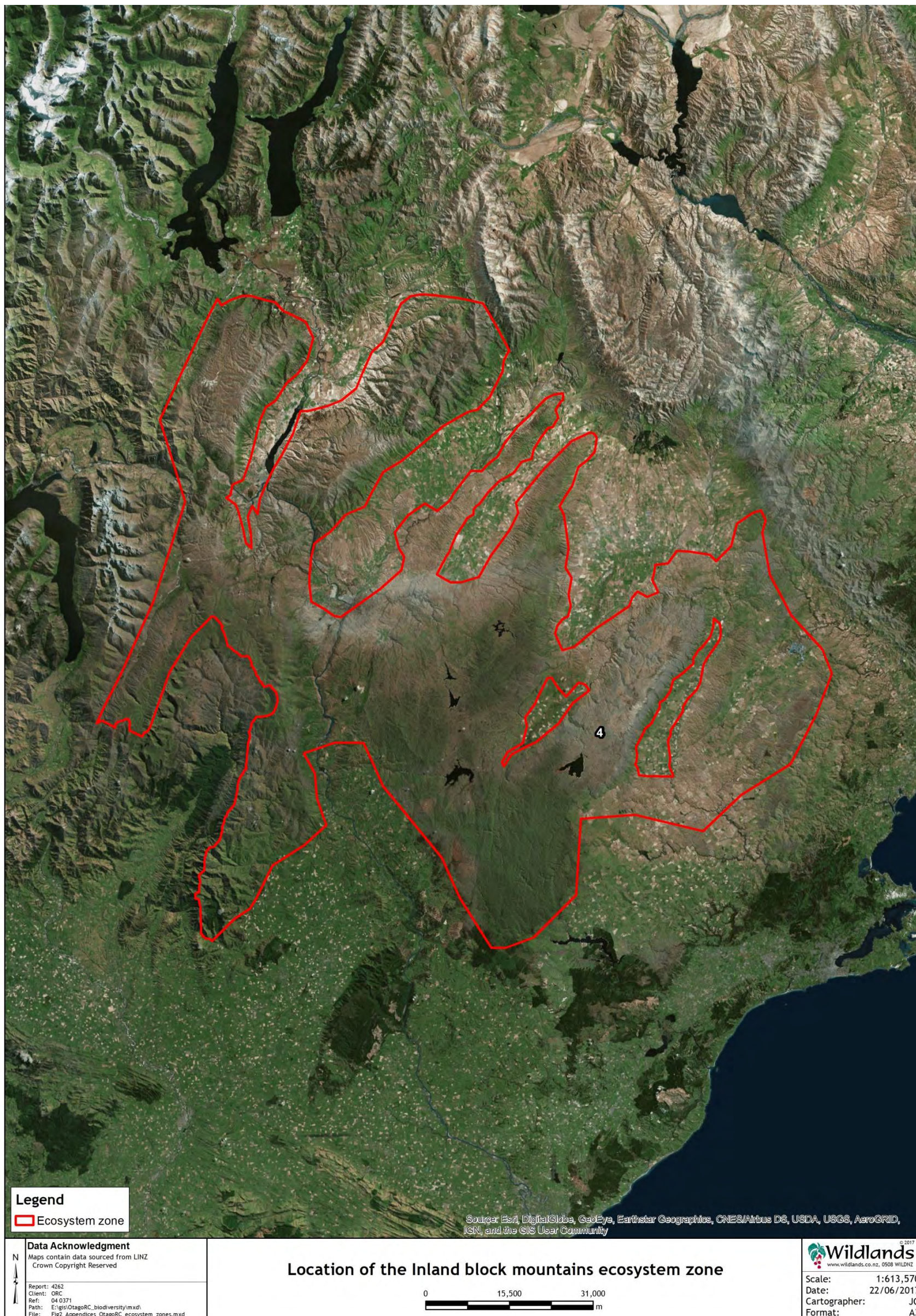
NORTHERN RANGES

The Northern Ranges zone takes in the greywacke ranges in the north of Otago Region, including the St Bathans Range, Hawkdun Range, Ida Range, Kakanui Range, and Razorback Range. In the central part of the zone only the southern slopes of these ranges are included within Otago Region. The Northern Ranges zone has a moderately high 58% indigenous cover, primarily made up of tall tussock grassland (41%), gravel or rock (5%), depleted grassland, alpine grass/herbfield and matagouri or grey scrub (all c.3%), and less extensive mānuka and/or kānuka (2%) and broadleaved indigenous hardwoods (1%). Exotic vegetation cover mostly comprises low producing grassland (36%), with relatively little (4%) high producing exotic grassland. Exotic forest again occupies less than 1% of the zone.



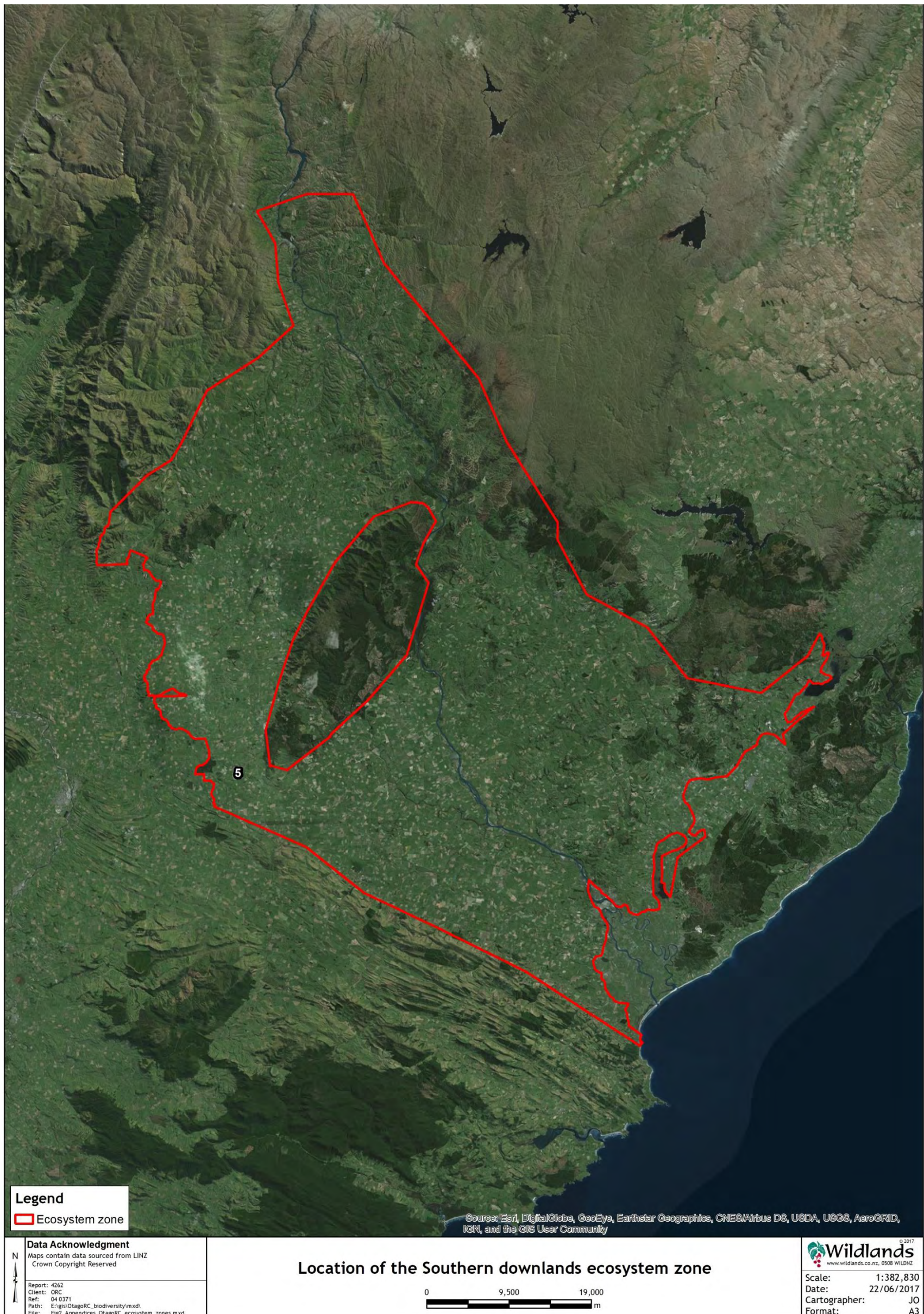
INLAND BLOCK MOUNTAINS

The Inland Block Mountains is the second largest (757,409 ha) zone, and forms a continuous zone that takes in all of the Otago schist block mountain ranges in Central Otago (the Criffel, Pisa, Carrick, Old Woman/Old Man, Knobby, Raggedy, Lammerlaw, and Rock and Pillar Ranges, the Garvie, Umbrella, and Dunstan Mountains, and the Taieri, and Rough Ridges), and the elevated ground between them, crossing the Clutha River where elevated ground occurs in close proximity on either side. Approximately 47% of the Inland Block Mountains zone is covered by indigenous vegetation, mainly tall tussock grassland (39%) and alpine grass/herbfield (1.2%). Low producing grassland is the dominant (36%) exotic cover type, followed by a relatively low 15% cover of high producing exotic grassland. Less than 1% of this zone is covered by exotic forest.



SOUTHERN DOWNLANDS

The Southern Downslands zone occurs on rolling hill country in the Pomahaka River catchment and the lower Clutha River catchment, and has a dominance of high producing exotic grassland (79%), but a lower proportion of low producing grassland (6%), while exotic coniferous forest covers 6% of the zone, and short rotation cropland 0.6% of the zone. Only 5% indigenous cover remains in the Southern Downslands zone, significant less than in the Northern Downslands zone. Half of indigenous cover comprises mānuka and/or kānuka, while 1% comprises broadleaved indigenous hardwoods and indigenous forest. The non-forest cover mainly comprises matagouri or grey scrub (0.6%).



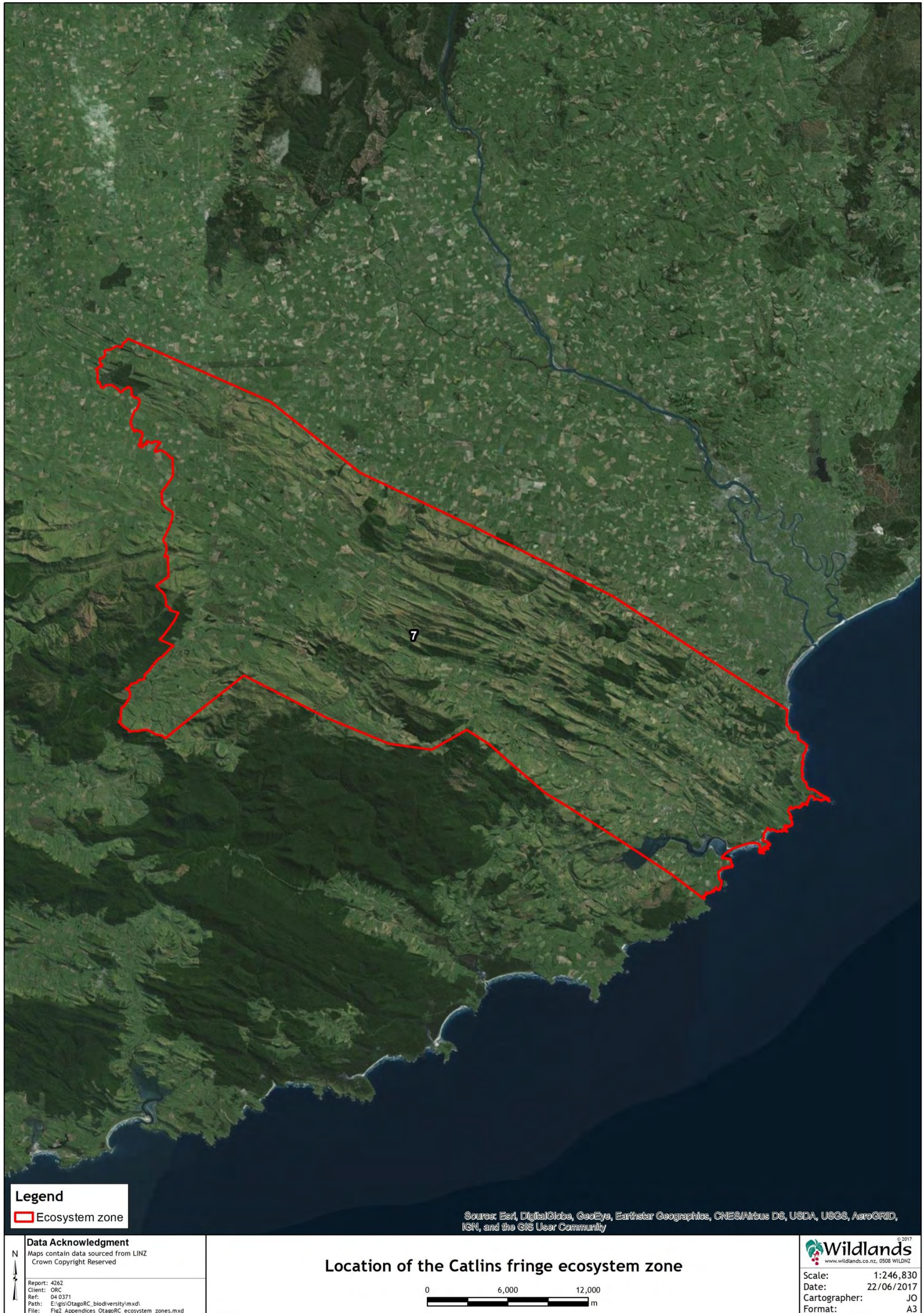
BLUE MOUNTAINS

The Blue Mountains zone (a relatively small 30,505 ha in size) forms an island within the Southern Downslands zone, formed by the abrupt topographic features of the Blue Mountains landform. The eastern part of the zone is largely covered in exotic plantation forest on dissected foothills, while the western part of the zone mostly comprises indigenous vegetation and habitats on the Blue Mountains ridge. Almost half of the zone (46%) is covered by indigenous vegetation, mostly comprising indigenous forest (36%), but also including extensive tall tussock grassland (8%). Exotic cover is primarily exotic forest (37%), with a relatively smaller proportion (11%) of high producing exotic grassland than the preceding zones. Low producing grassland occupies 4% of the Blue Mountains zone.



CATLINS FRINGE

The Catlins Fringe incorporates the Kaihiku, Wisp, and Rata Ranges on the northern half of the Southland Syncline, between the Southern Downslands and Catlins Zones. Vegetation cover in the zone is dominated by high producing exotic grassland (75%), followed by exotic forest (5.6%). Low producing grassland (4%) and gorse and/or broom (2%) are the other extensive exotic cover types. 13% of the Catlins Fringe zone is covered by indigenous vegetation, primarily indigenous forest types (8%), but also tall tussock grassland (1.8%) and a range of less extensive indigenous vegetation cover types including mānuka and/or kānuka, matagouri or grey scrub, estuaries, and freshwater wetlands.



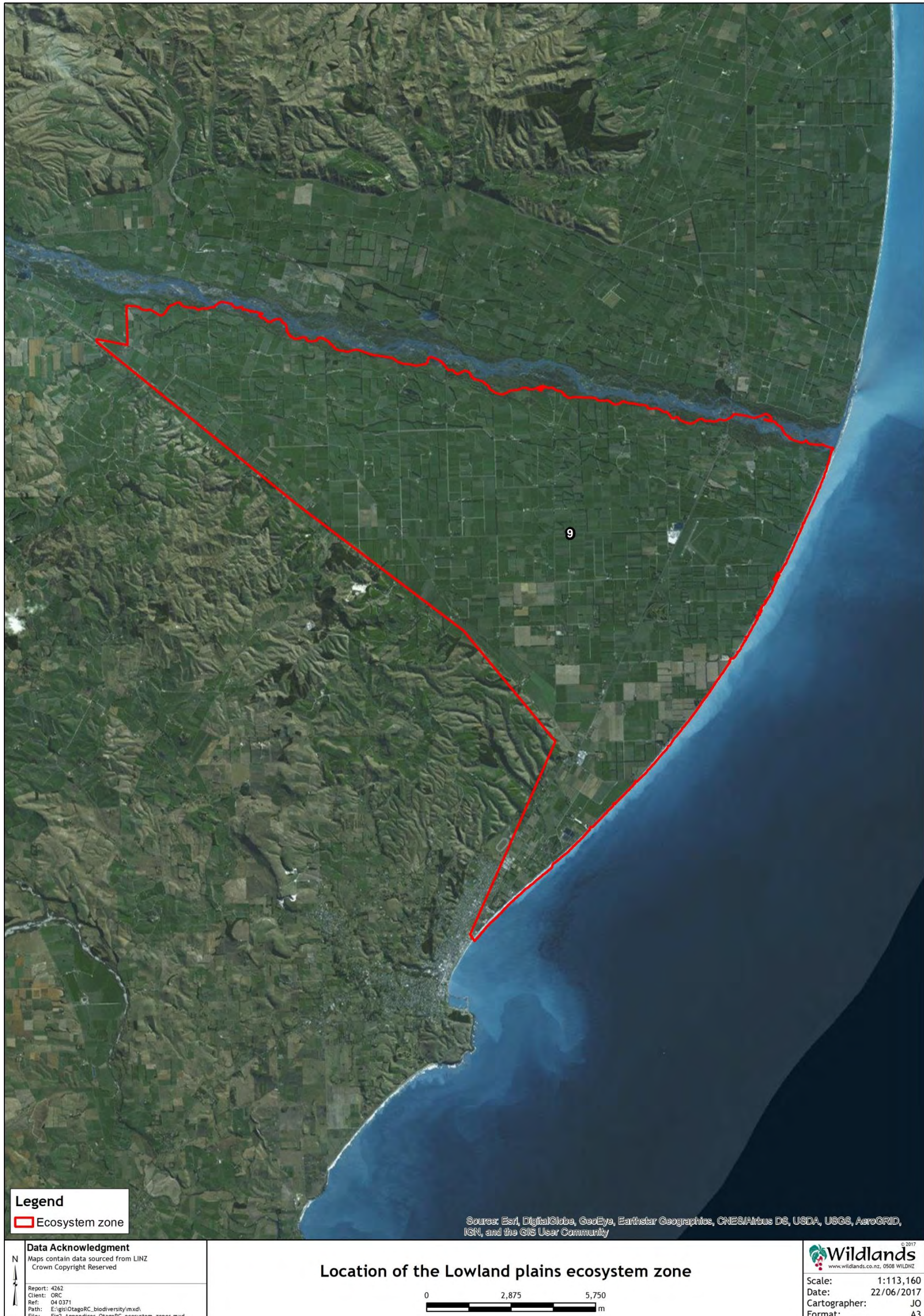
CATLINS

The Catlins zone is the most southern zone in Otago Region and is notable for relatively high proportion (64%) of its indigenous cover remaining, almost all of which comprises indigenous forest cover types. High producing exotic grassland occupies 25% of the zone, while exotic forest comprises 8% of the zone. No other cover types exceed 1% of the zone. The Catlins, Tahakopa, and Tautuku Rivers are mostly contained within the zone, where all reach the coast. Indigenous forest covers most of the upper catchments of the latter two rivers.




LOWLAND PLAINS

The Lowland Plains zone occurs on alluvial plains at the Waitaki River delta, on the lower Taieri Plains, on the Tokomairiro River plain, and on the lower Clutha River plains near Balclutha. High producing exotic grassland covers 84% of this zone, while indigenous cover is only 7%. Most of the indigenous cover on the Lowland Plains is non-forest indigenous cover, including significant areas (2,777 ha) of freshwater wetlands and lakes, including the Lakes Waihola-Waipori wetland complex, and Lake Tuakitoko in South Otago. The area of indigenous forest (92 ha) overstates the actual area of indigenous forest remaining, as approximately 30 ha of exotic willow forest on the lower Taieri Plain near North Taieri is incorrectly mapped as 'indigenous forest' in the land cover database.





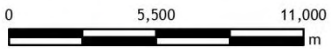
Legend
 Ecosystem zone

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Data Acknowledgment
 Maps contain data sourced from LINZ
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Location of the Lowland plains ecosystem zone



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Scale: 1:233,940
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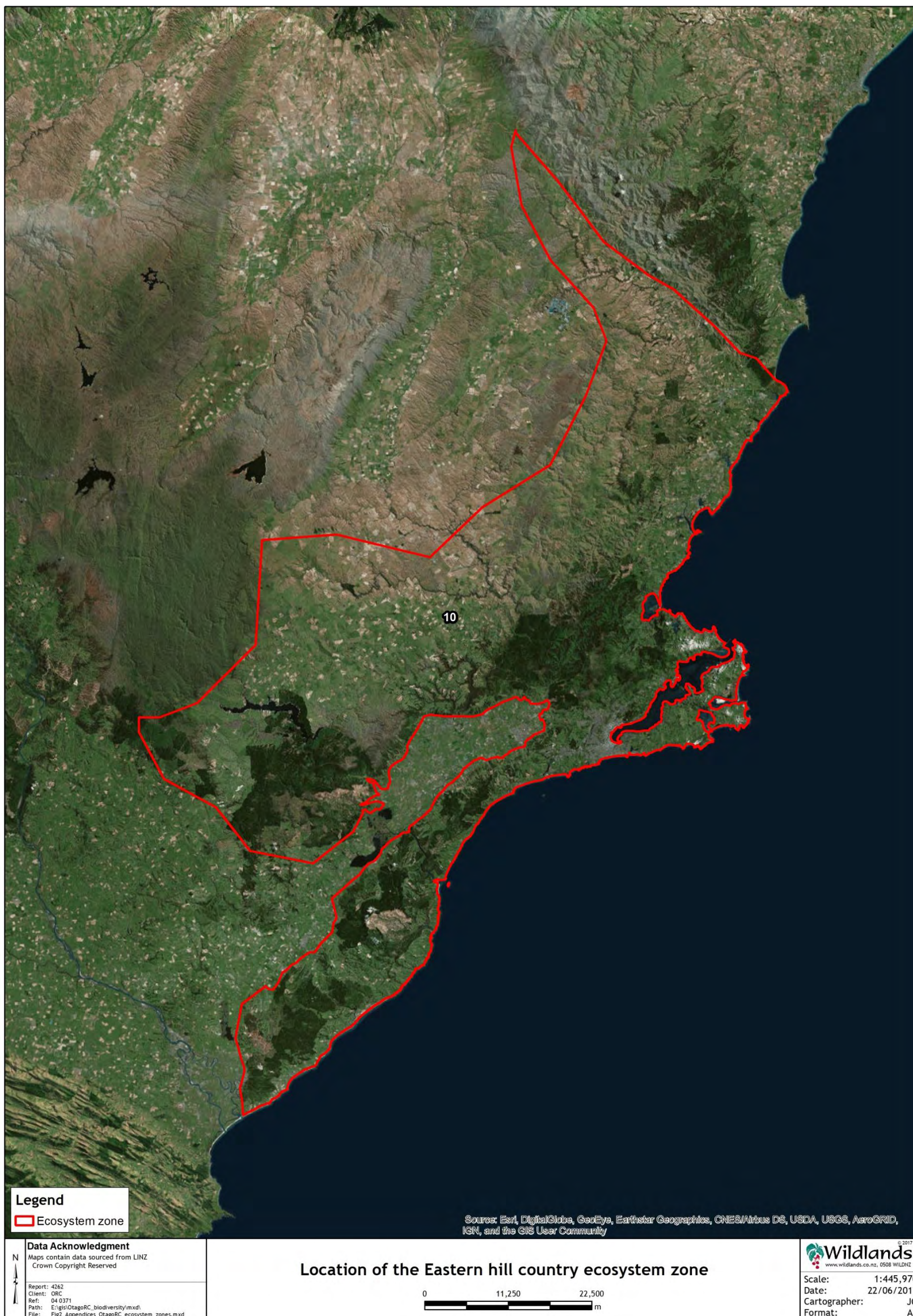
NORTHERN DOWNLANDS

The Northern Downslands zone is located on rolling hills between the Kakanui Range and the Waitaki River delta, and includes the Kakanui River catchment. High producing exotic grassland (66%) again covers most of the zone, with low producing grassland also extensive (12%). However land uses in the Northern Downslands zone are more mixed, supporting 7% exotic coniferous forest and 4% short rotation cropland. Approximately 8% of the Northern Downslands zone is covered by indigenous vegetation, most of which is indigenous forest. About half (4%) of the indigenous cover is manuka and/or kanuka, while broadleaved indigenous hardwoods cover just under 2.5% of the zone. These forest vegetation types are mainly restricted to steep gully sides which provide some resistance to clearance for agricultural use.



EASTERN HILL COUNTRY

The Eastern Hill Country zone takes in the coastal hills between the Waihemo/Shag and Clutha River, and the inland hill country, below approximately 500 m asl (above sea level), north of the Clutha River, including much of the Waihemo/Shag, Waikouaiti, Deep Stream, and Waipori River catchments except for the higher elevation parts of these waterways. A wide range of habitat types are extensive within the Eastern Hill Country zone. It retains a larger proportion (14%) of its original indigenous cover compared to the lowland plains and downlands zones described above, approximately two thirds this being indigenous forest (broadleaved indigenous hardwoods, indigenous forest, and mānuka and/or kānuka). Tall tussock grassland covers 1.7% of the zone, while wetlands, lakes, and ponds make up a further 1.3% of indigenous cover, although this includes Lake Mahinerangi, a man-made lake. High producing exotic grassland (54%) covers less of this zone than the preceding zones, and low producing grassland 5.5%. Exotic forest is extensive, covering about 20% of the Eastern Hill Country Zone. Gorse and/or broom also cover a significant part (2.4%) of the zone.





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Call Free 0508 WILDNZ
Ph: +64 7 343 9017
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PO Box 7137, Te Ngae
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