

MAPPING OF SIGNIFICANT HABITATS FOR INDIGENOUS FAUNA IN TERRESTRIAL, FRESHWATER, AND MARINE ECOSYSTEMS IN OTAGO REGION



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Project Team:

Kelvin Lloyd - Report author, project manager
Brian Patrick- Report author, invertebrates
Steve Rate - Report author, invertebrates
Kerry Borkin - Report author, bats
Carey Knox - Report author, lizards
Rachel McClellan - Report author, avifauna
Melanie Vermeulen - Report author, freshwater
Tom Pyatt - GIS analysis and mapping

Prepared for:

Otago Regional Council
Private Bag 1954
Dunedin 9054

Reviewed and approved for release by:



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

EXECUTIVE SUMMARY

Significant habitats of indigenous fauna were mapped across Otago Region, across terrestrial, freshwater, and marine ecosystems. Twenty-two different habitat layers were created, to address 22 different fauna groups.

Otago Region contains breeding habitat for approximately 87 indigenous bird species, of which 38 are classified as Threatened or At Risk. Data from the eBird database, important bird areas (IBA) defined for seabirds, and other databases were used to define areas that comprised important habitat for several of the Threatened and/or At Risk birds, and wetland and river birds. Significant habitats of forest birds were identified as those indigenous and areas of exotic forest and scrub that contained records of koekoeko/long tailed cuckoo, South Island kaka, tītītipounamu/rifleman, toutouwai/South Island robin, pipirihika/brown creeper, or mohua/yellowhead. In addition, areas defined in the land cover database (LCDB) v5 as 'indigenous forest', and areas 10 hectares or larger of LCDB 'broadleaved indigenous hardwoods' and 'mānuka or kānuka' were mapped as significant habitat of indigenous forest birds. The resulting forest bird layer was manually inspected and numerous misclassified polygons were removed. Significant forest bird habitat defined and mapped using the above methods is notably scarce in Central Otago District, but widespread in Clutha District, Dunedin City District, and Queenstown Lakes District. In Waitaki District, significant habitat of forest birds is concentrated in the Waianakarua and Kakanui catchments.

Significant habitats of long-tailed bats were mapped by establishing a buffer of 11 kilometres around known bat records obtained from the Department of Conservation Bat Distribution database (Accessed 5 June 2019) to indicate likely bat habitat. The 11 kilometer buffer closely approximates the median home range span for long-tailed bats. Other sources of information were used to find two additional records of bats which were similarly treated. Long-tailed bats are currently found in habitats close to the main divide in the Dart and Makarora catchments, in the Catlins, and with recent unconfirmed reports at Leithen Bush and near Warrington. Ten areas that are priorities for future bat surveys were also determined.

Otago Region provides habitat for at least 24 currently-recognised lizard taxa, of which all but three are classified as Threatened or At Risk. Lizard locations were determined from a variety of sources including the Department of Conservation Herpetofauna Database, latest field guides, scientific papers, technical reports, discussions with other herpetologists, and Wildlands staff expert knowledge based on more than a decade of working with lizards across the Region. These records were then used to define boundaries around known significant habitats of lizards, and potentially significant habitats lacking information on lizard occurrences. Eighty-seven significant habitats and 106 potentially significant habitats were identified in this way. A precautionary approach should be applied to release of public information on several lizard species, due to issues with wildlife trafficking of lizards.

One hundred and thirty-eight significant habitats of terrestrial invertebrates were identified and mapped, based on a long history of entomological surveys of sites in Otago undertaken by BHP over the period 1984-2018. These sites were selected on the basis of the presence of representative, diverse, distinctive, and/or rare invertebrate assemblage and taxa. Most of these sites are on conservation land or sites assessed under the Protected Natural Areas Programme.

Otago has freshwater habitats for 25 species of indigenous fish, of which 18 are classified as Threatened or At Risk. Significant habitats of indigenous fish were defined as freshwater

stream segments associated with records of Threatened indigenous fish, and streams in Freshwater Ecosystems of New Zealand (FENZ) catchments that were ranked in the top 10% regionally or nationally. In addition, significant inanga spawning habitats were mapped based on information provided by Otago Regional Council.

Information from existing layers, scientific information, student theses, maps, publicly-available reports and statements from a variety of databases and websites were used to identify significant habitats of indigenous fauna in the marine environment. These included biogenic and rocky reefs, kelp beds, important seabird and marine mammal feeding areas, cockle beds, and seagrass beds. Important terrestrial habitats of marine mammals were identified during consultation with Department of Conservation staff and staff of the New Zealand Sea Lion Trust, and were mapped at a number of sites on the Otago Peninsula and in other areas on the Otago coast.

Significant habitats mapped in this project represent a starting point for mapping of indigenous fauna habitats, based on the information available now. They can be improved as further fauna surveys are undertaken and provide new information that can be taken into account.

Nonetheless, the significant habitats of indigenous fauna mapped during this project will provide an important basis for evaluating sites in terms of RMA Section 6(c), which specifies that the protection of significant areas of indigenous vegetation and significant habitats of indigenous fauna is a matter of national importance that shall be recognised and provided for. Significance assessments have generally focussed on the identification of significant indigenous vegetation and much more rarely on the identification of significant habitats of indigenous fauna. To the extent that this has resulted from a lack of collated information, the sites identified by the mapping presented in this report will help to address this deficiency.

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1. INTRODUCTION

Otago Regional Council commissioned Wildland Consultants Ltd to map the significant habitats of indigenous fauna across Otago Region, including the coastal marine part of the Region.

The maps are intended to be used to:

- Prioritise areas within Otago that would benefit most from active biodiversity management.
- Provide a baseline of the integrity and extent of indigenous biodiversity within Otago.
- Inform the upcoming reviews of the Regional Water Plan and the Regional Plan Coast.

The key outputs of the project are maps of:

- Terrestrial habitat of significant indigenous fauna.
- Freshwater habitats of significant fauna.
- Coastal marine habitats of significant indigenous fauna.

This report describes the methods that were used to map significant habitats of indigenous fauna across Otago Region. A companion report (Wildland Consultants 2020) describes the mapping of potential and current natural ecosystems across Otago's terrestrial, freshwater, and marine ecosystems.

2. METHODS AND FINDINGS

2.1 Overview

Rather than mapping all terrestrial, freshwater, and/or marine fauna in a single layer, which would have resulted in numerous overlapping polygons, different fauna groups were mapped in different layers. By intersecting these layers, areas that are important for multiple fauna groups can be identified. Table 1 summarises the fauna habitat layers that were created.

The layers summarised in Table 1 were compiled from:

- Existing layers (e.g. seabird Important Bird Areas) which in some cases were amended based on additional information
- Raw data on species occurrences, either by drawing generalised polygons around areas with high densities of records, or by utilising habitat outlines (e.g. wetland habitats) to determine the extent of significant habitat
- Habitat polygons used alone to define significant habitat (e.g. LCDB cover classes above certain size thresholds).

Not all species could be mapped using these methods, for example it proved difficult to map significant habitats of kea (*Nestor notabilis*) or karearea (*Falco novaeseelandiae*)

‘eastern’). While no specific mapping of significant habitats of these two species was undertaken, generalised mapping of forest bird habitat would include many of their habitats.

Table1: Key information sources for mapping of indigenous fauna habitat in Otago Region by fauna group. Each fauna group is mapped in a separate GIS layer.

Fauna Group	Summary of Methods
Forest birds	Indigenous forest areas above size thresholds; forest which support selected bird species based on eBird records.
Rock wren	Polygons generalised from eBird records.
Whio/blue duck	Polygons generated from eBird and Whio Forever records.
Kaka/mohua	Polygons generalised from eBird records and indigenous forest.
Crested grebe	OSNZ survey data and lake polygons.
Matuku hūrepo/bittern	Wetlands with matuku/bittern records; eBird, DOC matuku/bittern database, Wildlands staff knowledge.
Mātātā/fernbird	Wetlands and scrub with mātātā/fernbird records; eBird, Wildlands staff knowledge.
Seabird breeding sites	Coastal and Inland IBAs and Wildlands staff knowledge.
Seabird feeding areas	High density of eBird, iNaturalist records, dense hoiho tracks from MoveBank.
Bats	Habitat based on maternal home range size and DOC bat distribution records.
Lizards	DOC herpetofauna database, Wildlands staff knowledge.
Terrestrial invertebrates	Habitat based on a long history of surveys; Wildlands staff knowledge.
Inanga spawning sites	Amended polygons provided by Otago Regional Council.
Regionally highly-ranked FENZ catchments	Streams and rivers within FENZ regional ranked 3 rd -order catchments 1-151.
Nationally high-ranked FENZ catchments	Streams and rivers within FENZ national ranked 3 rd -order catchments 1-2,697.
Threatened freshwater fish	Stream reaches with known occurrences of freshwater fish classified as Threatened by Dunn <i>et al.</i> (2018).
Highly ranked lakes	FENZ ranking of Otago lakes.
Marine mammal sites	Consultation with DOC, NZ Sea Lion Trust, literature.
Biogenic and rocky reefs	Modelled biogenic reefs, known rocky reefs, trawl data.
Kelp beds	Sea Sketch information.
Seagrass beds	Sea Sketch information.
Estuaries	Cockle beds and seagrass beds in estuarine habitats.

2.2 Birds

Otago has about 87 bird species which have breeding populations within the Region. In addition, Otago supports non-breeding populations of at least two indigenous species: white heron (*Ardea modesta*) and kuaka/eastern bar-tailed godwit (*Limosa lapponica baueri*). Many other international migratory bird species regularly use Otago estuaries and coastlines during their non-breeding season. Offshore, a diverse community of pelagic seabird species is present. Criteria were developed to identify significant habitats for birds which focused on Threatened and At Risk species (Robertson *et al.* 2017), as well as locations of burrowing seabird colonies, which are highly threatened on mainland New Zealand. Table 2 lists Threatened and At Risk species with mainland breeding populations in Otago.

Table 2: eBird records of Threatened and At Risk avifauna species with breeding populations in Otago Region.

Common Name	Numbers of eBird Records (one or more individuals)	Threat Classification
Matuku/bittern	24	Threatened-Nationally Critical
Black-billed gull	1,694	Threatened-Nationally Critical
Black stilt	34	Threatened-Nationally Critical
Black-fronted tern	577	Threatened-Nationally Endangered
Kea	883	Threatened-Nationally Endangered
Reef heron	35	Threatened-Nationally Endangered
Southern rock wren	287	Threatened-Nationally Endangered
Yellow-eyed penguin	971	Threatened-Nationally Endangered
Wrybill	55	Threatened-Nationally Vulnerable
Banded dotterel	455	Threatened-Nationally Vulnerable
Caspian tern	555	Threatened-Nationally Vulnerable
New Zealand kākā	724	Threatened-Nationally Vulnerable
Whio/blue duck	151	Threatened-Nationally Vulnerable
Australasian grebe	611	Threatened-Nationally Vulnerable
Blue penguin	1,124	At Risk-Declining
South Island oystercatcher	2,454	At Risk-Declining
Australasian pipit	438	At Risk-Declining
Marsh crake	3	At Risk-Declining
Mātātā/South Island fernbird	462	At Risk-Declining
Red-billed gull	5,643	At Risk-Declining
White-fronted tern	1,850	At Risk-Declining
New Zealand robin	742	At Risk-Declining
Sooty shearwater	1,021	At Risk-Declining
Variable oystercatcher	2,549	At Risk-Recovering
Karearea/New Zealand falcon	1,212	At Risk-Recovering
Pied shag	141	At Risk-Recovering
Otago shag	1,753	At Risk-Recovering
Mohua/yellowhead	785	At Risk-Recovering
Broad-billed prion	21	At Risk-Relict
Common diving petrel	24	At Risk-Relict
Red-crowned parakeet	14	At Risk-Relict
Fairy prion	148	At Risk-Relict
White-faced storm petrel	8	At Risk-Relict
Buff weka	N/A	At Risk-Relict
Northern royal albatross	1,480	At Risk-Naturally Uncommon
Black shag	1,405	At Risk-Naturally Uncommon
Black-fronted dotterel	17	At Risk-Naturally Uncommon
Royal spoonbill	1,549	At Risk-Naturally Uncommon

Sources used to describe significant habitats of birds included:

- The eBird global database (Cornell Lab of Ornithology).
- Important Bird Area documents (BirdLife International/Forest and Bird).
- Otago Regional Council significant wetland habitats (data available via the Otago Regional Council website).
- Other published and unpublished sources of information, including Wildlands reports.
- Expert knowledge.

These sources are described in the following sections.

2.2.1 eBird database

eBird is a citizen science, global database, which is available online. New Zealand data were requested and downloaded in May 2019 (Sullivan *et al.* 2009; eBird 2019). This data set contains 147,145 species records for the Otago Region; each record may consist

of one or more individuals of the same species (for example, the database contains seven observations of 10,000 or more sooty shearwaters seen in one location)¹.

Use of the data set requires an understanding of its limitations. Anyone can submit data to the website. In Aotearoa/New Zealand, records are submitted by a range of people, from not-so-skilled bird watchers to highly experienced observers, or people working in environmental fields submitting data collected during field trips, such as Department of Conservation staff. Records submitted to eBird may include misidentifications, or locations may be imprecise. Importantly, the eBird data set is also biased towards areas where people visit, such as tourist areas, tracks, and towns. This has implications when using these data to determine 'significant' habitats.

eBird records were used to examine the distribution of all At Risk and Nationally Threatened bird species in Otago. The following examples show how the data were used:

- Karearea/New Zealand falcon (At Risk-Recovering) data were analysed by mapping 'positive' records of the species against all eBird records. The species was found to be distributed throughout the Otago Region; that is, virtually everywhere that eBird records have been logged also included records of karearea/ falcon. This made it difficult to determine significant habitat.
- The same process was undertaken for kea (Threatened-Nationally Endangered). The species was observed throughout all habitats in the western parts of the Otago Lakes District, but only occasionally in the eastern parts of the district. The western part of Otago was not mapped as significant kea habitat due to the broad scale of this subregion.
- South Island kākā (Threatened-Nationally Vulnerable) and mohua (At Risk-Recovering) eBird records were strongly associated with presence of indigenous forest in the Caples, Greenstone, Dart, Rees, Matukituki, Wilkin, and Makarora valleys, while mohua also have significant habitat in the Blue Mountains and Catlins. Both species were largely absent from the Richardson Mountains.
- Significant southern rock wren (Threatened-Nationally Endangered) sites were mapped where concentrations of eBird records were located (Figure 1); the actual distribution of the species, based on eBird records, is much wider.
- Significant wetland habitats identified by Otago Regional Council that are potentially or known significant bird habitats were checked for relevant eBird data. In many cases, eBird data provided further information on the diversity and abundance of bird species present.

2.2.2 Important bird areas

The 'Important Bird Area' (IBA) concept was developed by BirdLife International, and has been in use for over 30 years. Identification of an IBA is based on a relatively simple set of criteria that can be applied in both terrestrial and marine environments. Over 12,000 IBAs have been identified worldwide. The identification of IBAs is based on

¹ iNaturalist is another online citizen science database that contains bird records for Otago. However, the data set is very small compared to eBird. A relatively new development is that searches within eBird can now include verified data from iNaturalist. This particular analysis does not include iNaturalist data.

the presence of globally threatened bird species as identified by IUCN Red List criteria, not the New Zealand threat classification system.

In New Zealand, only seabird IBAs have been identified to date. Seabird IBAs are described in three major documents which addressed seabird IBAs at sea (Forest & Bird 2014), coastal sites and islands (Forest & Bird 2015), and rivers, estuaries, coastal lagoons and harbours (Forest & Bird 2016). The identification process was undertaken by a seabird scientist, Chris Gaskin, on behalf of Forest and Bird (a partner of Birdlife International), and involved extensive published and grey literature reviews and communications with species experts. For this project, a 'seabird' was defined as a species that spends some part of its life cycle feeding over the open sea. This definition includes species such as black-billed gulls and black-fronted terns. Because of this, 'seabird' IBAs have been identified on inland braided riverbeds in various part of Aotearoa/New Zealand.

Criteria for the identification of an IBA are:

- A₁ - More than threshold numbers of one or more globally threatened species.
- A₂ - More than threshold species complements of restricted-range species.
- A₃ - More than threshold species complements of biome-restricted species.
- A₄ - More than threshold numbers of one or more congregatory species, including:
 - A_{4i} >1% of the biogeographic population of waterbirds.
 - A_{4ii} >1% global population of seabirds.
 - A_{4iii} >10,000 pairs, seabirds or 20,000 individuals, waterbirds.
 - A_{4iv} > Threshold numbers at migration bottleneck sites.

Nineteen seabird IBAs have been identified in the Otago Region: four extensive marine IBAs, six coastal IBAs, and nine river IBAs (Figure 2). The relevant IBA reports provide extensive information on both the 'trigger' species, along also all other bird species known to be breeding or potentially breeding within each site.

Excessive visitation by humans can adversely affect hoiho, hence information documenting hoiho breeding sites needs to be managed sensitively.

2.2.3 Other mapping approaches

Significant whio/blue duck habitats were mapped based on records obtained from the Department of Conservation's 'Whio Manager', a database with extensive, up-to-date information on whio sightings and management, and from eBird records, where high concentrations of observations were found, the latter of which showed a wide distribution in the tributaries of the Makarora; (Figure 1).

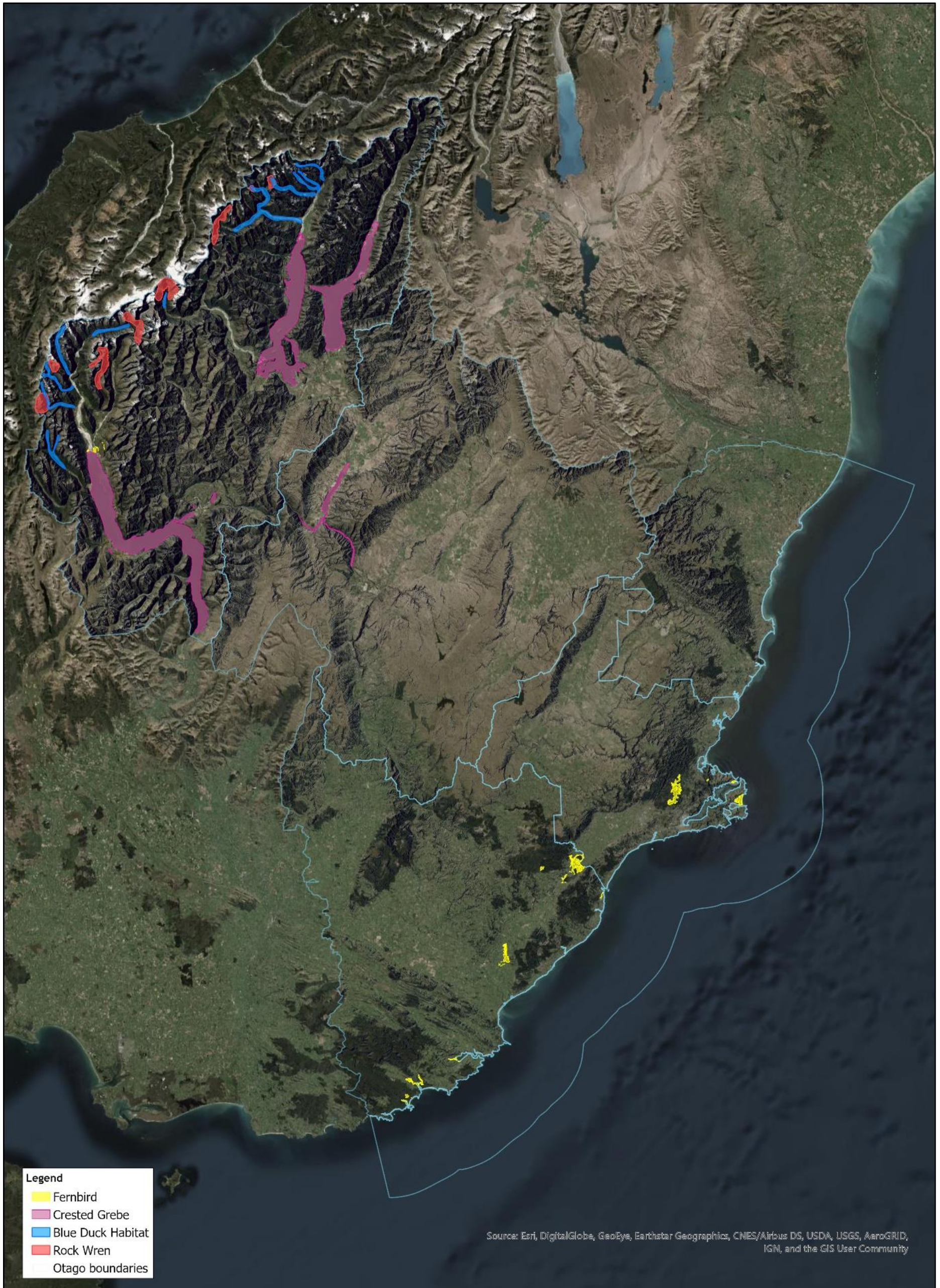
Significant crested grebe habitats were defined from the most recent survey undertaken by the Otago branch of Birds New Zealand (Thompson and Schweigman 2009). Whole lakes were mapped (Figure 1) but actual records within the lakes are patchier, although often widespread.

Significant habitats of matuku hūrepo/bittern (*Botaurus poiciloptilus*) was mapped across Otago Region by assembling matuku/bittern distribution data, then delineating polygons around sites with a high density of matuku/bittern records, a long time sequence of matuku/bittern records, and/or contained known wetland habitats of matuku/bittern. Significant habitats of matuku/bittern are widespread in Otago, comprising wetland habitats in both coastal and inland areas (Figure 3). A similar approach was also used to map significant habitats of mātātā/South Island fernbird (*Bowdleria punctata punctata*; Figure 1).

Significant habitats of forest birds included both indigenous and exotic forest and shrubland that contained recent records of koekoeā/long tailed cuckoo (*Eudynamis taitensis*), South Island kākā (*Nestor meridionalis meridionalis*), tītipounamu/ rifleman (*Acanthisitta chloris*), toutouwai/South Island robin (*Petroica australis*), pipirihika/brown creeper, or mohua/yellowhead (*Mohoua ochrocephala*). All areas classified in the Landcover Database (Version 5, LCDB) as ‘indigenous forest’ were also mapped as significant forest bird habitat, as these areas comprise mature indigenous forest that will support higher population sizes of forest birds, and contain a greater diversity of forest bird habitats and seasonal food sources for forest birds. In addition, areas of 10 hectares or larger of ‘broadleaved indigenous hardwoods’ and ‘mānuka or kānuka’ were mapped as significant habitat of indigenous forest birds. These younger successional stands of forest vegetation have also been shown to provide important habitat for indigenous forest birds (Wildland Consultants 2016). A larger size threshold was used to capture these cover types due to the more numerous misclassifications of these types in LCDB. For example, the LCDB ‘broadleaved indigenous hardwoods’ layer often captures non-coniferous exotic trees around farm houses and operational bases and in woodlots. The layer was manually inspected and many obvious misclassifications that had been captured by the 10 hectare threshold were removed. This checking process found and removed numerous misclassifications where groves of exotic trees were classified as indigenous forest habitat. Despite this checking process, there will inevitably be misclassifications due to thematic errors and spatial resolution of the LCDB polygons used for this analysis.

The capture of ‘matagouri or grey scrub’ polygons was also attempted using a similar size threshold, as often areas mapped as this cover class contains indigenous trees and forest remnants. Also, where indigenous forest is absent, these larger shrubland areas are significant for the more widespread indigenous forest birds such as riroriro/grey warbler (*Gerygone igata*), pipihi/silvereye (*Zosterops lateralis*), piwakawaka/ fantail (*Rhipidura fuliginosa*), and/or kōparapara/bellbird (*Anthornis melanura*). However the LCDB mapping of ‘matagouri or grey scrub’ is too inconsistent, and use of this approach would likely result in adverse feedback from end users if it was used to define significant habitat of indigenous forest birds.

Significant forest bird habitat defined and mapped using the above methods is notably scarce in Central Otago District, but widespread in Clutha District, Dunedin City District, and Queenstown Lakes District (Figure 4). In Waitaki District, significant habitat of forest birds is concentrated in the Waianakarua and Kakanui catchments.



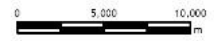
- Legend**
- Fernbird
 - Crested Grebe
 - Blue Duck Habitat
 - Rock Wren
 - Otago boundaries

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

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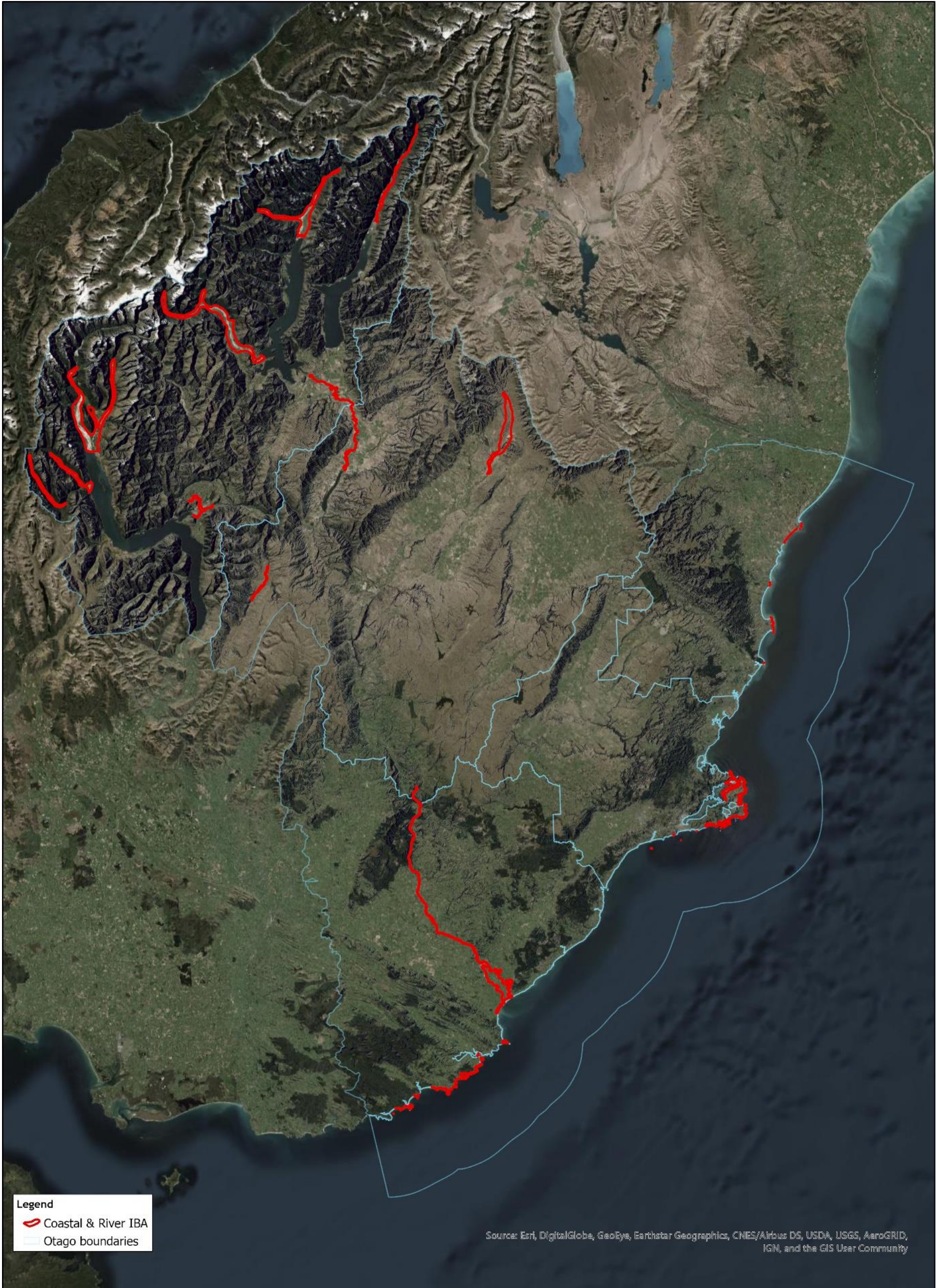
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Figure 1: Significant habitat for selected bird species in Otago



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 Date: 25/06/2020
 Cartographer: TP
 Format: A3



Legend
 Coastal & River IBA
 Otago boundaries

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

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Figure 2: Coastal and river IBAs for seabirds in Otago



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 Cartographer: TP
 Format: A3



Legend
 Bittern Habitat
 Otago boundaries

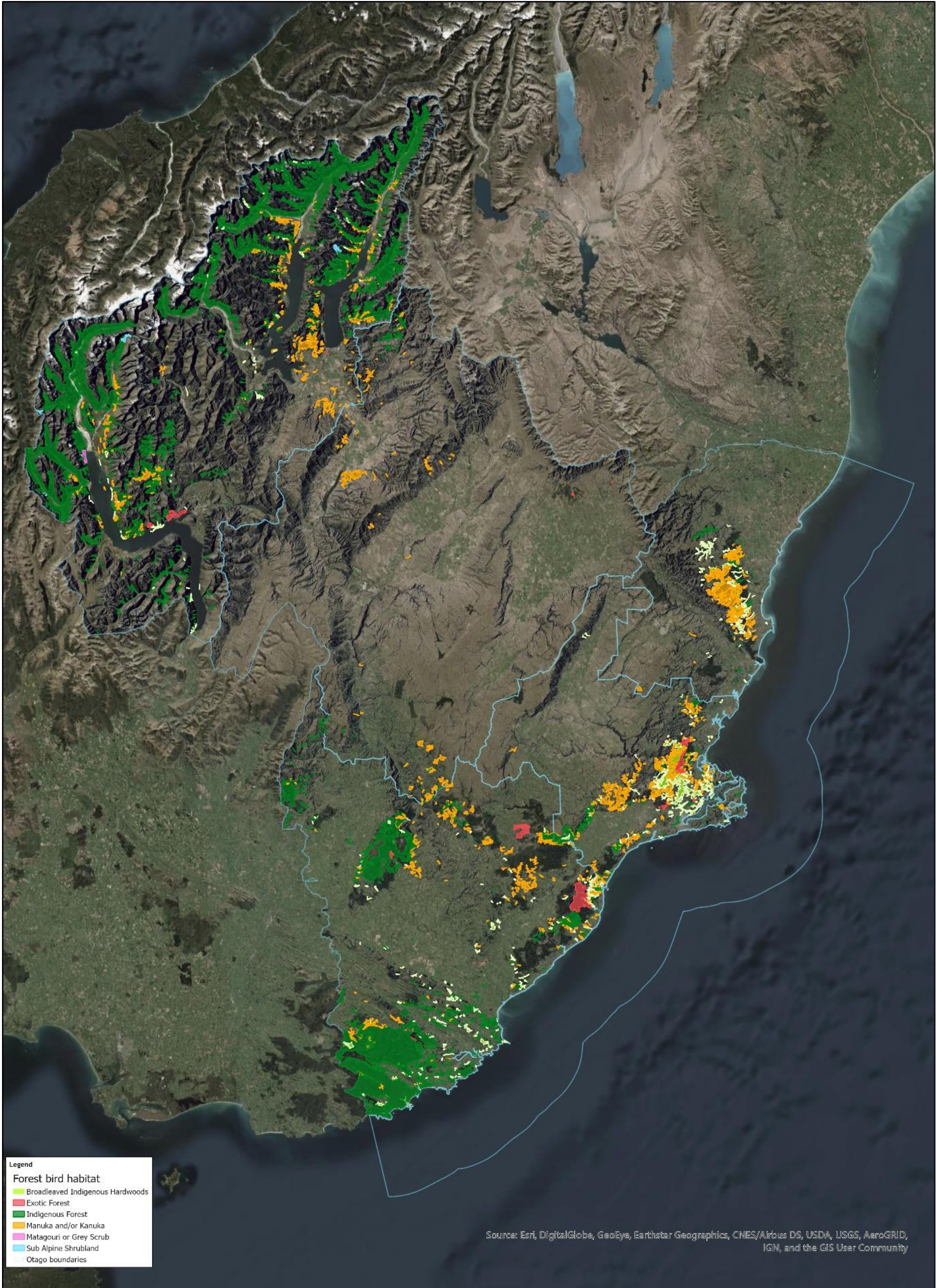
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Figure 3: Significant habitats of Australasian bittern in Otago



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Legend

Forest bird habitat

- Broadleaved Indigenous Hardwoods
- Exotic Forest
- Indigenous Forest
- Manuka and/or Kanuka
- Matagouri or Grey Scrub
- Sub Alpine Shrubland
- Otago boundaries

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

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Figure 4: Significant habitat of forest birds in Otago



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 Format: A3

2.3 Bats

Mapping of significant bat habitat was undertaken using the following methods:

- A buffer of 11 kilometres was used around known bat records obtained from the Department of Conservation Bat Distribution database (Accessed 5 June 2019) to indicate likely bat habitat. These records included those of long-tailed bats (*Chalinolobus tuberculatus*), lesser short-tailed bats (*Mystacina tuberculata*), and unknown bat species. Eleven kilometres was chosen as the buffer distance because this closely approximates the median home range span - the distance from one side of a bat's home range to the other extreme - for both long-tailed bats and lesser short-tailed bats¹
- In addition to this, a variety of sources were used to attempt to seek records of bats and prioritise sites for survey within the Otago Region. These included discussions with locally- and nationally-based bat ecologists, Department of Conservation staff, searches via the internet for bat sightings, and Wildlands staff expert knowledge. Two additional records of bats were obtained in this way.

Sedgeley and O'Donnell (2012 Page 7) suggest that the following criteria are used to identify areas to survey for the presence of bat populations:

- Areas where historic records indicate that important bat populations were once present.
- Areas where no previous work on bats has been undertaken, e.g. parts of Southland, the West Coast, Northwest Nelson, eastern North Island, and Northland.
- Sites such as mainland islands, Operation Ark sites, and kiwi zones where management of threats (e.g. through predator control) is being undertaken for other reasons. Inventory at these sites would be worthwhile because, if bats are found to be present, the likely benefits of the management to the bat population can be monitored in the future.

Because large areas of Otago appear to have never been surveyed for bats a habitat approach was used to identify potential sites for future surveys. Habitat types were identified that corresponded to bat records using the LCDB cover types, and other sites with the same habitat types were mapped, but where there were no bat records. These are areas where additional bat surveys are warranted.

2.4 Current bat habitats

Long-tailed bats are known to be present in various parts of Otago Region. Long-tailed bats are classified as 'Threatened-Nationally Critical', the highest threat classification in the Department of Conservation threat classification system (O'Donnell *et al.* 2018). Therefore all sites where bats occur comprise significant habitats of indigenous fauna.

¹ For long-tailed bats the largest median home range spans were for adult male bats 10.85 km (Interquartile range = 3.41 – 14.01 km); post-lactating female 10.73 km (IQR = 8.89 – 13.35 km) (O'Donnell 2001). For southern lesser short-tailed bats the home range span of post-lactating females was 10.9 km (IQR = 7.1 – 11.2 km); the home range spans of adult male bats were amongst the smallest of those measured (Christie and O'Donnell 2014).

There are very few known long-tailed bat populations east of the Southern Alps. These known populations include those in South Canterbury (Geraldine-Temuka-Timaru-Albany), the Catlins (Owaka-Catlins Forest Park-Papatowai), and Waikaia Forest in northern Southland (Figure 5; Department of Conservation Bat Distribution Database, Version 5 June 2019). However, very few bat surveys have been undertaken in other areas more distant from the Southern Alps.

Within Otago, the Department of Conservation bat database also shows records of long-tailed bats being detected along the river valleys near Glenorchy, notably in the Dart River-Te Awa Whatipu catchment (Figure 5). There are also sightings of unknown bat species in this area. The database also shows detections of long-tailed bats near Makarora, along the Makarora-Lake Hawea Road (Figure 5).

Of these known populations, two - Dart and Catlins - have been identified by the Department of Conservation as “recommended priority sites for management of bat populations” (Sedgeley and O’Donnell 2012). Sedgeley and O’Donnell (2012) noted that these populations were not however considered ‘secure’.

In addition to these records, there are anecdotal reports of bats being seen flying at Leithen Bush in Clutha District, by hunters (Ian Davidson-Watts, pers. comm., 9 August 2019), and Warrington, Dunedin City (by an anonymous source, Catriona Gower, pers. comm., 9 August 2019). Surveys should take place to confirm these populations, but on a precautionary basis, bat habitat has been mapped around these locations as being significant (Figure 5). Note that Warrington is close to the 307 hectare Orokonui Ecosanctuary, where pest eradication has occurred and intensive pest animal control has been undertaken adjacent to the Ecosanctuary. No bat surveys have been undertaken within the Ecosanctuary (Elton Smith, Orokonui Ecosanctuary, pers. comm., 28 May 2020).

There are no records of lesser short-tailed bats in Otago Region, although there are records nearby, particularly along the Te Anau-Milford Highway, less than two kilometres from the Otago Region boundary (Department of Conservation Bat Distribution Database, Version 5 June 2019). The sub-species present in this area is the southern lesser short-tailed bat. Southern lesser short-tailed bats may therefore be present in Otago.

Short-tailed bats are notoriously difficult to detect because their calls attenuate over short distances and are emitted at relatively low intensity (S. Parsons, unpublished data, cited in Borkin and Parsons 2010). This species is more likely to use forest interiors than edges (O’Donnell *et al.* 2006), where surveys are usually targeted. Even where short-tailed bat populations are suspected to be present, it may take multiple surveys for these bats to be detected (Borkin and Parsons 2010).

Southern lesser short-tailed bat has a threat classification of “At Risk-Recovering” (O’Donnell *et al.* 2018). This is because the last known mainland population, at the time of the last assessment, was protected by effective predator control over large areas. The other extant population occurs on the predator-free Whenua Hou/Codfish Island (O’Donnell *et al.* 2018). Any population that is subsequently identified will likely be in decline if not protected by an extensive area of predator control.

Using the LCDB database, bat records from the Department of Conservation Bat Distribution Database (Version 5 June 2019) were found to be present in the following habitat types: mānuka and/or kānuka; broadleaved indigenous hardwoods; deciduous hardwoods; indigenous forest; and exotic forest.

Figure 5 shows these habitats within 11 kilometres of known bat records in Otago Region.

2.5 Priorities for further bat survey

Surveys for bats should be prioritised in areas that have bat habitat but where surveys have not yet taken place. This generally corresponds to forested areas with the following LCDB cover types: mānuka and/or kānuka; broadleaved indigenous hardwoods; deciduous hardwoods; indigenous forest; and exotic (plantation) forest.

Based on these criteria, a number of areas have been identified as high priority areas for bat surveys: coastal Otago, Blue Mountains area, and additional sites in the western lakes area (Figure 6). In the Dunedin area the Orokonui Ecosanctuary is a high priority for bat survey. Even if all these areas are surveyed there will remain a large area without any information about the distribution of bats. This includes exotic plantation forests. Bats commonly use exotic trees and forest and in other regions plantation forest managers often survey their forests for the presence of bats using automated bat monitoring devices (ABMs).

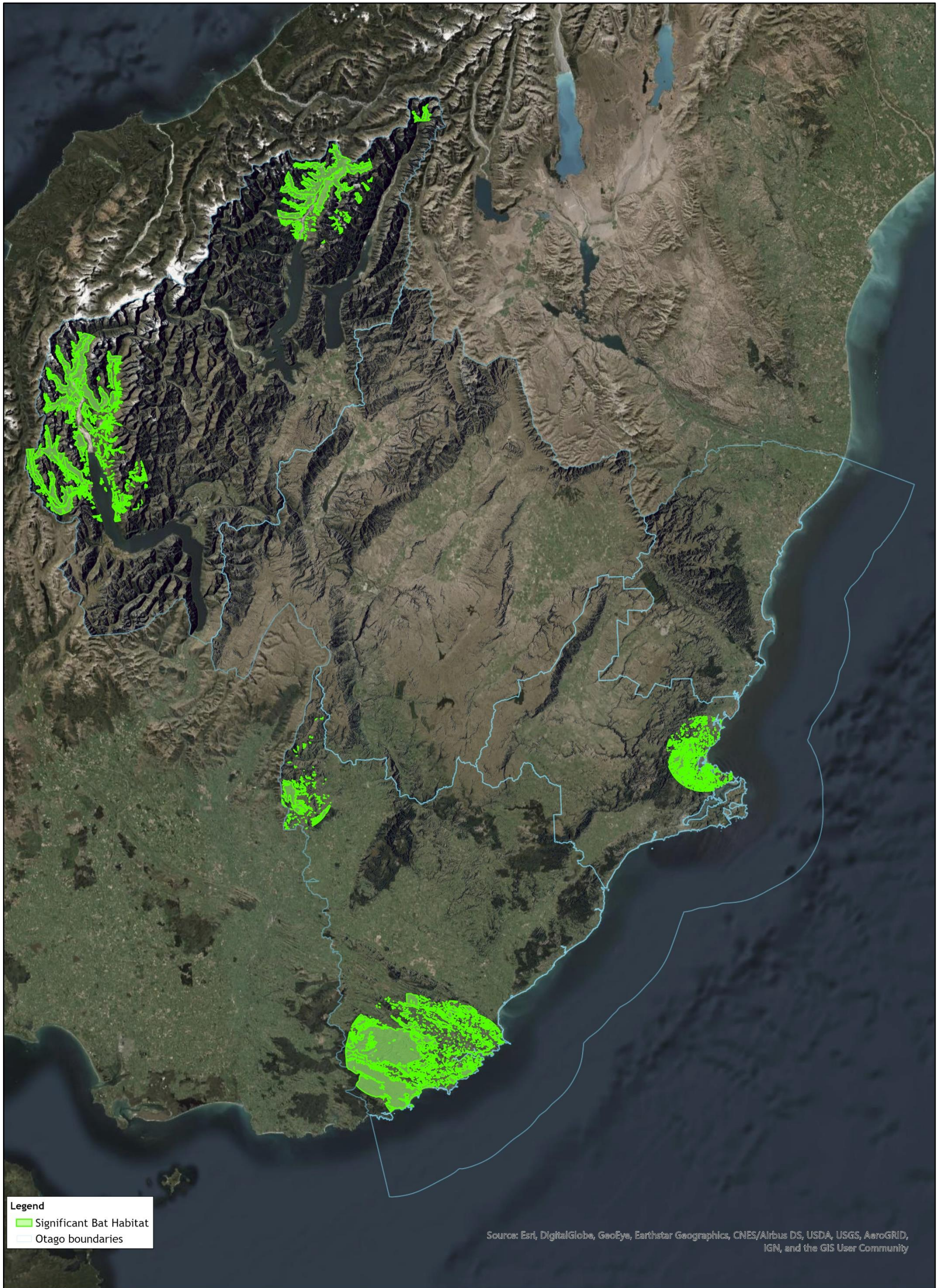
Relatively few bat surveys have taken place within the Region and some were undertaken using equipment that has limitations. For example, there are no records of surveys that have been undertaken in the Dunedin City area using modern automated bat monitoring devices (ABMs). Surveys that took place in 1995 within Dunedin did not detect bats, and these surveys were likely to have been undertaken using hand-held bat detectors or old technology ABMs. Hand-held bat detector surveys may miss bats due to the short time period over which surveys take place, i.e. when people are available, and may be biased due to tiredness, or concentration (Stahlschmidt and Brühl 2012). There is, however, one reported sighting of bats of an unknown species in this area, seen flying around lights in Warrington (sighting reported to Catriona Gower, 9 August 2019).

2.6 Future bat survey methodology

Future bat surveys should utilise best practice bat survey methods. Currently the Department of Conservation recommends placing multiple automated bat monitoring devices (ABMs) at each survey location for at least 15 fine nights where use of the site is likely to be occasional or bat populations may be small (Moir Pryde, Department of Conservation, pers. comm., 8 August 2019).

Surveys should target both long-tailed bats and southern lesser short-tailed bats. To maximise chances of detecting long-tailed bats, Sedgeley (2012 Page 20) suggests that ABMs should be placed “*in edge habitats (e.g. along bush-grassland edges, on tracks or roads through bush, in bush clearings, alongside riparian vegetation, by ponds)*”. In comparison, surveys designed to target southern lesser short-tailed bats should place

ABMs along “*terraces and saddles between catchments within old age forest*” (Sedgeley 2012, Page 20). Short-tailed bats do fly through edge and open areas but they are less likely to be detected in these places (Sedgeley 2012).



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Figure 5: Significant bat habitat in Otago



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Legend
 BatPriorityAreas
 Otago boundaries

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

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Figure 6: Priority areas for future bat surveys

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2.7 Lizards

Otago Region has a total of 24 currently recognised lizard taxa, as shown in Table 3 below. Known distributions of these taxa were used as a basis from which to begin mapping of significant lizard habitats across Otago Region.

To assist with mapping, all known lizard records from across Otago were collated. Records came from a variety of sources including the Department of Conservation Herpetofauna Database, latest field guides, scientific papers, technical reports, discussions with other herpetologists, and Wildlands staff expert knowledge based on more than a decade of working with lizards across the Region. All available lizard information was then pooled and a spatial layer constructed from these records with different sub-layer for each lizard taxon.

Table 3: Lizard taxa (24) currently known from the Otago Region. Threat status is from Hitchmough *et al.* (2016) unless otherwise indicated.

Common name	Scientific name ¹	Threat Status
McCann's skink	<i>Oligosoma maccanni</i>	Not Threatened
Southern Alps gecko	<i>Woodworthia</i> "Southern Alps"	Not Threatened
Short-toed gecko	<i>Woodworthia</i> "Southern Mini"	Not Threatened
Korero gecko	<i>Woodworthia</i> "Otago-large"	At Risk-Declining
Schist gecko	<i>Woodworthia</i> "Central Otago"	At Risk-Declining
Kawarau gecko	<i>Woodworthia</i> "Cromwell"	At Risk-Declining
Southern grass skink	<i>Oligosoma polychroma</i> ; Clade 5	At Risk-Declining
Cryptic skink	<i>Oligosoma inconspicuum</i>	At Risk-Declining
Otago green skink	<i>Oligosoma</i> aff. <i>chloronoton</i> "East Otago"	At Risk-Declining
Southland green skink	<i>Oligosoma</i> aff. <i>chloronoton</i> "Southland"	At Risk-Declining
Jewelled gecko	<i>Naultinus gemmeus</i>	At Risk-Declining
Orange-spotted gecko	<i>Mokopirirakau</i> "Roy's Peak"	Threatened-Nationally Vulnerable
Lakes skink	<i>Oligosoma</i> aff. <i>chloronoton</i> "West Otago"	Threatened-Nationally Vulnerable
Takitimu gecko	<i>Mokopirirakau cryptozoicus</i>	Threatened-Nationally Vulnerable
Nevis skink	<i>Oligosoma toka</i>	Threatened-Nationally Vulnerable
Scree skink	<i>Oligosoma waimatense</i>	Threatened-Nationally Vulnerable
Rockhopper skink	<i>Oligosoma</i> sp.	Threatened-Nationally Vulnerable ²
Tautuku gecko	<i>Mokopirirakau</i> "southern forest"	Threatened-Nationally Endangered
Grand skink	<i>Oligosoma grande</i>	Threatened-Nationally Endangered
Otago skink	<i>Oligosoma otagense</i>	Threatened-Nationally Endangered
Alpine rock skink	<i>Oligosoma</i> sp.	Threatened-Nationally Endangered ²
Oteake skink	<i>Oligosoma</i> aff. <i>inconspicuum</i> "North Otago"	Threatened-Nationally Critical ²
Burgan skink	<i>Oligosoma burganae</i>	Threatened-Nationally Critical
North Otago black-eyed gecko	<i>Mokopirirakau</i> aff. <i>kahutarae</i> "North Otago"	Threatened-Nationally Critical ²

These lizard records - in combination with evaluation of aerial imagery - were used as a basis to begin defining potential boundaries around significant lizard habitats. Whilst drawing these boundaries it became clear that many areas were poorly known or lacked recent reports of lizard taxa. It was therefore decided to split areas into two categories - 'significant' and 'potentially significant' - based on the level of confidence about what was known of the lizard fauna within these areas (Figure 7; Appendix 2). Potentially significant areas require field assessment to increase confidence of exactly what lizard taxa are present, but can be treated as being significant on a precautionary basis until

¹ Taxonomic descriptions and field guides are currently lagging behind field knowledge and continuing discoveries mean that not all taxa have been taxonomically described, but all are thought likely to be unique species. Where this is the case a 'tag name' is used to denote a likely unique species that has not yet been allocated a scientific name e.g. Tautuku gecko (*Mokopirirakau* "southern forest"). The majority of these taxa have genetic support for being unique species, except for three which are currently being assessed.

² Threat status suggested by Wildland Consultants (2019).

the lizard fauna is better known. These sites could then be moved to the significant category or considered to be not significant subject to the lizards that are present.

Each site was assessed against the ecological significance criteria in the proposed Otago Regional Policy Statement (RPS). The criteria for assigning sites to ‘significant’ and ‘potentially significant’ categories, and how this corresponds to the RPS significance criteria, is outlined below in Table 4.

Table 4: Criteria used to assign lizard habitat sites to either ‘significant’ or ‘potentially significant’ and assessment against ecological significance criteria in the Otago Regional Policy Statement.

RPS Significance Criteria	Explanation
2a(i)	Presence of one or more ‘Threatened’ lizard species.
2a(ii)	Presence of jewelled gecko, Otago green skink, or Southland green skink ¹ .
3	Presence of three or more lizard taxa, excluding ‘Not Threatened’ species
4	Presence of an unusually high-density lizard population (regardless of species), an outlier population at their distributional limit, or a unique morphological form of a taxon.

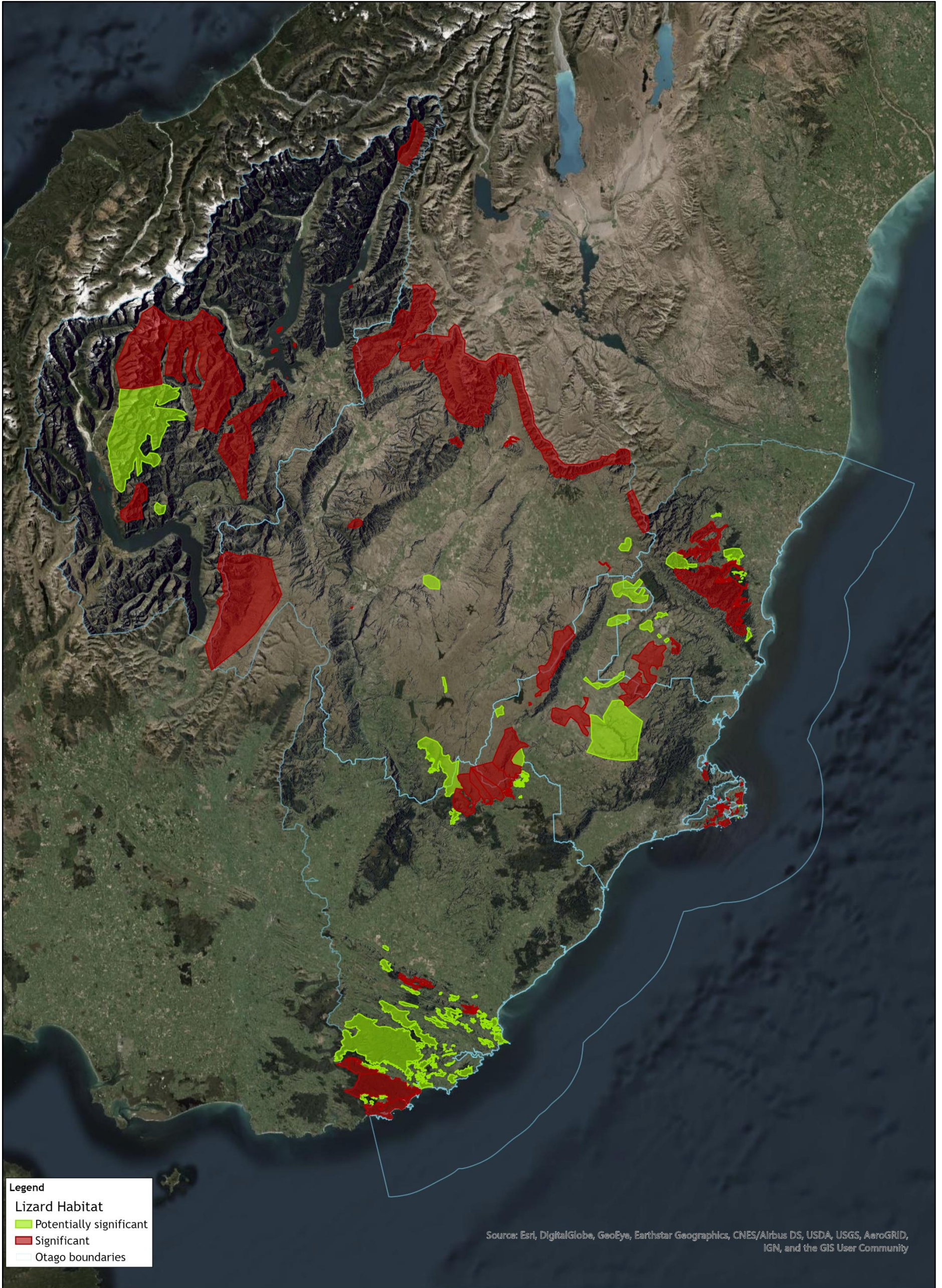
A total of 193 sites were identified as important lizard habitat, including 87 ‘significant’ habitats and 106 ‘potentially significant’ habitats (Figure 7; Appendix 1). These sites are summarised below within 10 geographical areas (or sub-regions) for ease of interpretation (Table 5).

As there is concern about wildlife trafficking of indigenous lizards, a precautionary approach should be applied to information on sites that contain any of the following gecko and/or skink taxa:

- Jewelled gecko (*Naultinus gemmeus*).
- Tautuku gecko (*Mokopirirakau* “southern forest”).
- Orange-spotted gecko (*Mokopirirakau* “Roy’s Peak”).
- Takitimu gecko (*Mokopirirakau cryptozoicus*).
- Southern black-eyed gecko (*Mokopirirakau* “North Otago”).
- Otago skink (*Oligosoma otagense*).
- Grand skink (*Oligosoma grande*).

This could potentially be done by making significant sites publicly-known, but restricting publication of information on the lizard taxa that are present in these sites, although even this approach would have risks.

¹ These three taxa are considered the rarest three of the eight ‘At Risk-Declining’ taxa in the Otago region by some margin. Hence their habitats are considered significant.



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Figure 7: Significant and potentially significant lizard habitats in Otago

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Table 5: Summary of significant lizard habitats in Otago Region.

Sub Region	Area (ha)	Species Known to be Present (No. of Sites)	Species Potentially Present (No. of sites)	RPS Significance Criteria Met (No. of Sites)				Significance Justification
				2a (i)	2a (ii)	3	4	
Otago Peninsula and Dunedin (42 sites)	1,701	Jewelled gecko (38), cryptic skink (5), korero gecko (20), southern grass skink (42), Otago green skink (1).	Otago green skink (4)		37	18	10	Most sites are significant due to the presence of jewelled gecko and about half the sites also have korero gecko. Five sites have cryptic skink.
Lammermoor sites (7 sites)	22,446	Jewelled gecko (7), korero gecko (2), southern grass skink (7), McCann's skink (2).	Otago green skink (2), grand skink (1), korero gecko (2)	1-Possible	7	2		Sites significant due to jewelled gecko. Some also have korero gecko. Potential for Otago green skink and grand skink.
Rock and Pillar (2 sites)	7,822	Burgan skink (2), southern grass skink (2), McCann's skink (2), korero gecko (1).	Korero gecko (1)	2				Burgan skinks present (Threatened-Nationally Critical).
Macraes/Middl emarch (5 sites)	15,995	Otago skink (4), grand skink (2), Otago green skink (3), cryptic skink (2), korero gecko (4), southern grass skink (5), McCann's skink (5).	Otago green skink (2), grand skink (2)	4	3-5	2		Most sites have grand and Otago skink, which are both Threatened. Some sites have Otago green skink and cryptic skink.
Northeast Otago (3 sites)	26,492	Jewelled gecko (2), Otago green skink (1), southern grass skink (3), korero gecko (3), McCann's skink (3).	Otago green skink (2), jewelled gecko (1)		3	3		Significant due to presence of jewelled gecko and/or Otago green skink.
Ida/Hawkdun Ranges (2 sites)	19,174	North Otago black-eyed gecko (1), alpine rock skink (2), rockhopper skink (2), Oteake skink (1), scree skink (1), Otago green skink (2), korero gecko (1), southern grass skink (2), Southern Alps gecko (2), McCann's skink (2).	North Otago black-eyed gecko (1), scree skink (1), jewelled gecko (1)	2	2	2	1	At least 10 lizard taxa including several threatened species and newly discovered taxa.
Northwest Otago (5 sites)	73,846	Otago skink (2), grand skink (2), lakes skink (3), Otago green skink (1), scree skink (1), nevis skink (3), southern grass skink (4), McCann's skink (4), Southern Alps gecko (4), jewelled gecko (1).	Grand skink (1), Otago skink (1), orange-spotted gecko (1), alpine rock skink (1)	3	2		1	At least 10 lizard taxa including several threatened species i.e. Otago skink, grand skink, scree skink, lakes skink, orange-spotted gecko, and Nevis skink.
Western Lakes (11 sites)	131,124	Orange spotted gecko (4), takitimu gecko (1), lakes skink (1), nevis skink (2), cryptic skink (4), Kawarau gecko (2), korero gecko (3), southern grass skink (2), drylands grass skink (1), McCann's skink (3), Southern Alps gecko (5).	Nevis skink (2), lakes skink (2), southern grass skink (1), korero gecko (1), cryptic skink (1)	4		4	1	At least 11 lizard taxa including several threatened species i.e. lakes skink, orange-spotted gecko, Takitimu gecko, and Nevis skink.
Central Otago (3 sites)	1,247	Orange-spotted gecko (1), lakes skink (1), Kawarau gecko (1), schist gecko (1), korero gecko (2), southern grass skink	Orange spotted gecko (1)	3	1	2		Significant sites include orange-spotted gecko and lakes skink.

Sub Region	Area (ha)	Species Known to be Present (No. of Sites)	Species Potentially Present (No. of sites)	RPS Significance Criteria Met (No. of Sites)				Significance Justification
				2a (i)	2a (ii)	3	4	
		(3), McCann's skink (3), jewelled gecko (1).						
Catlins (7 sites)	17,824	Tautuku gecko (6), Southland green skink (1), cryptic skink (1), korero gecko (2), southern grass skink (7), McCann's skink (1).	Korero gecko (5)	6	1	1		Tautuku gecko present in podocarp forest and adjacent shrubland. Some open, rocky sites may have Southland green skink.

2.8 Terrestrial invertebrates

The approach used to identify significant habitat of terrestrial invertebrates relied on numerous entomological surveys of sites in Otago undertaken over the period 1984-2018 (see numerous report citations with B.H. Patrick as author in the References section). These were mainly undertaken on conservation or other reserve land, or during assessment of Recommended Areas for Protection (RAPs) for Protected Natural Areas Programme (PNAP) surveys. Sites on conservation land or in other reserves were sometimes defined as the cadastral parcel that the significant invertebrate assemblage occurred in, or by generalised outlines that captured the typical vegetation the invertebrate assemblage was present in. RAP boundaries were mapped by hand, based on figures presented in the various PNAP survey reports, then digitised using ARCGIS. Coordinates for salt pan sites in Table 1 of Allen and McIntosh (1997) were converted in ARCGIS data files and site boundaries were mapped based on Wildlands staff knowledge of these sites.

Sites were generally determined as significant habitats for terrestrial invertebrates based on areas or habitats where representative, diverse and/or distinctive invertebrate assemblages occurred, or areas that had records of Threatened, At Risk, or locally uncommon invertebrates.

One hundred and thirty-eight (138) significant habitats of terrestrial invertebrates were identified (Figure 8; Appendix 1). As most of the invertebrate survey records were from sites on conservation land or sites assessed under the PNAP, these sites make up the bulk of those that were mapped.

2.9 Freshwater habitats

2.9.1 Overview

Otago Region has a total of 27 species of indigenous freshwater fish, as shown below in Table 5.

Table 5: Freshwater indigenous fish species records for Otago Region from the NIWA New Zealand Freshwater Fish Database.

Common Name	Scientific Name	Number of Records	Threat Status
Alpine galaxias	<i>Galaxias paucispondylus</i>	70	At Risk-Naturally Uncommon
Banded kōkopu	<i>Galaxias fasciatus</i>	195	Not Threatened
Black flounder	<i>Rhombosolea retiarii</i>	37	Not Threatened
Bluegill bully	<i>Gobiomorphus hubbsi</i>	136	At Risk-Declining
Canterbury galaxias	<i>Galaxias vulgaris</i>	773	At Risk - Declining
Common bully	<i>Gobiomorphus cotidianus</i>	558	Not Threatened
Common smelt	<i>Retropinna retropinna</i>	66	Not Threatened
Dusky galaxias	<i>Galaxias pullus</i>	330	Threatened-Nationally Endangered
Eldon's galaxias	<i>Galaxias eldoni</i>	514	Threatened-Nationally Endangered
Estuarine triplefin	<i>Grahamina sp.</i>	5	Not threatened
Flathead galaxias	<i>Galaxias depressiceps</i>	435	Threatened-Nationally Vulnerable
Giant bully	<i>Gobiomorphus gobioides</i>	36	At Risk-Naturally Uncommon
Giant kōkopu	<i>Galaxias argenteus</i>	91	At Risk-Declining

Common Name	Scientific Name	Number of Records	Threat Status
Gollum galaxias	<i>Galaxias gollumoides</i>	279	Threatened-Nationally Vulnerable
Inanga	<i>Galaxias maculatus</i>	276	At Risk-Declining
Kōaro	<i>Galaxias brevipinnis</i>	548	At Risk-Declining
Lamprey	<i>Geotria australis</i>	199	Threatened-Nationally Vulnerable
Longfin eel	<i>Anguilla dieffenbachii</i>	1,477	At Risk-Declining
Lowland longjaw galaxias	<i>Galaxias cobitinis</i>	666	Threatened-Nationally Critical
Redfin bully	<i>Gobiomorphus huttoni</i>	167	Not Threatened
Roundhead galaxias	<i>Galaxias anomalus</i>	471	Threatened-Nationally Endangered
Shortfin eel	<i>Anguilla australis</i>	267	Not threatened
Torrentfish	<i>Cheimarrichthys fosteri</i>	191	At Risk-Declining
Upland bully	<i>Gobiomorphus breviceps</i>	1,487	Not Threatened
Yelloweye mullet	<i>Aldrichetta forsteri</i>	12	Not Threatened

Sources used to determine significant habitats of freshwater fish included:

- New Zealand Freshwater Fish Database (NIWA).
- Inanga spawning sites (Otago Regional Council).
- Freshwater Ecosystems of New Zealand (Department of Conservation).

These sources are described in the following sections.

2.9.2 New Zealand Freshwater Fish Database (NZFFD)

NZFFD records the occurrence of fish in fresh waters of New Zealand, including major offshore islands, and was established in 1977. Data collected include the site location, the species present and their abundance, as well as information such as the fishing method used and a qualitative assessment of the site's physical features. Data, which are recorded in the field on pre-printed forms, are contributed voluntarily to the online database by NIWA, Fish and Game New Zealand, the Department of Conservation, regional councils, environmental consultants, universities, and interested individuals. A user guide assists users of the NZFFD to perform effective searches from the web site and enter their own data.

Using these records, stream reaches were identified that contain nationally Threatened indigenous fish (Dunn *et al.* 2018), and these reaches were mapped as significant (Figure 9).

2.9.3 Significant freshwater habitats

Freshwater Ecosystems of New Zealand (FENZ) was used to identify high-ranking catchments in Otago, both on a national scale and regional scale. These rankings were undertaken using zonation software, taking account of pressures and connectivity constraints, and identify the relative value of third-order stream catchments (Leathwick *et al.* 2010). Regional third-order catchment rankings are undertaken within each FENZ biogeographical unit, and are therefore useful for identification of within-unit priorities. National river rankings are provided for third-order catchments across biogeographic units, thus highly-ranked catchments have been recognised across all of Aotearoa/New Zealand. The top ranked (top 10%) catchments on a regional scale are the catchments

that rank from 1-151, while the top ranked catchments on a national basis are those ranked 1-2,697. Streams passing through these high-ranking catchments were mapped as significant freshwater habitat. In addition, as described above, stream and river segments were added that had known locations of Threatened indigenous fish, based on the threat classification of Dunn *et al.* (2018). This was particularly important for identification of significant habitats of inland galaxiids, which are not taken account of in FENZ rankings. In the spatial layer produced from these data, segments with Threatened fish supplant both national and regional catchment rankings, and nationally-ranked segments supplant regionally-ranked segments (Figure 9).

There was not a great deal of overlap between catchments that had high ranks regionally and nationally, and many Threatened indigenous fish records were located outside of these highly-ranked catchments. Highly-ranked catchments on a national scale were located in the western mountains, on the Garvie Mountains/Old Woman Range/Old Man Range complex, on the Manorburn and Lammerlaw uplands, and along the lower Clutha/Mata Au River (Figure 9). Catchments with high regional rankings were mostly located in the Taieri catchment, on the slopes of Maungatua, in coastal Otago and on the Otago Peninsula, and in the Tahakopa River catchment in the Catlins (Figure 9). Stream reaches identified as significant because of the presence of Threatened indigenous fish were located in a number of inland catchments (Figure 9), reflecting the high diversity of Threatened inland galaxiid fish taxa in Otago.

2.9.4 Inanga spawning sites

After around six months in fresh water, mature inanga (*Galaxias maculatus*) migrate downstream in large schools to spawn in estuarine areas. Inanga eggs develop above normal river levels amongst vegetation that is flooded by spring tides. This layer of moist overlying vegetation results in the high humidity and moderate temperatures necessary for egg development. Most spawning takes place during late summer and autumn, but some occurs at other times. Successive inanga generations often use the same spawning sites year after year and allows these ecologically-sensitive areas to be identified, improved, and protected (Richardson and Taylor 2002)

A shapefile of inanga spawning locations was provided by Otago Regional Council and processed in ARCGIS. These locations were based on field surveys of inanga spawning behaviour during spring tides and searches of riparian vegetation for eggs. Polygons were drawn around these locations (Figure 10) to encompass areas of suitable habitat, particularly tall rank vegetation comprising graminoids such as grasses and sedges, including species such as Yorkshire fog, creeping bent, tall fescue, jointed rush (*Apodasmia similis*), harakeke (*Phormium tenax*), and/or raupo (*Typha orientalis*) (Richardson and Taylor 2002).

2.9.5 Significant lakes

FENZ was also used to identify and map significant lake habitats in Otago. This layer was compiled directly from the FENZ outputs of a zonation analysis similar to the one undertaken for third-order river catchments.

The FENZ layer identifies 381 lakes in Otago Region with a minimum size of one hectare. These lakes include the well-known larger western lakes, but also constructed

lakes and reservoirs, hydro-lakes, and the larger ephemeral wetlands and alpine tarns. FENZ broadly characterises lakes based on depth and surface area (Figure 11).



Legend
 Significant Invertebrates
 Otago boundaries

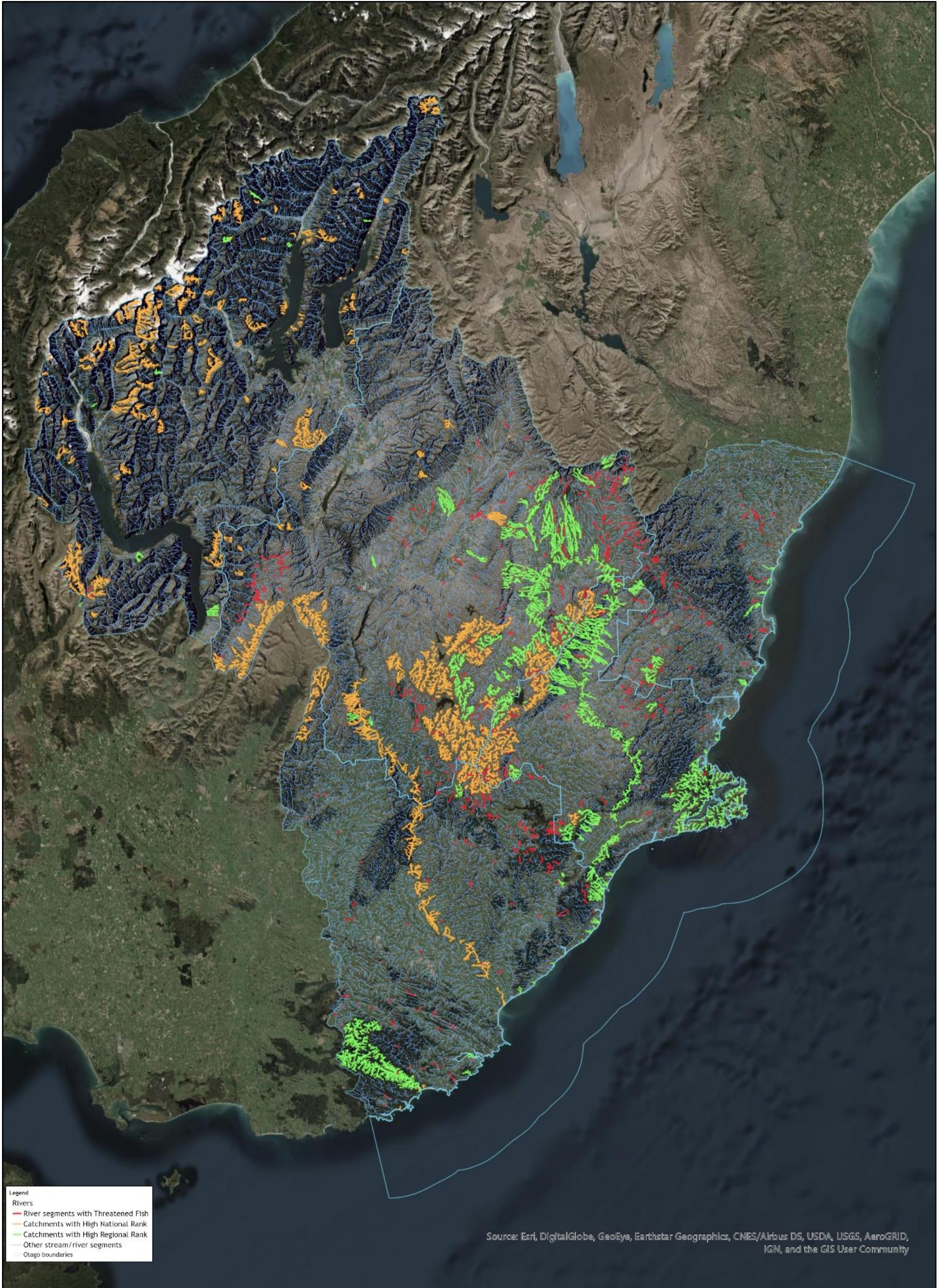
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Figure 8: Significant habitats of terrestrial invertebrates in Otago



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Legend
 Rivers
 — River segments with Threatened Fish
 — Catchments with High National Rank
 — Catchments with High Regional Rank
 — Other stream/river segments
 — Otago boundaries

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

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Figure 9: Significant stream and river habitats in Otago



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Legend
 — Inanga Spawning Habitat
 — Otago boundaries

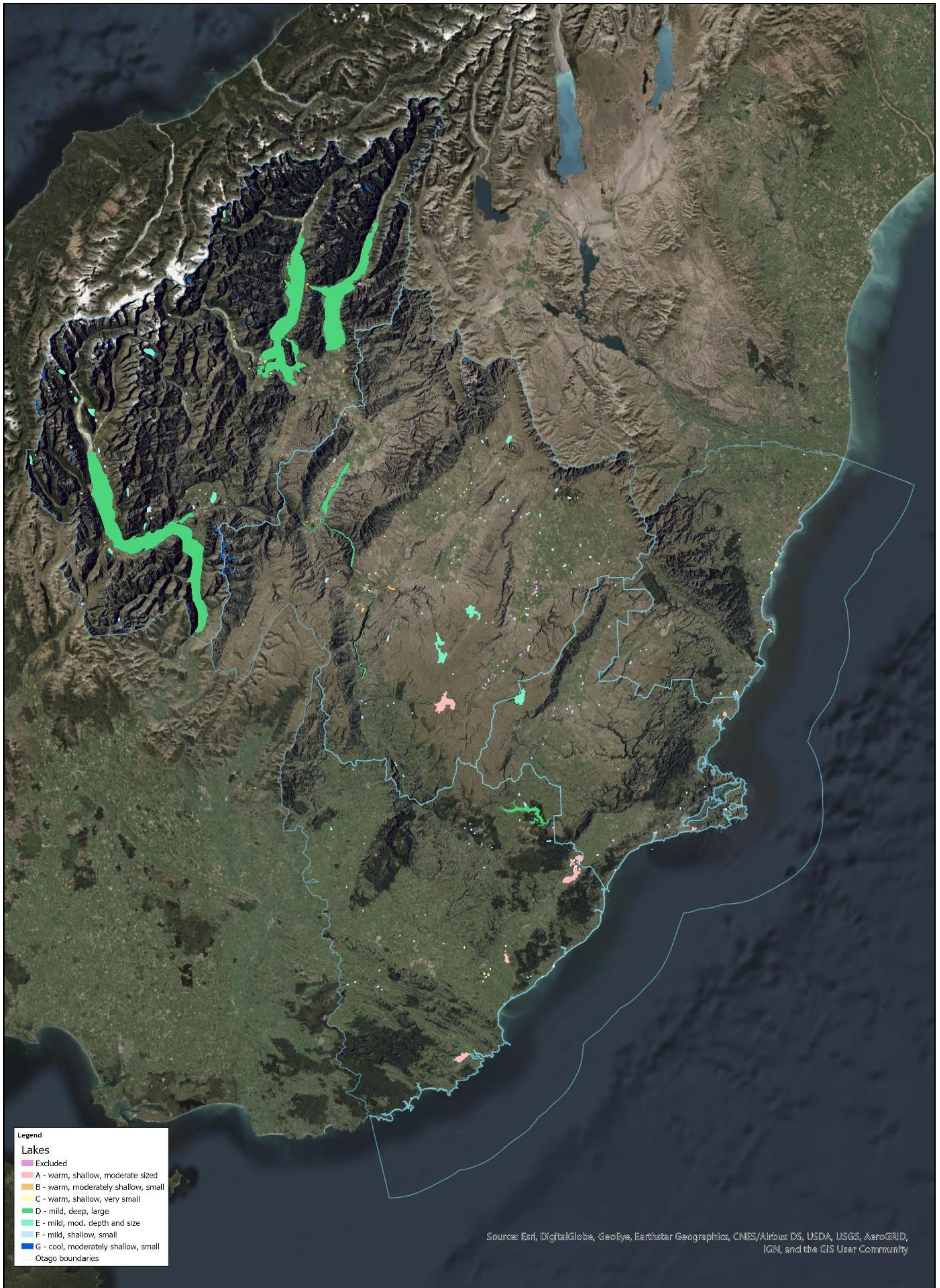
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure 10: Selected significant inanga spawning habitats



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- Legend**
- Lakes**
- Excluded
 - A - warm, shallow, moderate sized
 - B - warm, moderately shallow, small
 - C - warm, shallow, very small
 - D - mild, deep, large
 - E - mild, mod. depth and size
 - F - mild, shallow, small
 - G - cool, moderately shallow, small
 - Otago boundaries

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

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Figure 11: FENZ-classified lakes in Otago Region



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2.10 Marine ecosystems

Extensive desktop research was carried out to collate relevant scientific publications and reports, student theses, maps, publicly-available reports and statements from a variety of databases and websites.

Ecosystem types of a higher resolution were mapped based on information in reports by the South-East Marine Protection Forum (2018) and various scientific publications as well as reports by environmental consultancies, Crown Research Institutes, and central government agencies. Polygons of the ecosystem types were created in a separate layer and associated data was added to an Excel spreadsheet.

Biogenic reefs were mapped from based on existing modelling and research (Probert *et al.* 1979; Wood & Probert 2013). The ecosystems types based entirely on modelling (denoted 'Bryoz.pos' 1-6 in the mapping layer) used standard and widely-used criteria in all of the models. Furthermore, the distribution and position of feeding grounds for pelagic birds, hoiho, and marine mammals support the data.

The information collated from a variety of sources allows identification of a range of knowledge gaps, in particular the information gaps on biogenic reefs, their composition and size, and former ecosystem types or habitat of indigenous fauna that have been lost could also be mapped. Using the current reduced baseline can limit future management as protection and rehabilitation of habitat and ecosystems may not be taken into account, e.g. the effective size of marine protected areas (Edgar *et al.* 2014).

2.11 Significant marine habitats

Habitats of significant indigenous marine fauna were identified using a similar approach. Primary scientific literature and scientific reports were used as a source of information. Marine feeding areas for hoiho were based on records from tracked hoiho¹ off breeding colonies along the Otago coast (Mattern *et al.* 2007; 2013). These were hand-digitised based on areas that were densely tracked by hoiho (Figure 12).

Seabird location records were obtained from databases such as iNaturalist and Ebird, and used to determine areas where seabirds congregated for feeding. These feeding areas were mapped as significant habitat.

The coastal zone from Karitane to Brighton appears to support a greater abundance and diversity of marine ecosystems and fauna than elsewhere along the Otago coastline. This may be because ecosystems outside this area are not as well understood, or are less intensively researched, hence relatively less information is available. Also, as loss of former habitat has not been taken into account, loss of the marine fauna that would have used this habitat has also not been taken into account.

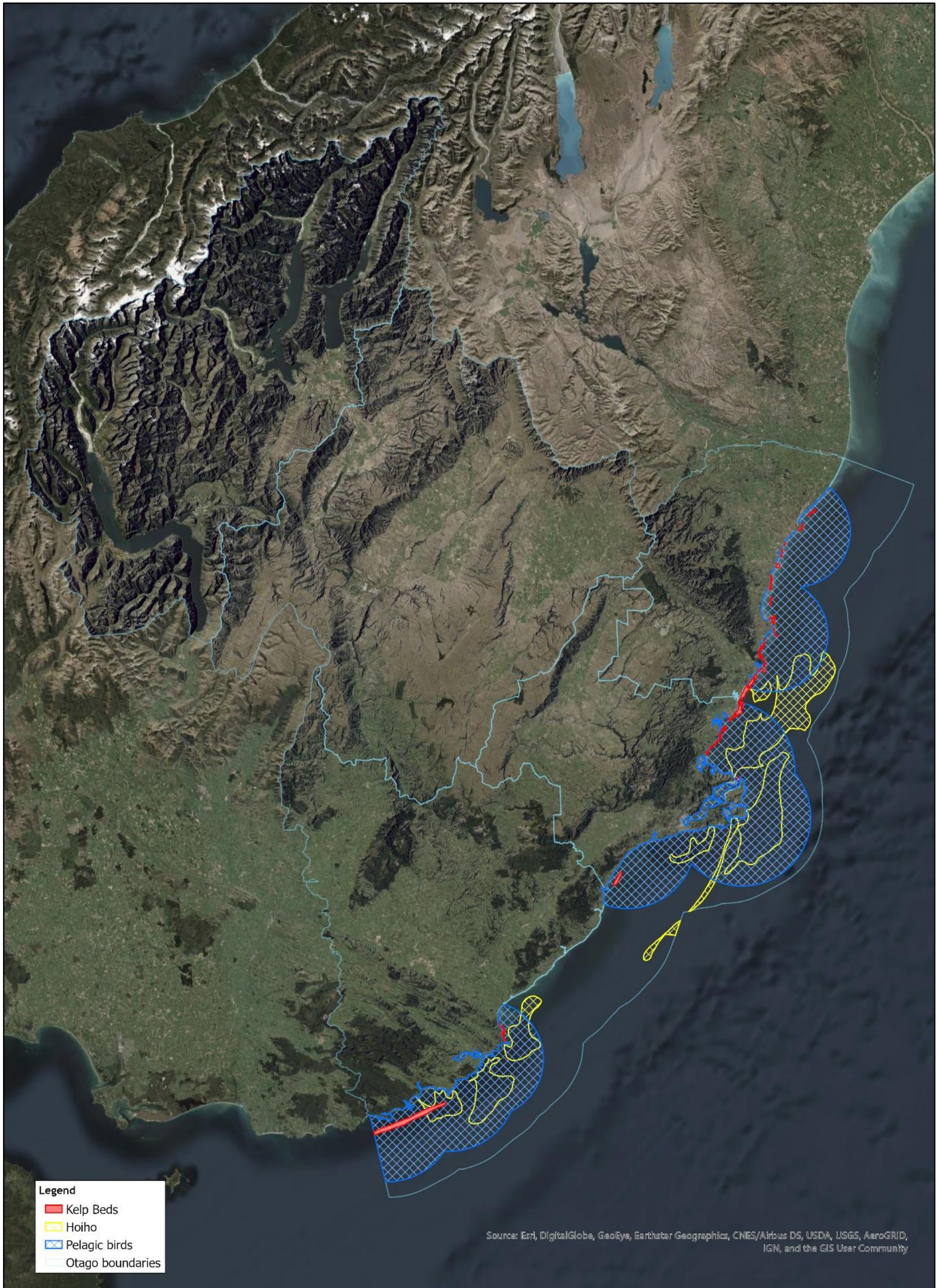
Important terrestrial habitats of marine mammals were identified during consultation with Department of Conservation staff and staff of the New Zealand Sea Lion Trust. Information on New Zealand fur seal rookeries was obtained from Lallas and Harcourt (1995). Examples of this mapping are shown in Figure 13.

¹ https://www.movebank.org/cms/webapp?gwt_fragment=page=search_map

Estuarine habitat comprising seagrass beds and cockle beds were mapped as significant habitats of indigenous fauna, drawing on information reported by Ismail (2001), Leduc *et al.* (2006), and Mills & Berkenbusch (2009) (Figure 14). Estuaries have been identified as highly productive key habitats for feeding, breeding, and resting, providing shelter and refuge for a diverse range of fauna. (Halpern *et al.* 2008, Cloern *et al.* 2016). As they act as a buffer zone and corridor between land and sea, deterioration of estuaries will affect functions and services of coastal marine ecosystems. Marine fauna (e.g. migrating birds, euryhaline fish, spat, fish eggs, zooplankton, and phytoplankton) also utilise various ecosystems with connected terrestrial and freshwater habitats and would also be negatively affected by deterioration of estuaries. Estuarine ecosystems provide fundamental services including coastal protection, maintenance of fisheries, nutrient cycling, filtering, and detoxification (Barbier *et al.* 2011).

Kelp beds were also mapped as significant habitat for indigenous fauna, based on information published in Seasketch¹ as part of the southeast Otago marine protected area consultation process. They provide habitat for a wide range of finfish, crustaceans, molluscs, and other algae species Wernberg *et al.* (2019). Kelp beds protect local coasts from erosion and play a crucial part in the coastal marine - terrestrial nutrient flow through carbon sequestration and nutrient uptake. They are described as some of the most ecologically dynamic and biologically diverse habitats and are considered to be a keystone ecosystem. If lost, there can be significant shifts in community composition and abundance.

¹ https://seasketch.doc.govt.nz/seas_metadata/otago/Macrocyctis.html



- Legend**
- █ Kelp Beds
 - █ Hoiho
 - Pelagic birds
 - Otago boundaries

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

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Figure 12: Significant feeding habitat of hoiho and pelagic birds, and significant kelp beds



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- Legend**
- ▭ Dolphin
 - ▭ Fur seal
 - ▭ Sea lion
 - ▭ Coastal seabirds terrestrial

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

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Figure 13: Significant coastal and marine habitat in the vicinity of Otago Peninsula



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

Legend

- Cockles
- Seagrass

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Figure 14: Significant cockle and seagrass habitats in Otago Harbour



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3. CONCLUSIONS

Mapping of significant fauna habitats across Otago Region was a challenging task which drew on information from a wide range of sources, including existing data layers, information in databases, articles, and reports, information provided during interviews with stakeholders, and Wildlands staff knowledge. Significant habitats were mapped across terrestrial, freshwater, and marine habitats, and covered a wide range of taxa, including birds, bats, lizards, invertebrates, and fish in terrestrial and freshwater habitats, and marine mammals, seabirds, bryozoans, and cockles.

The mapping identified gaps in information, and from this priority areas were identified for surveys for lizards and long-tailed bats. In the marine environment, more information on marine habitats and fauna was available for the area off the Dunedin City District coastline, and was more scarce for other parts of coastal Otago.

Significant habitats mapped in this project represent a starting point, based on the information available now. They can be improved as further fauna surveys are undertaken, providing new information that can be taken into account.

Nonetheless, the significant habitats of indigenous fauna mapped during this project will provide an important basis for evaluating sites in terms of RMA Section 6(c), which specifies that the protection of significant areas of indigenous vegetation and significant habitats of indigenous fauna is a matter of national importance that shall be recognised and provided for. Significance assessments have generally focussed on the identification of significant indigenous vegetation and much more rarely on the identification of significant habitats of indigenous fauna. To the extent that this has resulted from a lack of collated information, the sites identified by the mapping presented in this report will help to address this deficiency.

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Jim Fyffe and Tom Waterhouse (Department of Conservation), Will Rayment (NZ Sea Lion Trust), and Trudi Webster (Yellow-eyed Penguin Trust) provided very helpful information on the distribution of terrestrial breeding, resting, and refuge habitats of marine fauna. Catriona Gower and Dr Ian Davidson-Watts are thanked for useful discussions regarding priority sites for future bat surveys. Colin O'Donnell (Department of Conservation) is thanked for facilitating provision of the database of matuku/bittern records.

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SIGNIFICANT HABITATS OF TERRESTRIAL INVERTEBRATES IN OTAGO REGION

SITE NAME	ATTRIBUTES	REFERENCES
DUNEDIN ECOLOGICAL DISTRICT		
Doctor's Point	The At Risk-Declining red katipo spider (<i>Latrodectus katipo</i>) is present in sand dunes at its natural southern distributional limit. The dune landscape and flora are highly modified.	Barker <i>et al.</i> 2003; Patrick 1990c; Patrick 2002; Peat and Patrick 1995.
Aramoana Saltmarsh	Representative and diverse saltmarsh habitat for specialist estuarine and dune insects including chafer beetle (<i>Pericoptus truncatus</i>), and moths and butterflies. From salt-marsh ribbonwood and flax through to extensive herbfield, a multitude of specialist moths thrive on their particular hostplant. Many of the moths are diurnal and colourful such as the geometrid <i>Arctesthes catapyrrha</i> .	Barker <i>et al.</i> 2003; Peat and Patrick 1995; Patrick 1990c; Patrick 1995a.
Blueskin Bay including Rabbit Island	Representative estuarine saltmarsh herb moths and other insects. Of note is the only lowland population of a normally low-alpine, winter-emerging moth species. It is the diurnal moth - <i>Eurythecta leucothrinca</i> - significantly with a short-winged flightless female also.	Barker <i>et al.</i> 2003; Peat and Patrick 1995; Patrick 1990b and c.
Mount Cargill Scenic Reserve	Representative and diverse habitats including lowland to upper montane forest and shrubland, basalt bluffs and upper montane herbfield on its summit, for a wide range of insects including moths, butterflies, beetles, grasshoppers, stick insects, peripatus and bugs. One of the standout moths is the distinctive dayflying <i>Charixena iridoxa</i> whose caterpillars form a zigzag pattern on the leaves of the sedge <i>Astelia nervosa</i> high up on Mount Cargill. This is the only eastern South Island record of a Main Divide species. These forests are also a stronghold for the "valuable moth" the South Island zebra moth (<i>Declana egregia</i>) that is featured on the New Zealand \$100 banknote. Its caterpillars defoliate five and three finger foliage (<i>Pseudopanax</i> species). The tiny, jawed and day-flying moth <i>Sabatınca quadrijuga</i> is a feature of the forests here too, particularly from 500 m to the summit grassland at 680 m.	Allen <i>et al.</i> 2003; Patrick 1990c; Peat and Patrick 1995.
Caversham Bush	This Dunedin City Council forest reserve primarily protects one of the only known habitats of an undescribed species of peripatus - ancient invertebrates linking worms (Annelida) with Arthropoda including insects and spiders.	Allen <i>et al.</i> 2003; Patrick 1990c; Peat and Patrick 1995.
Hereweka - Harbour Cone	A rich and representative insect fauna including bugs, beetles and moths is supported by a hardwood - podocarp forest. The uncommon lacewing <i>Micromus bifasciatus</i> is found here associated with rimu and other podocarps.	Patrick 1990c; Peat and Patrick 1995.
Heyward Point Scenic Reserve	A representative and rich insect fauna associated a mixed hardwood - podocarp forest and special lianes and populations of small-leaved, deciduous tree daisies. All supporting a specialist insect fauna, some of it rare and local.	Patrick 2000c; Peat and Patrick 1995 reprint 2014.
Okia Flat - Taiaroa Bush	Representative insect fauna of a large forest remnant of characteristic species including some podocarps with abundant and diverse lianes and tree species. Adjacent extensive	Barker <i>et al.</i> 2003; Patrick 1990c; Peat and Patrick 1995.

SITE NAME	ATTRIBUTES	REFERENCES
	saltmarsh flats and dunes supports many diurnal moths, beetles and bugs thriving in this natural open habitat.	
Swampy Summit - Flagstaff Reserves - Leith Saddle (Water Catchment and Scenic Reserves) - upper Leith Valley down to 300 m. (Site traverses both Dunedin and Waikouaiti EDs)	Representative and highly diverse range of natural habitats including extensive low alpine snowgrass area with sphagnum wetlands, shrublands, herbfield and flanked by forest below supporting a wide range of insect groups including moths and butterflies, beetles, cicadas, grasshoppers, stoneflies, caddisflies and beetles. The shrublands of <i>Hebe odora</i> are particularly rich in specialist moth species including geometrids, plume-moths and leaf-rollers. The tiny, jawed and day-flying moth <i>Sabatinca quadrijuga</i> is a feature of the wet flushes above 600 m but also in the Leith Valley. The caddisflies <i>Olinga fumosa</i> and an undescribed species of <i>Pseudoeconesus</i> are endemic to Swampy Summit streams and seepages. A flightless and undescribed stonefly in the genus <i>Apteryoperla</i> is found here in copper tussock wetlands. It joins an undescribed cave wētā that tunnels in the sphagnum moss on the summit wetlands too. The giant ghost moth <i>Aoraia rufivena</i> with a male wingspan of up to 7 cm and a short-winged flightless female, is locally common in these montane forests through to the snowgrass community. The rare and localised diurnal crambid moth <i>Scoparia tuicana</i> was described from the "Waitati Hills" and rediscovered here and on the Slopedown Range in the Catlins. Additionally, the local endemic carabid beetle <i>Oregus inaequalis</i> lives in the summit grasslands and wetland edges. Ground beetles including this species are a special feature of the uplands above Dunedin in terms of biodiversity and conservation.	Lloyd and Patrick 2018; Mark <i>et al.</i> 2003; Patrick 1990c; Peat and Patrick 1995; Lloyd and Patrick 2018; Patrick 2018.
Cape Saunders	Cliff and cliff-top habitat with lichen encrusted rock, herbs and shrubs support a specialist insect fauna that is representative of such coastal habitats.	Barker <i>et al.</i> 2003; Patrick 1990c; Peat and Patrick 1995.
Sandymount Recreation Reserve - Sandfly Bay Wildlife Refuge	This large and diverse area supports a representative Otago Peninsula insect fauna of forest remnants, shrublands including tree nettle and <i>Helichrysum lanceolatum</i> , cliffs covered with lichens and herbs, dunes, and saltmarsh.	Barker <i>et al.</i> 2003; Patrick 1990c; Peat and Patrick 1995.
Woodhaugh Gardens	High quality and representative lowland forest remnant with abundant lianes and shrubs and trees with specialist insects including rare and Threatened noctuid moths <i>Meterana pansicolor</i> (Nationally Uncommon), and rare <i>M. octans</i> whose larvae are specialist defoliators of <i>Streblus</i> . Also present is the elegant small moth <i>Parectopa aethalota</i> whose larvae mine the foliage of <i>Parsonsia</i> vines, and a suite of specialist moths on the mistletoe <i>Ileostylus micranthus</i> , which has a particularly strong population here as do its specialist moths. These moths include three species classified as At Risk - the leaf mining <i>Zelleria sphenota</i> , and defoliators <i>Tatosoma agrionata</i> and <i>Declana griseata</i> .	Allen <i>et al.</i> 2003; Patrick 1990c; Peat & Patrick 1995; Hoare <i>et al.</i> 2017.
Mihiwaka - Mount Kettle	The summit wetlands and shrublands, and forested slopes down to 300 m support a diverse and representative insect fauna of such habitats in eastern Otago. The tiny, jawed and day-flying moth <i>Sabatinca quadrijuga</i> is a feature of the wetlands at about 560 m. Specialist moths on various tree species abound including a suite of standout species on silver beech patches and shrubs of <i>Dracophyllum longifolium</i> . These include leaf miners, flower feeders and defoliators of the foliage for both species.	Allen <i>et al.</i> 2003; Patrick 1990c; Peat and Patrick 1995.

SITE NAME	ATTRIBUTES	REFERENCES
TOKOMAIRO ECOLOGICAL DISTRICT		
Waipori Gorge (includes Waipori Falls Scenic Reserve)	Waipori Gorge forests support a rich and representative insect fauna, particularly of moths and butterflies, many of which are specialists on particular elements of the flora from lianes, herbs through to trees. Silver beech forest and its specialist moths are a feature. The red admiral butterfly (<i>Vanessa gonerilla</i>) has a particularly strong population here also, with its larvae on the appropriately named nettle <i>Urtica ferox</i> . The forest also supports the rare geometrid moths <i>Asaphodes obarata</i> (Threatened-Nationally Critical), present at one of its only known localities over the past 100 years, large ghost moth <i>Aoraia rufivena</i> , locally uncommon <i>Austrocidaria parora</i> and tiny day-flying jawed moth <i>Sabatinca quadrijuga</i> .	Allen <i>et al.</i> 2003; Peat and Patrick 1995; Hoare <i>et al.</i> 2017.
Akatore Creek (forest and saltmarsh)	Riparian-coastal forest and shrubland here supports a representative butterfly and moth fauna including the Threatened day-flying moth <i>Cephalissa siria</i> (Nationally Vulnerable) whose caterpillars feed on the liane <i>Fuchsia perscandens</i> . The tiny, jawed and day-flying moth <i>Sabatinca quadrijuga</i> is a feature of the damper parts of the forests here too.	Allen <i>et al.</i> 2003; Hoare <i>et al.</i> 2017; Peat and Patrick 1995.
Chrystalls Beach Reserve	A representative insect fauna of sand dunes, rock face (Cook's Head Rock) and coastal cushionfield is present here. A local endemic Boulder copper butterfly (<i>Lycaena</i> new species) present in the reserve's carpark is a Threatened species and listed as Nationally Critical. The restricted cushionfield supports many diurnal moth species that are now rare as their habitat is much reduced Otago-wide.	Barker <i>et al.</i> 2003; Hoare <i>et al.</i> 2017; Patrick 1992b, 2016b and c.
Otago Coast Forest	This large mixed forest supports a representative insect fauna of forest, shrubland and understorey species including a rich butterfly and moth fauna specialist on tree nettle <i>Urtica ferox</i> . The large ghost moth <i>Aoraia rufivena</i> is found here. It has a male with a 7 cm wingspan while its female is short-winged and flightless, but with a large abdomen fill of eggs.	Allen <i>et al.</i> 2003; Patrick 2018.
Lakes Waipori and Waihola wetland	Representative and rich insect fauna associated with wetland habitat is present here.	Hurn <i>et al.</i> 2003; Patrick 1993b.
Taieri River Scenic Reserve (larger area of mouth to gorge)	Representative and rich insect fauna of river gorge forests, shrublands and open steep rock faces. Of note is the high diversity in geometrid moth genus <i>Dichromodes</i> whose caterpillars feed on rock face lichens and the adult moths fly by day.	Allen <i>et al.</i> 2003; Patrick 1992a; Patrick 2018.
MANIOTOTO ECOLOGICAL DISTRICT		
Patearoa Saline Area (QE II Covenant)	Representative and significant saltpan habitat for specialist saline insects including Threatened day-flying saltpan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> (both At Risk-Relict); and <i>Sporophylla oenospora</i> (Nationally Critical).	Grove 1994b; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a; Patrick 1994c and e; Patrick 2004b; Peat and Patrick 1999; Hoare <i>et al.</i> 2017; Mark <i>et al.</i> 2003; Matthews and Patrick 1998.
Belmont Salt Pans (QE II Covenant)	Representative and significant saltpan habitat for specialist saline insects including the At Risk-Relict saltpan moth <i>Paranotoreas fulva</i> .	Grove 1994b; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a; Patrick 1994c and e; Peat & Patrick 1999; Hoare <i>et al.</i> 2017.

SITE NAME	ATTRIBUTES	REFERENCES
Conroys Dam (DoC)	Representative and significant saltpan habitat for specialist saline insects including the At Risk-Relict saltpan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> .	Grove 1994b; Mark <i>et al.</i> 2003; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a; Patrick 1994c and e; Peat & Patrick 1999; Hoare <i>et al.</i> 2017.
Rockdale (Private)	Representative and significant saltpan habitat for specialist saline insects including the At Risk-Relict and diurnal saltpan moth <i>Paranotoreas fulva</i> .	Grove 1994b; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a; Patrick 1994c and e; Peat & Patrick 1999; Hoare <i>et al.</i> 2017.
Chatto Creek (Private)	Representative and significant saltpan habitat for specialist saline insects including the At Risk-Relict and diurnal saltpan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> .	Grove 1994b; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a; Patrick 1994c and e; Peat and Patrick 1999; Hoare <i>et al.</i> 2017.
Chapman Road (Private - RAPs 10 & 11))	Representative and significant saltpan habitat for specialist saline insects including the diurnal saltpan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> (both At Risk-Relict).	Grove 1994b; Mark <i>et al.</i> 2003; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a; Patrick 1994c and e; Peat and Patrick 1999; Hoare <i>et al.</i> 2017.
Patrick's Place (Private - RAP 12)	Representative and significant saltpan habitat for specialist saline insects including the dayflying saltpan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> (both At Risk-Relict), and day-flying <i>Sporophylla oenospora</i> (Nationally Critical); Type locality for Threatened dayflying noctuid <i>Australothis volatilis</i> (Nationally Critical).	Grove 1994b; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a; Patrick 1994c and e; Peat and Patrick 1999; Hoare <i>et al.</i> 2017; Matthews and Patrick 1998.
Blackmans (Private - Pastoral Lease - RAP 13)	Representative and significant saltpan habitat for specialist saline insects including the dayflying saltpan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> (both At Risk-Relict).	Grove 1994b; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a; Patrick 1994c and e; Peat and Patrick 1999; Hoare <i>et al.</i> 2017.
Wilsons Road (Private - RAP 15)	Representative and significant saltpan habitat for specialist saline insects including the diurnal saltpan moth <i>Paranotoreas fulva</i> (At Risk-Relict).	Grove 1994b; Mark <i>et al.</i> 2003; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a; Patrick 1994c and e; Peat and Patrick 1999; Hoare <i>et al.</i> 2017.
MANORBURN ECOLOGICAL DISTRICT		
Flat Top Hill Conservation Area	Representative dryland insects of montane Central Otago; Specialist saltpan moth fauna including the saltpan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> (both At Risk-Relict) & undescribed geometrid <i>Pseudocoremia</i> new species (Nationally Endangered). The last named is a specialist on the tree daisy <i>Olearia odorata</i> where it is joined by other <i>Olearia</i> moths including the noctuids <i>Meterana exquisita</i> and <i>M. grandiosa</i> (both At Risk-Relict). Insects associated with large tors are a feature too with moths in the genus <i>Dichromodes</i> exemplifying this diversity and ecology. The seven Lepidoptera with their Type locality in the Manorburn ED are listed in Patrick (1989b) with most being in the Ida Valley. The rare	Hoare <i>et al.</i> 2017; Peat and Patrick 1999; Patrick 1989b; Patrick 2000c.

SITE NAME	ATTRIBUTES	REFERENCES
	flightless chafer beetles <i>Prodontria modesta</i> and <i>P. bicolorata</i> have significant populations here too.	
Galloway Saline Areas 1 & 2	The salt pans here support a representative salt pan moth fauna including the diurnal salt pan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> (both At Risk-Relict).	Grove 1994b; Mark <i>et al.</i> 2003; McIntosh, Beecroft and Patrick 1990 and 1991; Patrick 1989a and b; Patrick 1994c Peat and Patrick 1999.
Moa Creek Saline Area	The saline soil habitat here supports a representative range of specialist salt pan moths including the diurnal salt pan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> (both At Risk-Relict).	Grove 1994b; McIntosh, Beecroft and Patrick 1990 and 1991; Peat and Patrick 1999; Patrick 1989a and b; Patrick 1994c.
South Rough Ridge to Pinelheugh including Long Valley Ridge and Greenland Reservoir wetlands	Alpine grassland, cushionfield, herbfield and extensive wetlands with prominent copper tussock and moss bogs, and tors down to 750 m support a highly representative alpine insect fauna including moths, butterflies, grasshoppers and cicada species. Wetland moths such as large-bodied ghost moths (<i>Aoraia</i> species), diurnal crambids (<i>Orocrambus</i> and <i>Scoparia</i> species) and geometrids (<i>Notoreas</i> , <i>Dasyuris</i> , <i>Arctesthes</i> and <i>Aponotoreas</i>) are a feature. Another feature is the winter-emerging moth fauna exemplified by the Threatened geometrid moth <i>Theoxena scissaria</i> (Nationally Vulnerable) and a suite of day-flying tortricid moths breeding in the montane-low alpine grassland-shrublands here. Another ghost moth present is the colourful, sphagnum ghost moth <i>Heloxycanus patricki</i> which is classified as At Risk-Declining.	Hoare <i>et al.</i> 2017; Huryn <i>et al.</i> 2003; Mark <i>et al.</i> 2003; Patrick 1989a and b; Peat and Patrick 1999; Patrick 2004a; Patrick 2018.
RICHARDSON ECOLOGICAL DISTRICT		
Mounts Aurum - Larkins including Lochnagar (all land above 1000m)	Representative alpine and high alpine snowgrass and herbfield communities with high insect biodiversity for beetles and moths, and Type Locality for the rare shield bug <i>Hypsithocus hudsonae</i> (At Risk-Naturally Uncommon)	Mark <i>et al.</i> 2003; Patrick 2016; Peat and Patrick 1999.
Pigeon, Pig and Tree Islands in Lake Wakatipu	Representative insects of significant and natural mixed beech-podocarp forests and associated shrubland and herbfield.	Allen <i>et al.</i> 2003; Legge 1991; Peat & Patrick 1999.
Rees River flats (Camp Hill to Diamond Lake and to Rees Valley Homestead)	Representative and rich moth fauna associated with groves of small-leaved tree daisies in genus <i>Olearia</i> such as <i>O. hectorii</i> on the riparian flats. New and Threatened species of moth in the genera <i>Pyrgotis</i> , <i>Protosynaema</i> (both Nationally Vulnerable) and <i>Stigmella</i> (Nationally Critical) were discovered here.	Hoare <i>et al.</i> 2017; Patrick 1991b; Patrick 2000c; Peat and Patrick 1999.
EYRE ECOLOGICAL DISTRICT		
Von River wetlands	Representative insect fauna of wetland, herbfield and associated grassland and shrubland. It is the Type locality for local endemic dayflying geometrid moth <i>Arctesthes titanica</i> . It is also a Threatened species and classified as Nationally Vulnerable. A colourful ghost moth present here is the sphagnum ghost moth <i>Heloxycanus patricki</i> , which is classified as At Risk-Declining.	Huryn <i>et al.</i> 2003; Patrick <i>et al.</i> 2019; Peat and Patrick 1999; Hoare <i>et al.</i> 2017.
Te Kere Haka Scenic Reserve	Representative silver beech and grassland area for a moderately rich fauna of insects of several Orders.	Mark, Dickinson and Patrick 1987.

SITE NAME	ATTRIBUTES	REFERENCES
Glen Allen Scenic Reserve	Representative montane to alpine area with a mixed beech forest and snow tussock grassland, which supports a moderately rich range of insects.	Mark, Dickinson and Patrick 1987.
Eyre Mountains (extensive montane beech forest to alpine - high alpine area from West Dome to Cecil Peak, and from Jane Peak to Symmetry Peaks (400 -2,035 m), with 950 m in areas not marked in Mark <i>et al.</i> 1987.	Representative montane, alpine and high alpine zones with rock bluff, scree, snowbank, cushionfield, grassland, herbfield, wetland and shrubland habitat, all with a distinctive insect fauna. Nationally a particularly rich insect fauna across many groups including beetles, grasshoppers, cicadas, moths, butterflies and aquatic groups. This insect fauna includes the rare shield bug <i>Hypsithocus hudsonae</i> (At Risk-Naturally Uncommon), and rare moths including <i>Xanthorhoe frigida</i> (Nationally Vulnerable), <i>Helastia salmoni</i> , <i>Asterivora exocha</i> , <i>Epichorista</i> n.sp. and <i>Orocrambus cultus</i> . Three giant ghost moths in the genus <i>Aoraia</i> are also a feature with their short-winged and flightless females. Another ghost moth present is the sphagnum ghost moth <i>Heloxycanus patricki</i> which is classified as At Risk-Declining. The tiny, jawed and day-flying moth <i>Sabatinca quadrijuga</i> is a feature of the damp areas at about 1000 m here too. Additionally, among the beetles here the large carabid beetle <i>Mecodema chiltoni</i> and stout weevil <i>Lyperobius spedenii</i> are present in reasonable numbers in contrast to other places in western Otago where they have decreased in abundance dramatically. The large and rare land snail <i>Powelliphanta spedeni</i> was present at tree-line on the Mount Bee ridge in snow tussockland. Additionally, an undescribed species of scree wētā (<i>Pharmacus</i> n.sp.) is reasonably widespread here in the alpine zone of the highest peaks. The occurrence of six grasshopper species here underlines the high diversity of the Eyre Mountains.	Allen <i>et al.</i> 2003; Mark, Dickinson and Patrick 1987; 1987; Patrick 2016a; Peat and Patrick 1999; Patrick 1989c; Patrick 2004a; Hoare <i>et al.</i> 2017; Mark, Dickinson and Patrick 2003; Mark <i>et al.</i> 2003; Patrick 2012; Patrick 2018.
PISA ECOLOGICAL DISTRICT		
Cromwell Chafer Beetle Nature Reserve	Only known population of the Threatened-Nationally Endangered flightless Cromwell chafer beetle (<i>Prodontria lewisi</i>). Another scarab beetle <i>Pericoptus frontalis</i> also has its Type locality on the "Cromwell Sands" and although it has a slightly wider distribution, it is also a rare species. An undescribed and rare diurnal moth (<i>Dichromodes</i> n.sp.) also has a significant population on the reserve amongst a representative inland sand dune moth fauna.	Barratt & Patrick 1992; Grove 1995; Mark <i>et al.</i> 2003; Peat & Patrick 1999; Patrick 1990d.
Mount Iron (Scenic Reserve and RAP A1)	The mixed, low stature montane forest-shrubland, rocky areas and shrubland supports an insect fauna that is representative of such dry woody and rocky areas. Of note is the moth fauna associated with native broom <i>Carmichaelia petriei</i> and the small-leaved daisy shrub <i>Helichrysum lanceolatum</i> .	Allen <i>et al.</i> 2003; Grove 1995; Peat & Patrick 1999.
Pisa Flats (RAP A5)	This site supports the most representative specialist moth fauna of salty soils in the upper Clutha Valley including the saltpan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> (both At Risk-Relict). An adjacent dryland cushionfield-herbfield also supports many uncommon insect species typical of the Central Otago valley floors.	Grove 1995; McIntosh, Beecroft & Patrick 1990 & 1991; Patrick 1989a; Patrick 1994c; Peat & Patrick 1999.
Luggate Creek (RAP A2)	Representative insect fauna of dry forest and shrublands of montane zone of Upper Clutha. Key foodplants for indigenous insects such as silver beech, kānuka, mountain ribbonwood, <i>Hebe subalpina</i> , <i>Corokia cotoneaster</i> , <i>Dracophyllum longifolium</i> , <i>Helichrysum lanceolatum</i> and several species of pōhuehue are present and support a rich specialist insect fauna, particularly butterflies and moths.	Grove 1995; Peat & Patrick 1999; Patrick 1994c.

SITE NAME	ATTRIBUTES	REFERENCES
Pisa (RAP A3 plus extension to eastern faces below and including Mount Dottrel and Column Rocks down to 700 m)	Representative, species rich and distinctive insect fauna occupying a range of habitats from montane to high alpine cirques. High alpine cushionfields, scree, large tors, snow grasslands and associated herffield, shrublands and alpine seepages, wetlands and streams all support a distinctive and diverse assortment of indigenous insects from many Orders including beetles, cicadas, moths and butterflies, stoneflies, caddisflies, mayflies, bugs, cockroaches and grasshoppers. The Pisa Range is type locality for several insect species including stonefly and caddisfly species. Diurnal geometrid moths are a feature of the alpine areas and include the recently described <i>Notoreas elegans</i> whose caterpillars feed on <i>Pimelea</i> species here. The day-flying males of the large ghost moth <i>Aoraia senex</i> are a feature of high alpine snowbanks, and noteworthy for their short-winged flightless females.	Grove 1995; Mark <i>et al.</i> 2003; Peat & Patrick 1999; Patrick 1995b; Patrick and Hoare 2010; Patrick 2012; Patrick 2018.
Skeleton Stream & Lower Meg (RAPs A6 & 8)	By linking these two RAPs in the Roaring Meg, a highly representative insect fauna of aquatic insects, and insects of riparian silver beech forest and associated shrublands is encapsulated.	Grove 1995; Peat & Patrick 1999.
Double Rock (RAP A9)	A highly representative insect fauna of mixed shrublands on which many of the beetles and moths are specialist feeders. Of note here are the specialist moth larvae on the shrubs of a rare native broom <i>Carmichaelia compacta</i> , the extensive silver tussockland and the many rock faces where they feed on lichens. The rare and Threatened geometrid moth <i>Theoxena scissaria</i> (Nationally Vulnerable) is present in these shrublands associated with native brooms.	Grove 1995; Peat & Patrick 1999.
Poison Creek Flats (RAP B2)	A representative insect fauna, mostly moths and butterflies associated with dryland cushionfield, herffield and low-growing shrubs such as <i>Pimelea oreophila</i> .	Grove 1995; Peat & Patrick 1999; Patrick 1989a; Patrick 1994c.
LINDIS ECOLOGICAL DISTRICT		
Lindis Pass Scenic Reserve & Double Peak extension (RAP A2)	A representative insect fauna of dry mixed grasslands and matagouri-dominated shrubland is found here. Of note in the extension is the daisy shrub <i>Olearia odorata</i> which is so rich in specialist moths including the noctuid moths <i>Meterana exquisita</i> and <i>M. grandiosa</i> (At Risk-Relict).	Grove 1995; Peat & Patrick 1999; Patrick 2000c; Hoare <i>et al.</i> 2017.
Lindis Head (RAP A1)	A representative insect fauna of dry montane mixed grassland - shrubland to high alpine cushionfield, grassland and snowbank communities.	Grove 1995; Peat & Patrick 1999.
Chain Hills (RAP A3)	This area contains a representative insect fauna from diverse upper montane to the high alpine zone with snow tussock and associated cushionfield and herffield. Red tussock, pōhuehue, <i>Hebe subalpina</i> , <i>Melicytus alpinus</i> and <i>Olearia odorata</i> are noteworthy components of the montane zone here, and support specialist insects including a diverse assemblage of moths. The noctuid moths <i>Meterana exquisita</i> and <i>M. grandiosa</i> (both At Risk-Relict) are found here.	Grove 1995; Peat & Patrick 1999; Patrick 2000c; Hoare <i>et al.</i> 2017.
Hospital Creek (RAP A8)	A representative insect fauna of montane shrublands and rock bluffs up to low alpine snow tussock and associated herffield and woody species, all of which support specialist insects. The noctuid moths <i>Meterana exquisita</i> and <i>M. grandiosa</i> (both At Risk-Relict) are found here.	Grove 1995; Patrick 2000c Peat & Patrick 1999; Hoare <i>et al.</i> 2017.

SITE NAME	ATTRIBUTES	REFERENCES
East Camp Creek (RAP A10)	This altitudinal sequence from the montane to low alpine zone contains kānuka and rock outcrop habitat at its lower part, through to snow tussock with associated herbfield, all of which support a representative insect fauna.	Grove 1995; Peat & Patrick 1999.
DUNSTAN ECOLOGICAL DISTRICT		
North Dunstan (RAP A1)	A highly representative insect fauna of montane to the high alpine zone of the North Dunstan Mountains including snowbank, snowgrass, cushionfield, herbfield, flush and shrubland communities with their diverse and mostly specialist insect species.	Grove 1995; Peat & Patrick 1999.
Dunstan Mountain tops down to 1100 m contour including Bendigo Tops - Scotts Creek - Fairfax Spur - Waikerikeri - Neds Creek - Dry Creek (RAPs A4, A5, A6, A7 & B9 & B10) and broadly Mounts Kinaki and Fulton.	A highly representative insect fauna of a large altitudinal sequence from montane shrubland, grasslands to high alpine cushionfield and impressive lichen-encrusted tors. The montane shrubland has a diverse flora that includes specialist insect-rich shrubs such as <i>Olearia odorata</i> and <i>Pimelea oreophila</i> . The recently described diurnal geometrid <i>Notoreas elegans</i> has its caterpillars feeding on the latter. The high alpine tops are home to a diverse and specialist insect fauna of cicadas, moths, beetles and grasshoppers including the large diurnal ghost moth <i>Aoraia senex</i> with its short-winged and flightless female living in snowbanks on the summit of the range.	Grove 1995; Mark <i>et al.</i> 2003; Peat & Patrick 1999; Patrick 2000c; Patrick 1995b; Patrick and Hoare 2010; Patrick 2012; Patrick 2018.
TAPANUI ECOLOGICAL DISTRICT		
Blue Mountains Conservation Area	Intact, diverse and extensive low alpine herbfield, grassland, shrubland and cushionfield, bordered by silver beech forest, with rich and distinctive insect fauna including local endemics - diurnal geometrid moth <i>Aponotoreas</i> n.sp., ghost moth <i>Aoraia oreobolae</i> and caddisfly <i>Tiphobiosis quadrifurca</i> . Another ghost moth present is the sphagnum ghost moth <i>Heloxycanus patricki</i> which is classified as At Risk-Declining. Other undescribed insects (cockroach and flightless stonefly) found here may also be endemic to the range.	Patrick <i>et al.</i> 1985; Peat & Patrick 1999; Patrick 2018; Hoare <i>et al.</i> 2017.
OLD MAN ECOLOGICAL DISTRICT		
Butchers Dam (DoC)	Representative and significant saltpan habitat for specialist saline insects including the saltpan moths <i>Loxostege</i> n.sp. and <i>Paranotoreas fulva</i> (both At Risk-Relict).	Patrick 1989a; Peat & Patrick 1999; Hoare <i>et al.</i> 2017.
Earnsclough Tailings Historic Reserve	Largest known populations of the grasshopper <i>Sigaus childi</i> (At Risk-Naturally Uncommon) and a significant population of an undescribed boulder copper butterfly - <i>Lycaena</i> new species.	Mark <i>et al.</i> 2003; Patrick 1994c; Trewick <i>et al.</i> 2016; Peat & Patrick 1999.
Garvie Mountains-Old Woman Range (linked RAPs 1/5, 1/6, 1/9, 1/10, 1/11, 1/12, 2/5, 2/7 & 2/8)	Representative and very rich insect fauna of altitudinal sequence from montane to alpine to high alpine areas with high biodiversity particularly in snowbanks, alpine wetlands, grasslands, herbfields, shrublands, rock fields and on rock tor lichens. Special features include large-bodied flightless wētā and black scree butterfly. Three species of large ghost moths in the genus <i>Aoraia</i> are found here in snowbanks (<i>Aoraia senex</i>) and snowgrass (<i>Aoraia rufivena</i> and <i>A. macropis</i>). They are noteworthy not just for their large size, but they all have short-winged flightless females. Another ghost moth present is the sphagnum ghost moth <i>Heloxycanus patricki</i> which is classified as At Risk-Declining.	Brumley <i>et al.</i> 1986; Hoare <i>et al.</i> 2017; Mark <i>et al.</i> 2003; Patrick 1986c; Peat & Patrick 1999; Patrick 1985; Patrick 2018.
Old Man Range (linked RAPs 1/7, 1/8, 1/13, 2/3 & 2/4)	Representative and very rich insect fauna of altitudinal sequence from montane to alpine to high alpine area with high biodiversity and particularly rich biodiversity in snowbanks, alpine	Brumley <i>et al.</i> 1986; Hoare <i>et al.</i> 2017; Patrick 1986c; Mark <i>et al.</i> 2003; Patrick

SITE NAME	ATTRIBUTES	REFERENCES
	wetlands, shrublands and snowgrass communities. Special features include large-bodied flightless wētā and an abundance of diurnal geometrid moths such as <i>Notoreas elegans</i> . Another special feature is the number of Type Localities (13) for insects (beetles, cicada and cockroach) listed by Brumley <i>et al.</i> (1986) for the Old Man Range, including the rare shield bug <i>Hypsithocus hudsonae</i> (At Risk-Naturally Uncommon). Several species of large ghost moths in the genus <i>Aoraia</i> are found here in snowbanks (<i>Aoraia senex</i>) and snowgrass (<i>Aoraia rufivena</i>). The former has its Type Locality here. Another ghost moth present is the sphagnum ghost moth <i>Heloxycanus patricki</i> which is classified as At Risk-Declining.	1991a; Peat & Patrick 1999; Brumley <i>et al.</i> 1986; Patrick and Hoare 2010; Patrick 2012; Patrick 2016a; Patrick 2018.
Barn Creek (RAP 1/4)	Representative insect community of montane to alpine grasslands with associated lichen-encrusted rock tors, and montane shrublands including specialist native broom and tree daisy (<i>Olearia odorata</i>) moth species. The distinctive noctuid <i>Meterana exquisita</i> (At Risk-Relict) is present. It is a specialist on <i>O. odorata</i> . An undescribed and rare new geometrid (<i>Dichromodes</i> n.sp.) with larvae feeding on lichens on tors is also present.	Brumley <i>et al.</i> 1986; Peat & Patrick 1999; Hoare <i>et al.</i> 2017; Patrick 2000c; Brumley <i>et al.</i> 1986.
Molyneux Faces (RAP 1/3)	Representative insect community of the dry shrublands and sunny rock faces of Central Otago with rich moth fauna associated with daisy shrub <i>Olearia odorata</i> including three specialists on <i>O. odorata</i> including the noctuids <i>Meterana exquisita</i> and <i>M. grandiosa</i> (both At Risk-Relict) and geometrid <i>Declana nigrosparisa</i> (Threatened-Nationally Vulnerable). The rare, diurnal, rock face and lichen-feeding moth <i>Dichromodes ida</i> is also present.	Brumley <i>et al.</i> 1986; Peat & Patrick 1999; Hoare <i>et al.</i> 2017; Patrick 2000c; Brumley <i>et al.</i> 1986.
Long Gully Bluffs (RAP 1/2)	Representative insect community of dry shrublands and sunny rock faces of Central Otago with rich moth fauna associated with daisy shrub <i>Olearia odorata</i> including two specialists on <i>O. odorata</i> , the noctuids <i>Meterana exquisita</i> and <i>M. grandiosa</i> (both At Risk-Relict).	Brumley <i>et al.</i> 1986; Peat & Patrick 1999; Hoare <i>et al.</i> 2017; Patrick 2000; Brumley <i>et al.</i> 1986.
Mount Difficulty (RAP 1/1) and significant extension to encompass all the lands down to Kawarau River to northeast and northwest of Mount Difficulty	Representative insect community of drylands of Central Otago with rich moth fauna associated with shrubs including <i>Olearia odorata</i> and <i>Pimelea aridula</i> . Populations of moths that are specialist feeding on <i>O. odorata</i> shrubs, including <i>Pasiphila</i> new species, <i>Protosynaema</i> new species, <i>Pseudocoremia cineracia</i> & <i>Declana nigrosparisa</i> (all Nationally Vulnerable), and two noctuids <i>Meterana exquisita</i> and <i>M. grandiosa</i> (both At Risk-Relict), are present here. Additionally, the Threatened and rare geometrids <i>Theoxena scissaria</i> (Nationally Vulnerable) and <i>Xanthorhoe bulbulata</i> (Nationally Critical) have both been recorded in the Kawarau Gorge part of this area and for the latter species this is the only record of it anywhere over the past 75 years. The rare and flightless chafer beetle <i>Prodontria jenniferae</i> , has its Type locality here and a small distribution from the Kawarau Gorge up to 750 m on the surrounding slopes.	Brumley <i>et al.</i> 1986; Emerson and Barratt 1997; Patrick 1986c; Peat & Patrick 1999; Hoare <i>et al.</i> 2017; Patrick 2000b & c; Brumley <i>et al.</i> 1986.
WAIPORI ECOLOGICAL DISTRICT		
Te Papanui Conservation Park Lammerlaw - Lammermoor Tops (adjacent RAPs 2, 3 & 4)	High biodiversity of alpine insects in intact snow tussock, shrubland, wetland and snowbank communities are exemplified by the local endemic grassmoth <i>Orocrambus geminus</i> , and two other moths and six beetles. The range also has a high diversity of alpine dayflying geometrids (18), grassmoths in genus <i>Orocrambus</i> (25) including other dayflying moths such as <i>Notoreas elegans</i> ; <i>O. thymiastes</i> , cicadas, grasshoppers, beetles, stoneflies and new undescribed caddisflies. The large-bodied alpine wētā <i>Hemideina maori</i> is also present, along with the large-bodied ghost moth <i>Aoraia orientalis</i> that it shares with the Rock & Pillar	Barratt & Patrick 1987; Grehan & Patrick 1984; Hoare <i>et al.</i> 2017; Mark <i>et al.</i> 2003; Patrick 1984; Peat & Patrick 1995; Patrick 1990, 1991a & 1991d; Patrick <i>et al.</i> 1993; Patrick 1993c; Carter 1994; Patrick and Hoare 2010; Patrick 2012.

SITE NAME	ATTRIBUTES	REFERENCES
	Range to the north. This species has a short-winged flightless female and a day-flying male, making for a spectacular mating event! Another ghost moth present is the sphagnum ghost moth <i>Heloxycanus patricki</i> which is classified as At Risk-Declining.	
Black Rock Scientific Reserve	Representative insect fauna of eastern Otago upland snowgrass, associated herbfield and diverse shrublands.	Patrick <i>et al.</i> 1993; Carter 1994.
Nardoo Scientific Reserve	Representative insect fauna of eastern Otago upland snowgrass and shrublands. Colourful day-flying moths such as <i>Dasyuris callicrena</i> are a feature of the <i>Hebe odora</i> shrublands, which are so extensive here.	Patrick <i>et al.</i> 1993; Carter 1994.
Stony Creek Scenic Reserve	Representative insect fauna of eastern Otago upland snowgrass, shrubland and silver beech forest, including moderate diversity of aquatic insect groups and specialist moths and beetles.	Patrick <i>et al.</i> 1993; Carter 1994.
Deep Stream Scenic Reserve	Representative insect fauna of eastern Otago upland snowgrass, shrubland and silver beech forest, including moderate diversity of specialist butterflies, moths, beetles and grasshoppers.	Patrick <i>et al.</i> 1993; Carter 1994.
Maungatua Scenic and Scientific Reserves	Representative insect fauna of eastern Otago upland snowgrass, herbfield, cushion bogs and shrublands. Patrick <i>et al.</i> (1993) list 48 invertebrates (spider, grasshopper, stonefly, moths and beetles) that have their Type Locality here. The <i>Hebe odora</i> and <i>Dracophyllum longifolium</i> shrublands here are particularly rich in specialist insects including beetles and moths. A ghost moth lives here in the summit wetlands. It is the sphagnum ghost moth <i>Heloxycanus patricki</i> which is classified as At Risk-Declining.	Hoare <i>et al.</i> 2017; Patrick <i>et al.</i> 1993; Patrick 1993c; Peat & Patrick 1985; Carter 1994.
Deep Creek Gorge (RAP 7)	Representative insect fauna of small-leaved shrubland, rock tors and flax land.	Patrick <i>et al.</i> 1993; Carter 1994.
Taiari Rapids (RAP 8)	Representative insect fauna of small-leaved shrubland and rock tors, including moderate diversity particularly of specialist moths and beetles.	Patrick <i>et al.</i> 1993; Carter 1994.
Black Rock (RAP 9)	Representative insect fauna of small-leaved shrubland and silver beech forest, including moderate diversity of beetles, bugs and moths.	Patrick <i>et al.</i> 1993; Carter 1994.
Lammerlaw Stream (RAP 10)	Representative insect fauna of small-leaved shrubland, rock outcrops, sphagnum moss wetlands and silver beech forest.	Patrick <i>et al.</i> 1993; Carter 1994.
Glendhu (RAP 13)	Representative insect fauna of grasslands, shrublands and forest.	Patrick <i>et al.</i> 1993; Carter 1994.
HAWKDUN ECOLOGICAL DISTRICT		
Mount Ida - Near Undaunted (DoC administered area and RAPs 12 & 13) - Oteake Conservation Park	Representative and highly diverse for insects from montane shrubland-grasslands to high alpine cushionfield-grassland-herbfield-rock tor area. Particularly rich in geometrid, noctuid and crambid moth species, giant weevils in genus <i>Lyperobius</i> in all ecosystems present.	Mark <i>et al.</i> 2003; Patrick 1994a; Peat & Patrick 1999; Hoare <i>et al.</i> 2017; Grove 1994a.
Hawkdun Range - entire summit ridge to 1876 m (includes RAPs 3, 5,6 & 9 and intervening high alpine	Representative and species-rich insect fauna of spectacular alpine and high alpine area containing abundant rock, scree, tors, grassland, herbfield, fellfield, tarns, seepages, wetlands and cushionfield, with altitudinal sequence down to valley-floor with shrublands, wetlands, herbfield and grasslands.	Mark <i>et al.</i> 2003; Patrick 1994a; Peat & Patrick 1999; Hoare <i>et al.</i> 2017; Grove 1994a; Patrick 2012.

SITE NAME	ATTRIBUTES	REFERENCES
grassland down to 1250m) with altitudinal sequences of Kirkwoods Creek RAP 6 and Berwen RAP 3. Oteake Conservation Park.		
TAHAKOPA ECOLOGICAL DISTRICT		
Ajax Bog - Mount Pye Conservation Area - Catlins Conservation Park (including all upland area from Catlins Cone & Tautuku to Beresford and McClennan Ranges)	Large and intact upland area of wetland, shrubland, forest and cushion bog with high biodiversity of representative upland insects including large population of At Risk-Declining ghost moth <i>Heloxycanus patricki</i> . Montane forest contains a rich biodiversity of insects also with many specialist moths present on a wide variety of tree, liane and shrub species.	Huryñ <i>et al.</i> 2003; Patrick <i>et al.</i> 1984; Hoare <i>et al.</i> 2017.
Cannibal Bay - False Islet	Representative insect fauna of sand dune - rocky coast of the Catlins.	Barker <i>et al.</i> 2003; Patrick 1994d.
Glenomaru Valley Scenic Reserve	This forest supports a representative insect fauna of forest and understorey in eastern parts of the Catlins.	Allen <i>et al.</i> 2003.
Nugget Point Conservation Area	Impressive coastal herbfield on steep rock faces with shrubland and forest species present too, all supporting a rich insect fauna with many specialist moths and butterflies present. Diverse array of insects includes cockroaches, beetles and moths including four species of casemoths of biodiversity and conservation interest. Key plants supporting important diversity of specialist insects includes <i>Olearia fragrantissima</i> , kowhai and prostrate kowhai, <i>Celmisia lindsayi</i> , <i>Ileostylus micranthus</i> , five finger, pōhuehue, mahoe and <i>Hebe salicifolia</i> .	Barker <i>et al.</i> 2003; Patrick & Archibald 1988.
Papatowai Scenic Reserve	Coastal forest here supports a representative insect fauna with many specialist moth species on particular trees, laines and understorey shrubs and herbs.	Allen <i>et al.</i> 2003.
Pounawea Scenic Reserve	The forest and extensive saltmarsh, including Catlins Lake, support a representative insect fauna of the coastal Catlins.	Allen <i>et al.</i> 2003; Barker <i>et al.</i> 2003.
Tautuku Beach /Tautuku Bay Scenic Reserve/ Tautuku Peninsula	Representative insect fauna of sand dune, headlands, saltmarsh and coastal forest. The Threatened noctuid moth <i>Meterana</i> new species (aff. <i>M. meyricki</i>) has one of its few populations here where it's caterpillars feed on the sprawling shrub <i>Pimelea lyallii</i> in the dunes. The moth is classified as Nationally Endangered.	Barker <i>et al.</i> 2003; Hoare <i>et al.</i> 2017; Patrick 1986b.
Tahakopa Bay Scenic Reserve	A representative insect fauna of coastal forest, containing significant tall podocarp species, and sand dunes is present here. Specialist moths of rimu, kahikatea and matai are present here in the forests while pīngao moths are present in the dunes.	Barker <i>et al.</i> 2003.
Purakaunui Falls Scenic Reserve	This mixed and moist forest supports a representative insect fauna including a rich array of moth species, most of which are specialist on the various trees of the mixed beech - podocarp forest, and the associated shrubs, herbs and lianes.	Allen <i>et al.</i> 2003.
Waipati Beach Scenic Reserve	Coastal forest and shrubland supports a representative insect fauna with many specialist moths and butterflies present.	Barker <i>et al.</i> 2003.

SITE NAME	ATTRIBUTES	REFERENCES
BALCLUTHA ECOLOGICAL DISTRICT		
Otanomomo Scientific Reserve	The coastal broadleaf forest here supports a characteristic and representative insect fauna of mixed podocarp and hardwood forest in southern New Zealand. The specialist moths of the giants in the forest such as rimu, matai and kahikatea are present in good population numbers.	Allen <i>et al.</i> 2003.
GORE ECOLOGICAL DISTRICT		
Popotunoa Hill Scenic Reserve	This forested hill with remnant podocarps and light mixed forest, shrubland with abundant lianes supports a representative insect fauna.	Allen <i>et al.</i> 2003.
LAWRENCE ECOLOGICAL DISTRICT		
Birch Island in Clutha River	Representative insect fauna of near-natural beech forest with a local endemic, and unnamed peripatus also. The tiny, jawed and day-flying moth <i>Sabatinca quadrijuga</i> is a feature of the forests here too, both on the island and in the forests on the bank of river opposite below the Blue Mountains.	Allen <i>et al.</i> 2003; Legge 1991; Patrick 2001a; Peat & Patrick 1999.
Rongahere Gorge	Representative insect fauna of beech and mixed beech-podocarp forest on steep slopes on both banks of the Clutha River. The site is significant too as it is the lower part of an unbroken sequence of natural vegetation and associated invertebrates from the Clutha Valley to the alpine tops of the Blue Mountains. The Threatened and diurnal moth <i>Cephalissa siria</i> (Nationally Vulnerable) is present along with its hostplant the liane <i>Fuchsia perscandens</i> . Significant features of the areas' invertebrates include an undescribed and local endemic peripatus (Onychophora), a surprisingly high diversity of 11 species of predatory carabid beetle and a rich leaf litter fauna across many different invertebrate groups.	Hoare <i>et al.</i> 2017; Patrick <i>et al.</i> 1996; Peat & Patrick 1999.
DANSEY ECOLOGICAL DISTRICT		
Dasher (RAP 5)	Representative and rich insect fauna of alpine snow tussock, wetlands and boulderfield shrublands of this part of the Kakanui Mountains on both schist and volcanic substrates. Particularly rich in diurnal moths, aquatic insects and large-bodied weevils in the genus <i>Lyperobius</i> .	Patrick 1991c; Peat & Patrick 1999; Comrie 1992.
Kakanui Peak (RAP 6)	Representative and rich insect fauna of montane shrublands and alpine grassland-shrubland, alpine rockfield and scree and wetlands including multiple flushes.	Mark <i>et al.</i> 2003; Patrick 1991c; Peat & Patrick 1999; Comrie 1992.
Pisgah (RAP 7)	Representative and rich montane to alpine grasslands and associated shrublands, scree and other rocky areas, and cushionfield. Significant for the number of diurnal butterflies and moths, particularly geometrid moths. Also significant for being habitat for the scree wētā, the large-bodied <i>Deinacrida connectens</i> .	Patrick 1991c; Peat & Patrick 1999; Comrie 1992; Patrick 2012.
Maerewhenua (RAP 8)	Representative insect fauna of forest, shrubland and grasslands of montane rocky gorge. Key habitat for the diurnal geometrids <i>Cephalissa siria</i> (Threatened-Nationally Vulnerable) and <i>Samana acutata</i> (At Risk-Relict).	Patrick 1991c; Peat & Patrick 1999; Comrie 1992; Hoare <i>et al.</i> 2017.

SITE NAME	ATTRIBUTES	REFERENCES
Benledi (RAP 9)	Representative and rich montane to alpine grasslands and associated shrublands, scree and other rocky areas, and cushionfield. Significant for the number of diurnal butterflies and moths, particularly geometrid moths.	Patrick 1991c; Peat & Patrick 1999; Comrie 1992.
Nobbler (RAP 10)	Representative and rich insect fauna of montane to alpine grassland, cushionfield, bluff, shrubland and wetland habitats. Of particular note is the diversity of indigenous moth, beetle, caddisfly and grasshopper species. The geometrid moth <i>Samana acutata</i> (At Risk-Relict) is present here.	Patrick 1991c; Peat & Patrick 1999; Comrie 1992; Hoare <i>et al.</i> 2017.
ARAWATA ECOLOGICAL DISTRICT		
Mount Aspiring National Park	Representative insect fauna of the valley floor to high alpine tops, frequenting herbfields, cushionfields, rock face lichens and mosses, grasslands, shrublands through to beech forest on the steep slopes and valley-floors. Open areas in the valley-floors support a rich insect fauna too, on shrublands, grasslands and open areas of lichens and herbs.	Allen <i>et al.</i> 2003; Mark <i>et al.</i> 2003; Peat & Patrick 1999.
HUXLEY and OKURU ECOLOGICAL DISTRICTS		
Riverbeds to high alpine tops of entire EDs in ORC area	A diverse and representative insect fauna is found in the diverse habitats from riverbeds, through forest and shrubland to alpine grasslands and high alpine cushionfield, rocky areas and herbfield of a multitude of mountain ranges and intervening valley floors.	Allen <i>et al.</i> 2003; Mark <i>et al.</i> 2003; Peat & Patrick 1999.
DART and WANAKA ECOLOGICAL DISTRICTS		
Mou Waho, Mou Tapu and Stevensons Islands, Lake Wanaka	Representative insects of natural vegetation of mixed natural forests with abundant and diverse mistletoes, rocky areas, natural grassland with herbfield and shrublands. Mou Waho has large-bodied wētā <i>Hemideina maori</i> at surprisingly low altitude whereas Mou Tapu has cave wētā of significance.	Allen <i>et al.</i> 2003; Legge 1991; Peat & Patrick 1999.
Humboldt Mountains - Mount Earnslaw - Richardson - Harris Mountains (high alpine zone down to valley floors in Rees, Dart, Matukituki and Motutapu Rivers, and 700 m adjacent to Lake Wakatipu, and includes Dart Conservation Area and other areas linking to Mount Aspiring National Park)	The alpine to high alpine grasslands above 950 m, and associated herbfields, shrublands and areas of bare rock support a representative insect fauna of the mountains of western Otago. This insect fauna includes the rare shield bug <i>Hypsithocus hudsonae</i> (At Risk-Naturally Uncommon). Many diurnal and conspicuous geometrid moth species are present in the alpine and high alpine zone such as in the genera <i>Notoreas</i> , <i>Dasyuris</i> , <i>Paranotoreas</i> and <i>Aponotoreas</i> . Valley-floor treeland and shrubland contains nationally important populations of the Threatened daisy tree <i>Olearia hectorii</i> , such an important host for a large diversity of rare and Threatened and At Risk moths such as the leaf roller <i>Pyrgotis</i> new species, <i>Pasiphila</i> new species, <i>Protosynaema</i> new species, <i>Pseudocoremia cineracia</i> & <i>Declana nigrosparsa</i> (all Nationally Vulnerable), and two noctuids <i>Meterana exquisita</i> and <i>M. grandiosa</i> (both At Risk-Relict). The large wētā <i>Deinacrida pluvialis</i> was described from valley-floor here and is not known elsewhere.	Hoare <i>et al.</i> 2017; Hury <i>et al.</i> 2003; Mark <i>et al.</i> 2003; Patrick 2000c; Patrick 2012; Patrick 2016a; Peat & Patrick 1999.
Mount Alta - broad montane alpine area westwards to Mount Aspiring National Park - down to 500 m in Matukituki Valley	Beech forest, upper montane grasslands, alpine to high alpine grasslands and herbfield, and high alpine rocky areas and cushionfield supports a rich and representative insect fauna which includes a new species of black butterfly in genus <i>Percnodaimon</i> and the rare alpine Butler's ringlet butterfly (<i>Erebiola butleri</i>). The Matukituki Valley shrublands and low forest contain the tree daisy species <i>Olearia lineata</i> , <i>O. fragrantissima</i> and <i>O. hectorii</i> and their suite of specialist rare and Threatened moths.	Allen <i>et al.</i> 2003; Hoare <i>et al.</i> 2017; Mark <i>et al.</i> 2003; Patrick 2000c; Peat & Patrick 1999.

SITE NAME	ATTRIBUTES	REFERENCES
Hawea Conservation Park	A large alpine area that supports a rich and representative insect fauna of high-altitude rocky areas with diverse cushionfield, herbfield and grasslands. Highlighting the high biodiversity here are twelve diurnal and brightly-coloured geometrid moths in the genera <i>Dasyuris</i> , <i>Aponotoreas</i> and <i>Notoreas</i> living here. Beech forests in the catchments around the Park are also important for indigenous insects.	Mark <i>et al.</i> 2003; Peat & Patrick 1999.
MACRAES ECOLOGICAL DISTRICT		
Lots Wife-Swampy Hill-Hummock	Representative and rich insect fauna of snowgrass, wetland including sphagnum areas, and shrublands of large and mostly intact low alpine-montane area. A feature of the fauna is the number of diurnal species. Threatened species present include the aniseed moth <i>Gingidiobora</i> new species (Nationally Critical) with caterpillars on the herbaceous <i>Gingidia montana</i> , the diurnal geometrid <i>Dasyuris partheniata</i> (At Risk-Declining) and the ghost moth <i>Heloxycanus patricki</i> (At Risk-Declining) with its caterpillars feeding on sphagnum moss. A population of New Zealand's sole mecopteran (<i>Nannochorista philpotti</i>) is also present here in streams.	Huryn <i>et al.</i> 2003; Patrick 1997; Peat & Patrick 1995; Hoare <i>et al.</i> 2017.
Emerald Stream	A diverse and representative insect fauna of grassland, shrubland and rocky areas.	Patrick 1997; Peat & Patrick 1995.
Flat Hill	A diverse and representative insect fauna of grassland, shrubland and rocky areas of the montane zone. A rich aquatic insect fauna is present too, particularly stoneflies, caddisflies, and mayflies.	Patrick 1997; Peat & Patrick 1995.
Taieri Ridge	Representative upper montane insect fauna of semi-natural grasslands and rock tor landscape.	Patrick 1997; Peat & Patrick 1995.
Taieri Gorge-Pukerangi	Representative insect fauna including cicadas and moths of rocky gorge area with diverse lichen and shrub flora with specialist insects particularly moths such as the large and local cicada <i>Amphipsalta strepitans</i> , moth <i>Horisme suppressaria</i> (caterpillars on corokia), and large diversity of case moths with larvae feeding on lichens.	Patrick 1997; Patrick 1992a; Peat & Patrick 1995.
Silver Peaks	Representative snowgrass, rock faces, shrublands and herbfield communities from the highest points down to 580 m. supporting a wide range of insect groups including grasshoppers, beetles, moths and butterflies. Diurnal moths and butterflies and grasshopper diversity are a feature of the rocky and grassland areas here including three species in the genus <i>Dichromodes</i> with larvae on lichens on the impressive rock faces here. Additionally, the diurnal moths <i>Cephalissa siria</i> (Nationally Vulnerable) and <i>Dasyuris partheniata</i> (At Risk-Declining) are present along with their hostplants, the liane <i>Fuchsia perscandens</i> and speargrass (<i>Aciphylla</i> species) respectively. This insect fauna includes the large ghost moth <i>Aoraia rufivena</i> with a male wingspan of about 7 cm and short-winged flightless females.	Patrick 1986a; Patrick 1987a; Patrick 1997; Peat & Patrick 1995.
Sutton Salt Lake Scenic Reserve	Representative dry grassland insects including grasshoppers, katydid, cricket and moths including the southern tiger moth <i>Metacrias strategica</i> . Does not support specialist saltpan insects on its salt flats flora. The reserve is the Type Locality for the casemoth <i>Scoriodyta suttonensis</i> which feeds lichens growing on tors within the reserve.	Patrick 1989; Peat & Patrick 1995; Patrick 1997.

SITE NAME	ATTRIBUTES	REFERENCES
REMARKABLES ECOLOGICAL DISTRICT		
Schoolhouse Flat	Representative insect fauna of dry, semi-natural short-tussock grassland in valley floor of the Nevis. The rare and Threatened crambid moth <i>Orocrambus sophistes</i> has its largest population here. It has a short-winged flightless female severely limiting its dispersal ability and is classified as “Nationally Vulnerable” in the threat ranking.	Hoare <i>et al.</i> 2017; Peat & Patrick 1999.
The Remarkables (includes Rastus Burn Recreational area, DoC stewardship lands and surrendered pastoral lands south to Staircase Creek). All lands from upper montane zone 850 to highest point at 2,324 m.	Representative alpine and high alpine habitat for a wide range of indigenous insects including conspicuous bugs, beetles, moths, butterflies, cicadas, grasshoppers and cockroaches. From montane beech forest, through diverse shrublands, grasslands, herbfield, rock bluffs, scree, cushionfield and snowbanks the insect fauna is diverse across many insect groups. A feature of the insect fauna here is the number of day active species in groups that are mostly nocturnal including ghost moths (<i>Aoraia senex</i>) and moths in the genera <i>Declana</i> , <i>Notoreas</i> , <i>Dasyuris</i> , <i>Aponotoreas</i> , <i>Paranotoreas</i> and <i>Orocrambus</i> . The rare shield bug <i>Hypsithocus hudsonae</i> (At Risk-Naturally Uncommon) is present in high alpine herbfields whereas the large and rare geometrid <i>Xanthorhoe frigida</i> with larvae on <i>Pachycladon</i> occurs here from 1640-1950 m and has a threat classification of Nationally Vulnerable. Other rare species found include the moths <i>Eudonia oreas</i> , <i>Scythris</i> n.sp., noctuid <i>Aletia sollennis</i> and a tortricid <i>Eurythecta</i> n.sp.	Huryn <i>et al.</i> 2003; Mark <i>et al.</i> 2003; Patrick <i>et al.</i> 1992; Patrick 2016a; Peat & Patrick 1999; Hoare <i>et al.</i> 2017; Patrick 2012.
ROCK AND PILLAR ECOLOGICAL DISTRICT		
Rock and Pillar Range - summit plateaux (from south of McPhees Rock to far north of Summit Rock, and altitudinal sequences down Rock and Pillar Creek (Department of Lands & Survey area mapped with high conservation values)	Complete alpine plateaux of the Rock & Pillar Range contain representative montane, alpine and high alpine habitat for a wide range of indigenous insects including the rare shield bug <i>Hypsithocus hudsonae</i> (At Risk-Naturally Uncommon), beetles, cicadas, wētā, grasshoppers, moths, butterflies, bugs, cockroach and aquatic insect groups. Of significance is large areas of impressive tors, wetlands, cushionfield, grasslands and associated herbfield. The five moths that are endemic to the range are listed in Peat & Patrick (1995). The large-bodied wētā <i>Hemideina maori</i> , growing to 65 mm in length, has a significant population on the summit crest of the Rock & Pillar Range where they inhabit rocky areas and hide under the largest slabs. It is joined in this high alpine habitat by a high-altitude cockroach and another wētā, this time a ground wētā - <i>Hemiandrus focalis</i> . The flightless chafer beetle <i>Prodontria montii</i> lives only in the cushionfields of the Rock & Pillar - Lammermoor Ranges, with the former range as its Type Locality. Two ghost moths are present here - the Threatened sphagnum ghost moth <i>Heloxycanus patricki</i> which is classified as At Risk-Declining, and the eastern alpine Otago endemic <i>Aoraia orientalis</i> , with its short-winged and flightless female.	Barratt & Patrick 1987; Mark <i>et al.</i> 2003; Department of Hoare <i>et al.</i> 2017; Lands & Survey 1983; Mark <i>et al.</i> 2003; Peat & Patrick 1995; Patrick 2016a; Patrick 2012.
Great Moss Swamp	A large moss bog supports a representative insect fauna of moss bog, tall tussock and associated herbfield and shrubland. At Risk moths present include the diurnal geometrid <i>Dasyuris partheniata</i> (At Risk-Declining) and the ghost moth <i>Heloxycanus patricki</i> (At Risk-Declining) with its caterpillars feeding on sphagnum moss.	Barratt & Patrick 1987; Huryn <i>et al.</i> 2003; Peat & Patrick 1995; Hoare <i>et al.</i> 2017.

SITE NAME	ATTRIBUTES	REFERENCES
UMBRELLA ECOLOGICAL DISTRICT		
Whitcomb-Gem Lake-Argyle Burn (part RAP 1)	Representative alpine and high alpine habitat for a wide range of indigenous insects including the rare shield bug <i>Hypsithocus hudsonae</i> (At Risk-Naturally Uncommon) and giant land snail <i>Powelliphanta spedenii</i> . The area encompasses tussock-shrubland, snowbank, herbfield and rock habitats. Emphasising its entomological richness, 73 of 83 beetle species were found in the Gem Lake catchment, while 92 moths and butterflies were found in the alpine zone.	Dickinson 1988; Patrick 1988; Patrick 2016; Mark <i>et al.</i> 2003; Peat & Patrick 1999; Patrick 2012.
Leithen Bush Scenic Reserve & Leithen Burn Headwaters (RAP 4)	Representative insect fauna of montane forest to low alpine grassland-shrubland-herbfield and rock bluff habitats with many diurnal low alpine crambids and geometrid moths are a feature.	Allen <i>et al.</i> 2003; Dickinson 1988; Patrick 1988; Peat & Patrick 1999.
Timber Creek Headwaters (RAP 5)	The sequence of vegetation from summit of Mount Benger down to montane grassland-shrubland of Timber Creek encompasses a highly representative and rich insect fauna including two species of large ghost moth with short-winged flightless females (<i>Aoraia senex</i> and <i>A. rufivena</i>). Diurnal moths in the genera <i>Dichromodes</i> , <i>Notoreas</i> , <i>Paranotoreas</i> , <i>Aponotoreas</i> and <i>Dasyuris</i> are also a feature in terms of diversity and population size.	Dickinson 1988; Patrick 1988; Peat & Patrick 1999.
Crown Rock - Stronach Hill (RAP 7)	The diverse shrublands, herbfield tussockland and rock bluffs support a highly representative insect fauna particularly in the Lepidoptera. The day-flying moths and butterflies are a standout feature.	Dickinson 1988; Patrick 1988; Peat & Patrick 1999.
Mckay Creek (RAP 20)	The mixed shrubland-silver beech forest containing dense tree daisy species here supports a rich specialist moth fauna including two noctuids <i>Meterana exquisita</i> and <i>M. grandiosa</i> (both At Risk-Relict) on <i>Olearia odorata</i> and its relatives. The spiny <i>Melicytus alpinus</i> also supports several specialist moths including the noctuid <i>Graphania lithias</i> .	Dickinson 1988; Patrick 1988; Patrick 2000; Peat & Patrick 1999.
DUNTRON ECOLOGICAL DISTRICT		
Earthquakes Reserve	Representative insect fauna of limestone bluffs and associated shrubland, herbfield and short-tussock grassland. Copper butterflies and other specialist Lepidoptera of pōhuehue (<i>Muehlenbeckia complexa</i> and <i>M. australis</i>), specialist moths of <i>Carmichaelia</i> , matagouri, <i>Dichondra repens</i> and <i>Melicytus alpinus</i> present too.	Peat & Patrick 2001.
OAMARU ECOLOGICAL DISTRICT		
Bushy Beach Scenic Reserve	The reserve supports a representative array of insect species of coastal forest, shrubland and herbfield with moths that are specialists on mahoe, ngaio, and <i>Hebe salicifolia</i> .	Barker <i>et al.</i> 2003; Peat & Patrick 2001.
WAIKOUAITI ECOLOGICAL DISTRICT		
Cornish Head	Steep cliffs and slopes support a rich flora and insect fauna that is representative of coastal herbfield and cliff refugia. Ancient and endemic moth family is represented here by small diurnal moth <i>Mnesarchaea paracosma</i> .	Allen <i>et al.</i> 2003; Patrick 2000a.
Goodwood Scenic Reserve	The mixed hardwood and podocarp forest present here with associated lianes support a representative insect fauna. A special feature is the presence of the deciduous small tree <i>Olearia fragrantissima</i> complete with its specialist moth fauna.	Allen <i>et al.</i> 2003; Patrick 2000c.

SITE NAME	ATTRIBUTES	REFERENCES
Karitane Beach	The red katipo spider (<i>Latrodectus katipo</i>) is present in sand dunes and is classified as At Risk-Declining.	Barker <i>et al.</i> 2003; Patrick 2002; Peat & Patrick 1995.
Waikouaiti Estuary	Representative insect fauna of estuarine habitat including saltmarsh, rushland habitat and associated saltmarsh ribbonwood community. The last-named shrub (<i>Plagianthus divaricatus</i>) is particularly rich in specialist moths feeding on foliage or leaf-mining the small leaves.	Barker <i>et al.</i> 2003; Patrick 2008.
Mount Watkin Scenic Reserve	Representative and intact insect fauna of volcanic plug and associated basalt screes, with shrublands and herbfields of this prominent mountain. The diurnal moths <i>Cephalissa siria</i> (Nationally Vulnerable), <i>Gingidiobora</i> new species (Nationally Critical) and <i>Dasyuris partheniata</i> (At Risk-Declining), are present along with their hostplants climbing fuchsia (<i>Fuchsia perscandens</i>) and speargrasses (<i>Aciphylla</i> species), respectively.	Hoare <i>et al.</i> 2017; Mark <i>et al.</i> 2003; Patrick 1997; Peat & Patrick 1995; Patrick 2007; Patrick 2017.
ST MARY ECOLOGICAL DISTRICT		
St Marys Range (broadly the highest peaks south to Danseys Pass at 900 m)	The alpine snowgrass areas through to high alpine screes and cushionfields support a rich and characteristic insect fauna with many species confined to these greywacke mountains of northern Otago. The large-bodied speargrass weevils <i>Lyperobius barbarae</i> and <i>L. patricki</i> - both specialist feeders of speargrass (<i>Aciphylla</i> species) are confined to the mountains of North Otago and South Canterbury where they are very local in distribution. The former found on alpine and high alpine speargrasses, while the latter is found lower down the range on larger speargrasses. Additionally, the flightless chafer beetle <i>Prodontria patricki</i> is a local endemic species found in the alpine grassland and herbfields down to 1000 m. Two large-bodied wētā species <i>Deinacrida connectens</i> and <i>Hemideina maori</i> live in areas of rock, both large boulders and scree, and the scree grasshopper <i>Brachaspis nivalis</i> is widespread on areas of bare rocky slopes. Three other grasshoppers live in adjacent grassland and herbfield.	Mark <i>et al.</i> 2003; Peat & Patrick 1999; Patrick 1982; Patrick 2012.
ST BATHANS ECOLOGICAL DISTRICT		
St Bathans Range - part Oteake Conservation Park	The sequence of alpine vegetation from snowgrass dominated slopes at 950 m, with a herbfield understorey through to areas of shrubland to the bare screes and rock outcrops of greywacke of the high alpine areas of the range with their patches of cushionfields and alpine tarns support a rich and characteristic insect fauna of the greywacke mountains that mark Central Otago northern ramparts. An undescribed black butterfly (<i>Percnodaimon</i> new species) is present here flying over screes as it is on adjacent greywacke mountains east to the Ida and St Marys Ranges. It is joined by the cryptic scree grasshopper <i>Brachaspis nivalis</i> and scree wētā <i>Deinacrida connectens</i> , both here at their southern distributional limit.	Mark <i>et al.</i> 2003; Peat & Patrick 1999; Patrick 2012.
Dunstan Range	The alpine slopes and high alpine tops here support a representative insect fauna of the greywacke mountains of northern Otago including two large-bodied and cryptic species, the scree grasshopper <i>Brachaspis nivalis</i> and scree wētā <i>Deinacrida connectens</i> .	Mark <i>et al.</i> 2003; Peat & Patrick 1999.

SITE NAME	ATTRIBUTES	REFERENCES
SHOTOVER ECOLOGICAL DISTRICT		
Coronet Peak Reserve	A representative insect fauna is present in the snowgrass, herbfield, cushionfield, shrubland and wetlands of the range down to 900 m. This fauna is of significance for its diversity of dragonflies and damselflies, scorpionfly and caddisflies, grasshoppers and moths and butterflies. Of note is the high biodiversity of grassmoths in the genus <i>Orocrambus</i> with 12 species present, some with short-winged flightless females such as <i>O. philpotti</i> and <i>O. crenaeus</i> and several that are diurnal over both tall and short grassland areas such as <i>O. scoparioides</i> and <i>O. aethonellus</i> . Additionally, the moth fauna is significant for the number of species and genera of diurnal geometrids present with six genera and 18 species present. A feature of the shrubland at about 1000 m is the daisy shrub <i>Olearia odorata</i> . Here it supports many specialist moths amongst them the At Risk-Relict noctuids, the appropriately named <i>Meterana exquisita</i> and <i>M. grandiosa</i> . New Zealand's only scorpionfly <i>Nannochorista philpotti</i> and the rarely recorded caddisfly <i>Tiphobiosis montana</i> are present in the wetlands including seepages.	Mark <i>et al.</i> 2003; Peat & Patrick 1999; Patrick 1992c; Patrick 2000c; Hoare <i>et al.</i> 2017.
Ben Lomond to Moke Lake	Alpine grasslands, shrublands down to wetland and short tussock grasslands support a rich and representative montane to high alpine insect fauna characteristic of western Otago. The moth fauna includes the rare and enigmatic geometrid moth <i>Asaphodes obarata</i> (Threatened-Nationally Critical) is present at one of its only known localities over the past 100 years. The insect fauna also includes the rare shield bug <i>Hypsithocus hudsonae</i> (At Risk-Naturally Uncommon) which lives in alpine cushionfield here.	Mark <i>et al.</i> 2003; Peat & Patrick 1999; Hoare <i>et al.</i> 2017.
Bobs Cove Scenic Reserve	The reserve supports a representative insect fauna of forest, forest under-storey and cliff face species. The large cryptic and undescribed geometrid moth <i>Gingidiobora</i> aff. <i>subobscurata</i> which is a specialist feeder on the large cliff-face herb <i>Gingidia montana</i> , has a population here. It is a Threatened species and classified as At Risk-Declining.	Patrick 2017; Peat & Patrick 1999; Hoare <i>et al.</i> 2017.
Skippers Canyon, Shotover River (McLeods Bluff to Skippers Point)	Steep rock faces with specialist herbs and shrubs support a distinctive insect fauna of this habitat type. The large cryptic and undescribed geometrid moth <i>Gingidiobora</i> aff. <i>subobscurata</i> which is a specialist feeder on the large cliff-face herb <i>Gingidia montana</i> , has a population here. It is classified as At Risk-Declining.	Patrick 2017; Peat & Patrick 1999; Hoare <i>et al.</i> 2017.
WAIANAKARUA ECOLOGICAL DISTRICT		
Shag Point - Matakaea Reserve- Shag River estuary	The reserve supports an intriguing array of insects reflecting its vegetation which includes many upland or alpine species at sea-level such as snowgrass (<i>Chionochloa rigida</i>), the sprawling sub-shrub <i>Pimelea oreophila</i> and the daisy <i>Celmisia hookerii</i> . The colourful diurnal moth <i>Notoreas elegans</i> has its only sea-level population here and is joined by several other unusual occurrences at sea-level such as the tussock butterfly <i>Argyrophenga antipodum</i> . A representative insect fauna of saltmarsh and coastal grassland-herbfield is present here. Rich insect fauna of beetle groups including tiger, click and chafer beetles, lacewings and rich moth fauna of shrubland, herbfield and mixed grasslands.	Barker <i>et al.</i> 2003; Patrick 1993a; Patrick & Hoare 2010; Peat and Patrick 2001.

SITE NAME	ATTRIBUTES	REFERENCES
South Peak, Horse Range (link broadly to Trotters Gorge SR from 100 - 280 m)	Slopes and rock bluffs of the Horse Range support a representative but distinctive insect fauna of grasslands, light forest, shrubland and herbfield of this extension of the Kakanui mountains with a Threatened geometrid moth. This moth is the large geometrid <i>Gingidiobora</i> new species aff. <i>subobscurata</i> which is listed as At Risk-Declining, and has its caterpillars feeding on the large herb <i>Gingidia grisea</i> which grows on steep rock faces here.	Hoare <i>et al.</i> 2017; Mark <i>et al.</i> 2003; Peat and Patrick 2001; Patrick 2017.
Trotters Gorge Scenic Reserve	This reserve supports a representative and rich insect fauna of northeastern Otago's open and mixed light forest. Many specialist moth and butterfly species are present including two species of copper butterfly (<i>Lycaena feredayi</i> and <i>Lycaena</i> new species) with their caterpillars feeding on pōhuehue vines, while kowhai here supports four specialist moths; the leaf-mining <i>Stigmella sophorae</i> , seed-feeding <i>Stathmopoda aposema</i> , and defoliators the kowhai moth (<i>Uresiphita maoralis</i>) and the noctuid <i>Meterana decorata</i> . Other rich hosts for specialist moths that are present here are small-leaved <i>Coprosma</i> species, <i>Hebe salicifolia</i> , <i>Haloragis erecta</i> , <i>Helichrysum lanceolatum</i> , ngaio and <i>Rubus</i> vines. Small trees of <i>Pseudopanax</i> are host to the South Island zebra moth (<i>Declana egregia</i>) that features on the New Zealand \$100 banknote. Streams here support a rich aquatic insect fauna of mayflies, caddisflies and stoneflies. The colourful and Threatened geometrid moth <i>Asaphodes stinaria</i> (Nationally Vulnerable) has a population here with its caterpillars feeding on the herb <i>Ranunculus reflexus</i> . An undescribed and local endemic peripatus also occurs here in forest.	Allen <i>et al.</i> 2003; Peat and Patrick 2001; Hoare <i>et al.</i> 2017; Peat and Patrick 2001.

SIGNIFICANT AND POTENTIALLY
SIGNIFICANT SITES FOR
INDIGENOUS LIZARDS IN
OTAGO REGION

SIGNIFICANT AND POTENTIALLY SIGNIFICANT SITES FOR INDIGENOUS LIZARDS IN OTAGO REGION

Site Name	Locality	Area (ha)	Species Known to be Present	Possibly Present	Significance Justification	Confidential
Okia	Otago Peninsula	380	Jewelled gecko, cryptic skink, korero gecko, southern grass skink	Otago green skink	Highest diversity lizard site on Otago Peninsula.	Yes
Pilots Beach	Otago Peninsula	0.66	Cryptic skink, southern grass skink	Otago green skink	High density of cryptic skinks living in South African ice plant.	No
Te Rauone Beach	Otago Peninsula	43.7	Southern grass skink	Korero gecko, jewelled gecko	Very large high density population of southern grass skink. Over 500 skinks recorded over seven days of monitoring in December 2018.	No
Weir Road	Otago Peninsula	20.5	Jewelled gecko, southern grass skink		High density population of jewelled gecko.	Yes
Papanui Inlet	Otago Peninsula	8.64	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Portobello Peninsula	Otago Peninsula	20.5	Jewelled gecko, southern grass skink		High density population of jewelled gecko.	Yes
Portobello #2	Otago Peninsula	4.48	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Portobello and Harbour Cone	Otago Peninsula	138	Jewelled gecko, korero gecko, southern grass skink	Otago green skink	Jewelled gecko and korero gecko present. One Otago green skink recorded in 2007, but not seen recently.	Yes
Broad Bay	Otago Peninsula	49.2	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Harbour Cone, west side	Otago Peninsula	3.94	Jewelled gecko, korero gecko, southern grass skink		High density population of jewelled gecko.	Yes
Hooper's Inlet #2	Otago Peninsula	8.5	Jewelled gecko, southern grass skink		High density population of jewelled gecko.	Yes
Hooper's Inlet	Otago Peninsula	2.2	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Hooper's Inlet west	Otago Peninsula	1.58	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko present.	Yes
Harbour Cone south	Otago Peninsula	13.5	Jewelled gecko, korero gecko, southern grass skink		High density population of jewelled gecko.	Yes
Styles Creek	Otago Peninsula	3	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko and korero gecko present.	Yes
Lime Kilns	Otago Peninsula	8.23	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko and korero gecko present.	Yes
Sandymount turn off	Otago Peninsula	2.41	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko present.	Yes
Dick's Hill	Otago Peninsula	5.53	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko present.	Yes
Nyphon Track	Otago Peninsula	7.1	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Pukehiki	Otago Peninsula	9.62	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Braidwood Road upper	Otago Peninsula	28.6	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Paradise Track #2	Otago Peninsula	3.79	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Paradise Track	Otago Peninsula	11.9	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Braidwood Road lower	Otago Peninsula	0.56	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Boulder Beach	Otago Peninsula	80.5	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko and korero gecko present.	Yes
Highcliff	Otago Peninsula	2.85	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko present.	Yes
Karetai Road	Otago Peninsula	3.79	Jewelled gecko, korero gecko, southern grass skink		High density population of jewelled gecko and korero gecko.	Yes
Highcliff Road	Otago Peninsula	8.34	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko present.	Yes
Soldiers Monument	Otago Peninsula	0.85	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Grassy Point	Otago Peninsula	4.25	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Sandymount	Otago Peninsula	399	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko and korero gecko present.	Yes
Hooper's Inlet North	Otago Peninsula	21.3	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Varley's Hill	Otago Peninsula	39.1	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko and korero gecko present.	Yes
Cape Saunders/Hoopers Inlet	Otago Peninsula	1.56	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Allan's Beach wetland	Otago Peninsula	2.1	Jewelled gecko, southern grass skink		High density population of jewelled gecko and korero gecko.	Yes
Allan's Beach Rd #1	Otago Peninsula	4.42	Jewelled gecko, southern grass skink		High density population of jewelled gecko and korero gecko.	Yes
Allan's Beach Rd #2	Otago Peninsula	0.74	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Mt Charles	Otago Peninsula	20.6	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko present.	Yes
Mt Charles east	Otago Peninsula	8.92	Jewelled gecko, korero gecko, southern grass skink		Jewelled gecko present.	Yes
Cape Saunders	Otago Peninsula	4.38	Cryptic skink, korero gecko, southern grass skink	Otago green skink	Cryptic skink and korero gecko present.	No
Orokonui Ecosanctuary	Dunedin	300	Otago skink, jewelled gecko, Otago green skink, cryptic skink, korero gecko, southern grass skink		Fenced Ecosanctuary with six lizard species.	Yes
Doctors Point	Dunedin	22.5	Cryptic skink, southern grass skink	Korero gecko	Cryptic skink and korero gecko present.	No
Glendhu	Waipori/Lammermoor	2,597	Jewelled gecko, southern grass skink	Korero gecko	Jewelled gecko present.	Yes
Deep Creek	Waipori/Lammermoor	2,769	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Waipori beech fragment	Waipori/Lammermoor	6.45	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Stony Stream	Waipori/Lammermoor	2,172	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Nardoo Stream	Waipori/Lammermoor	2,646	Jewelled gecko, southern grass skink		Jewelled gecko present.	Yes
Lammerlaw Stream	Waipori/Lammermoor	4,896	Jewelled gecko, korero gecko, southern grass skink, McCann's skink	Otago green skink	Jewelled gecko present.	Yes
Northern Lammermoors	Waipori/Lammermoor	7,360	Jewelled gecko, korero gecko, southern grass skink, McCann's skink	Otago green skink, grand skink	Potential for grand skink - Nationally Endangered. One report from 2006. Jewelled gecko widespread in shrublands and tussocklands.	Yes
Burgan Stream	Rock and Pillars	45.4	Burgan skink, southern grass skink, McCann's skink	Korero gecko	Burgan skink present - Threatened-Nationally Critical.	No
Rock and Pillars	Rock and Pillars	7,777	Burgan skink, korero gecko, southern grass skink, McCann's skink		Burgan skink present - Threatened-Nationally Critical.	No
Sutton	Macraes/Middlemarch	5,105	Otago skink, korero gecko, southern grass skink, McCann's skink	Grand skink, Otago green skink	Otago skink (Threatened-Nationally Endangered) populations known from recent records. Some potential for grand skink, also Threatened-	Yes

Site Name	Locality	Area (ha)	Species Known to be Present	Possibly Present	Significance Justification	Confidential
					Nationally Endangered. Recorded as present at several sites in 1987. Requires survey.	
Manuka Stream	Macraes/Middlemarch	4,472	Otago skink, grand skink, Otago green skink, cryptic skink, korero gecko, southern grass skink, McCann's skink		Important area for lizards. Seven species present.	Yes
Macraes to Nenthorn	Macraes/Middlemarch	5,690	Otago skink, grand skink, Otago green skink, cryptic skink, korero gecko, southern grass skink, McCann's skink		Populations of grand and Otago skink managed in this area and protected with pest control.	Yes
Stoneburn	Macraes/Middlemarch	615	Otago skink, korero gecko, southern grass skink, McCann's skink	Otago green skink, grand skink	Otago skink and korero gecko present.	Yes
Kokonga	Macraes/Middlemarch	113	Otago green skink, southern grass skink, McCann's skink		Recent reports of Otago green skink.	No
Waianakarua	North Otago	18,018	Jewelled gecko, southern grass skink, korero gecko, McCann's skink	Otago green skink	Jewelled gecko and korero gecko present. Potential for Otago green skink.	Yes
Kauru River	North Otago	5,333	Jewelled gecko, southern grass skink, korero gecko, McCann's skink	Otago green skink	Jewelled gecko and korero gecko present. Potential for Otago green skink.	Yes
Mt Pisgah	North Otago	3,141	Jewelled gecko, southern grass skink, korero gecko, McCann's skink	Otago green skink	Jewelled gecko and korero gecko present. Potential for Otago green skink.	Yes
Ida Range	North Otago	9,464	North Otago black-eyed gecko, alpine rock skink, rockhopper skink, Oteake skink, scree skink, Otago green skink, korero gecko, southern grass skink, Southern Alps gecko, McCann's skink	Jewelled gecko	Very significant location with at least 11 species, including several recent discoveries and threatened species: Alpine rock skink - newly discovered, Data Deficient - moderate-high altitude scree. North Otago black-eyed gecko - newly discovered, Data Deficient. Rock tors/ bluffs. Otago green skink - At Risk-Declining, scree edges, high altitude, damp areas. Rockhopper skink - newly discovered, Data Deficient - scree edges, high altitude. Oteake skink - soon to be described relative of cryptic skink. Two known populations. Scree skink - Nationally Vulnerable (low-moderate altitude scree). Jewelled gecko - one confirmed report. Not located during recent surveys. Korero gecko, AR declining. Southern grass skink - At Risk-Declining. McCann's skink - Not Threatened. Southern Alps gecko - Not Threatened.	Yes
Hawkdun Range	North Otago	9,710	Alpine rock skink, rockhopper skink, Otago green skink, southern grass skink, Southern Alps gecko, McCann's skink	North Otago black-eyed gecko, scree skink	Significant location with at least six species. Requires more survey. Only the southern end has been well surveyed.	No
Falls Dam	North Otago	317	Otago green skink, southern grass skink, McCann's skink, Southern Alps gecko		Important site for Otago green skink.	No
Hawea to Lindis Pass	North-west Otago	26,104	Otago skink, grand skink, lakes skink, nevis skink, southern grass skink, McCann's skink, Southern Alps gecko		Significant location with several threatened species.	Yes
Lindis Pass	North-west Otago	6,863	Otago skink, grand skink, lakes skink, nevis skink, southern grass skink, McCann's skink, Southern Alps gecko		Significant location with several threatened species.	Yes
Saint Bathans to Lindis Pass	North-west Otago	35,754	Scree skink, lakes skink, Nevis skink, southern grass skink, McCann's skink, Southern Alps gecko	Grand skink, Otago skink, orange-spotted gecko, alpine rock skink	Very significant location with several threatened species. Saint Bathans Range requires more survey.	No
Hunter Valley	North-west Otago	4,808	Jewelled gecko		Jewelled gecko present.	Yes
Crown Range	Southern Lakes	16,613	Orange spotted gecko, lakes skink, nevis skink, cryptic skink, Kawarau gecko, southern grass skink, drylands grass skink, McCann's skink, Southern Alps gecko		Very significant location with several threatened species and nine species in total. The area between Mt Cardrona and Mt Alpha requires survey.	Yes
Harris Mountains	Southern Lakes	41,542	Orange-spotted gecko, McCann's skink	Lakes skink, nevis skink, cryptic skink, southern grass skink	Orange-spotted geckos found at sites near Treble Cone and End Peak up to 1800 metres asl. Also potential for lakes skink and nevis skink.	Yes
Richardson Mts North	Southern Lakes	24,770	Takitimu gecko, cryptic skink, korero gecko	Nevis skink, lakes skink	Poorly known, requires survey.	Yes
Mount Creighton	Southern Lakes	4,462	Orange-spotted gecko, McCann's skink	Nevis skink, lakes skink, southern grass skink, korero gecko, cryptic skink	Orange-spotted gecko present. Potential for lakes skink and nevis skink.	Yes
Hector Mountains	Southern Lakes	43,367	Orange-spotted gecko, nevis skink, cryptic skink, korero gecko, southern grass skink, McCann's skink		Orange-spotted gecko and nevis skink present.	Yes
Tree Island, Lake Wakitipu	Southern Lakes	2.5	Cryptic skink, korero gecko		High density populations of cryptic skink and korero gecko	No
Mou Tapu, Lake Wanaka	Southern Lakes	120	Southern Alps gecko		High density population of Southern Alps gecko. Potential translocation site for other species, such as jewelled gecko	No
Mou Waho, Lake Wanaka	Southern Lakes	150	Southern Alps gecko		High density population of Southern Alps gecko. Potential translocation site for other species, such as jewelled gecko	No
Ruby Island, Lake Wanaka	Southern Lakes	3.8	Kawarau gecko		High density population of Kawarau gecko	No

Site Name	Locality	Area (ha)	Species Known to be Present	Possibly Present	Significance Justification	Confidential
Stevensons Island, Lake Wanaka	Southern Lakes	58	Southern Alps gecko		High density population of Southern Alps gecko	No
Silver Island, Lake Hawea	Southern Lakes	36	Southern Alps gecko		High density population of Southern Alps gecko	No
Leaning Rock	Central Otago	714	Orange-spotted gecko, Kawarau gecko, Korero gecko, southern grass skink, McCann's skink		Orange-spotted gecko, Kawarau gecko, and korero gecko present.	Yes
Dunstan Mountains North	Central Otago	519	Lakes skink, Korero gecko, southern grass skink, McCann's skink	Orange spotted gecko	Lakes skink present. Potential for orange-spotted gecko.	No
Mokomoko Drylands sanctuary	Central Otago	14	Otago skink, grand skink, jewelled gecko, schist gecko, southern grass skink, McCann's skink		Predator-resistant fence in place to protect translocated populations of Otago skink, grand skink, and jewelled gecko.	Yes
Romahapa	Catlins	574	Tautuku gecko, korero gecko, southern grass skink		Tautuku gecko present.	Yes
Kaihiku Range	Catlins	1,395	Southland green skink, cryptic skink, korero gecko, southern grass skink, McCann's skink		Diverse location with five lizard species.	No
Chaslands	Catlins	3,451	Tautuku gecko, southern grass skink	Korero gecko	Tautuku gecko present.	Yes
Catins forest / Tautuku	Catlins	9,943	Tautuku gecko, southern grass skink	Korero gecko	Tautuku gecko present.	Yes
Tahakopa Valley #6	Catlins	1,904	Tautuku gecko, southern grass skink	Korero gecko	Tautuku gecko present.	Yes
Tahakopa Valley #7	Catlins	79.8	Tautuku gecko, southern grass skink	Korero gecko	Tautuku gecko present.	Yes
Tahakopa / Waikawa	Catlins	477	Tautuku gecko, southern grass skink	Korero gecko	Tautuku gecko present.	Yes
Cape Saunders #2	Otago Peninsula	2.11		Jewelled gecko, southern grass skink	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Cape Saunders #3	Otago Peninsula	1.65		Jewelled gecko, southern grass skink	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Papanui Inlet South	Otago Peninsula	3.59		Jewelled gecko, southern grass skink	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Wharekakahu Island	Otago Peninsula	2		Otago green skink, korero gecko	Otago green skink - needs survey to confirm. Last recorded in 1990.	Unknown
Glendhu forest	Waipori/Lammermoor	546		Jewelled gecko, southern grass skink	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Beaumont River	Waipori/Lammermoor	8,021		Jewelled gecko, schist gecko, southern grass skink, McCann's skink	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Lake Mahinerangi	Waipori/Lammermoor	25.3		Jewelled gecko, southern grass skink	Habitat suitable for jewelled gecko and close to known reports.	Unknown
El Dorado	Waipori/Lammermoor	189		Jewelled gecko, southern grass skink, McCann's skink, korero gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
El Dorado #2	Waipori/Lammermoor	18.8		Jewelled gecko, southern grass skink, McCann's skink, korero gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
El Dorado #3	Waipori/Lammermoor	1.84		Jewelled gecko, southern grass skink, McCann's skink, korero gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
El Dorado #4	Waipori/Lammermoor	12.2		Jewelled gecko, southern grass skink, McCann's skink, korero gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Black Rock	Waipori/Lammermoor	90.4	Jewelled gecko	Southern grass skink, korero gecko, McCann's skink	Jewelled gecko present in 1965 and may still be present.	Yes
Black Rock #2	Waipori/Lammermoor	232		Jewelled gecko, southern grass skink, McCann's skink, korero gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Northern lammermoors #2	Waipori/Lammermoor	1,301	Grand skink	Jewelled gecko, southern grass skink, McCann's skink, korero gecko	Status of grand skinks uncertain in this area.	Unknown
Shepherds Hut Creek	Rock and Pillars	466	Burgan skink, McCann's skink	Southern grass skink	Burgan skink not detected on a recent survey.	Unknown
Mt Stoker / Pukerangi	Macraes/Middlemarch	19,772	Korero gecko, southern grass skink, McCann's skink	Otago skink, grand skink, Otago green skink	Grand skink most recent report is 1996. Otago skink most recent report is 1987. Resurvey would be informative.	Unknown
Middlemarch	Macraes/Middlemarch	1,373	Korero gecko, southern grass skink, McCann's skink	Otago skink, grand skink	Some potential for Otago skink and grand skink, both Threatened-Nationally Endangered. However, all the reports from this area are pre-1990 and it is uncertain whether they are still present or in what sort of numbers. Requires survey.	Unknown
Redbank road	Macraes/Middlemarch	98.9	Korero gecko, southern grass skink, McCann's skink	Otago skink, grand skink	Most recent reports: grand skink 1995, Otago skink 1983.	Unknown
Redbank road #2	Macraes/Middlemarch	69.6	Korero gecko, southern grass skink, McCann's skink	Otago skink, grand skink	Otago skink recorded in 2003.	Unknown
Macraes Flat	Macraes/Middlemarch	802	Korero gecko, southern grass skink, McCann's skink	Otago skink, grand skink	Most recent reports: grand skink 1996, Otago skink 1986.	Unknown
Macraes Flat #2	Macraes/Middlemarch	286	Korero gecko, southern grass skink, McCann's skink	Grand skink	Grand skink recorded in 1995. May be extirpated.	Unknown
Tiroiti	Macraes/Middlemarch	3,968	Korero gecko, southern grass skink, McCann's skink	Otago skink, grand skink	Otago skink and grand skink (both Threatened-Nationally Endangered) recorded in 1987. May still be present. Requires survey.	Unknown
Hyde / Macraes	Macraes/Middlemarch	1,304	Korero gecko, southern grass skink, McCann's skink	Otago skink, grand skink	Otago skink and grand skink (both Threatened-Nationally Endangered) recorded in 1987. May still be present. Requires survey.	Unknown
Kyeburn	Macraes/Middlemarch	847	Korero gecko, southern grass skink, McCann's skink	Grand skink	Potential for grand skink (Threatened-Nationally Endangered). 1986 report.	Unknown
Trotters Gorge	North Otago	256		Jewelled gecko, korero gecko, southern grass skink	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Herbert forest #2	North Otago	10.6		Jewelled gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Herbert forest #3	North Otago	9.99		Jewelled gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Herbert forest #4	North Otago	21.5		Jewelled gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Herbert forest #5	North Otago	74.2		Jewelled gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown

Site Name	Locality	Area (ha)	Species Known to be Present	Possibly Present	Significance Justification	Confidential
Herbert #2	North Otago	5.34		Jewelled gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Herbert #1	North Otago	3.49		Jewelled gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Waianakarua North Branch	North Otago	8.94		Jewelled gecko	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Maraeweka	North Otago	1,498		Jewelled gecko, korero gecko, southern grass skink	Habitat suitable for jewelled gecko and close to known reports.	Unknown
Fuschia Creek	North Otago	137		Jewelled gecko, southern grass skink	Habitat suitable for jewelled gecko and close to known reports.	Unknown
The Dasher	North Otago	2,378		Jewelled gecko, Otago green skink, korero gecko, southern grass skink	Jewelled gecko, Otago green skink, and korero gecko likely to be present. Requires survey to confirm.	Unknown
Richardson Mountains central	Southern Lakes	36,893	Mccann's skink	Orange-spotted gecko, takitimu gecko, lakes skink, nevis skink, korero gecko, cryptic skink, southern grass skink	Strong potential for orange-spotted geckos and/or Takitimu gecko. Also potential for lakes skink and nevis skink.	Unknown
Ben Lomond	Southern Lakes	753	Mccann's skink	Orange-spotted gecko, lakes skink, nevis skink, cryptic skink, southern grass skink	Unverified reports of Lakes skink. Strong potential for orange-spotted geckos.	Unknown
Moa Creek	Central Otago	1,452	Schist gecko, McCann's skink	Grand skink, Otago skink	Grand skink and Otago skink present in 1984, but may have been extirpated.	Unknown
Lake Onslow	Central Otago	248	Mccann's skink, southern grass skink	Otago green skink, korero gecko	Unverified old report of Otago green skink.	Unknown
Chaslands #2	Catlins	199		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Chaslands #3	Catlins	68.4		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Chaslands #4	Catlins	68.9		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Chaslands #5	Catlins	10.4		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Chaslands #6	Catlins	14		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Chaslands #7	Catlins	181		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Tahakopa River	Catlins	45.4		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Tahakopa Valley	Catlins	51.6		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Tahakopa Valley #2	Catlins	26.5		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Tahakopa Valley #3	Catlins	442		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Tahakopa Valley #4	Catlins	294		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
MacLennan	Catlins	779		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
MacLennan #2	Catlins	32.2		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
MacLennan #3	Catlins	33.5		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Kahuika	Catlins	301		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Catlins forest north	Catlins	22,287		Tautuku gecko, Southland green skink, korero gecko, Southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Puketiro	Catlins	774		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Purakaunui	Catlins	258		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Purakaunui #2	Catlins	93.9		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Purakaunui #3	Catlins	142		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Purakaunui #4	Catlins	244		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Purakaunui Bay	Catlins	383		Tautuku gecko, southern grass skink	Habitat suitable for Tautuku gecko and close to known reports.	Unknown
Hinahina Cove	Catlins	662		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Catlins Lake	Catlins	79.5		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Catlins Lake #2	Catlins	85.8		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Catlins Valley	Catlins	12		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Catlins Valley #2	Catlins	22.7		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Catlins Valley #3	Catlins	50.6		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Catlins Valley #4	Catlins	21.5		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Catlins Valley #5	Catlins	23.8		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Catlins Valley #6	Catlins	22.4		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Owaka Valley	Catlins	1,694		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Wisp Range	Catlins	2,780		Tautuku gecko, Southland green skink, cryptic skink, korero gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and Southland green skink and close to known reports.	Unknown
Owaka	Catlins	436		Tautuku gecko, jewelled gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Owaka #2	Catlins	163		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Owaka #3	Catlins	31.8		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Nugget Point	Catlins	623		Tautuku gecko, jewelled gecko, korero gecko, southern grass skink	Remote chance of jewelled gecko which were recorded at Nugget Point in the 1990s, but not found recently. Habitat also may be suitable for Tautuku gecko.	Unknown
Kaka Point	Catlins	419		Tautuku gecko, jewelled gecko, korero gecko, southern grass skink	Remote chance of jewelled gecko which were recorded at Nugget Point in the 1990s, but not found recently. Habitat also may be suitable for Tautuku gecko.	Unknown

Site Name	Locality	Area (ha)	Species Known to be Present	Possibly Present	Significance Justification	Confidential
Kaka Point #2	Catlins	220		Tautuku gecko, jewelled gecko, korero gecko, southern grass skink	Remote chance of jewelled gecko which were recorded at Nugget Point in the 1990s, but not found recently. Habitat also may be suitable for Tautuku gecko.	Unknown
Kaka Point #3	Catlins	55.6		Tautuku gecko, jewelled gecko, korero gecko, southern grass skink	Remote chance of jewelled gecko which were recorded at Nugget Point in the 1990s, but not found recently. Habitat also may be suitable for Tautuku gecko.	Unknown
Kaka Point #4	Catlins	78.2		Tautuku gecko, jewelled gecko, korero gecko, southern grass skink	Remote chance of jewelled gecko which were recorded at Nugget Point in the 1990s, but not found recently. Habitat also may be suitable for Tautuku gecko.	Unknown
Kaka Point #5	Catlins	18.8		Tautuku gecko, jewelled gecko, korero gecko, southern grass skink	Remote chance of jewelled gecko which were recorded at Nugget Point in the 1990s, but not found recently. Habitat also may be suitable for Tautuku gecko.	Unknown
Kaka Point #6	Catlins	116		Tautuku gecko, jewelled gecko, korero gecko, southern grass skink	Remote chance of jewelled gecko which were recorded at Nugget Point in the 1990s, but not found recently. Habitat also may be suitable for Tautuku gecko.	Unknown
Kaka Point #7	Catlins	12.5		Tautuku gecko, jewelled gecko, korero gecko, southern grass skink	Remote chance of jewelled gecko which were recorded at Nugget Point in the 1990s, but not found recently. Habitat also may be suitable for Tautuku gecko.	Unknown
Romahapa North	Catlins	57.4		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #2	Catlins	3.88		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #3	Catlins	14.8		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #4	Catlins	2.4		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #5	Catlins	24		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #6	Catlins	49.4		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #7	Catlins	12.9		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #8	Catlins	32.9		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #9	Catlins	9.22		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #10	Catlins	24.4		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa #11	Catlins	32.5		Tautuku gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Romahapa West	Catlins	240		Tautuku gecko, Southland green skink, cryptic skink, korero gecko, southern grass skink	Habitat suitable for Tautuku gecko and Southland green skink and close to known reports.	Unknown
Lochindorb	Catlins	32.5		Tautuku gecko, Southland green skink, cryptic skink, korero gecko, southern grass skink	Habitat suitable for Tautuku gecko and Southland green skink and close to known reports.	Unknown
Glenoamaru Reserve	Catlins	612		Tautuku gecko, korero gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Glenoamaru #1	Catlins	60.5		Tautuku gecko, korero gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Glenoamaru #2	Catlins	265		Tautuku gecko, korero gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Glenoamaru #3	Catlins	160		Tautuku gecko, korero gecko, southern grass skink	Habitat may be suitable for Tautuku gecko and close to known reports.	Unknown
Owaka Valley #2	Catlins	624	Korero gecko	Tautuku gecko, southland green skink, cryptic skink, southern grass skink, McCann's skink	Habitat suitable for Tautuku gecko and Southland green skink and close to known reports.	Unknown
Purekireki	Catlins	342		Southland green skink, cryptic skink, korero gecko, southern grass skink, McCann's skink	Habitat suitable for Southland green skink and close to known reports.	Unknown
Kaihiku Range #2	Catlins	362		Southland green skink, cryptic skink, korero gecko, southern grass skink, McCann's skink	Habitat suitable for Southland green skink and close to known reports.	Unknown
Clinton Kuriwao	Catlins	563	Southland green skink	Cryptic skink, korero gecko, southern grass skink, McCann's skink	Southland green skink recorded in 1970. Not known if still extant.	Unknown
Clinton	Catlins	124		Southland green skink, cryptic skink, korero gecko, southern grass skink, McCann's skink	Habitat may be suitable for Southland green skink. Close to known reports and within historical range.	Unknown



Call Free 0508 WILDNZ
Ph: +64 7 343 9017
Fax: +64 7 3439018
ecology@wildlands.co.nz

99 Sala Street
PO Box 7137, Te Ngae
Rotorua 3042,
New Zealand

Regional Offices located in
Auckland, Hamilton, Tauranga,
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