Conservation Status of Amphibians in Otago, 2025

Scott Jarvie

April 2025

Otago Threat Classification Series 10

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Otago Threat Classification Series is a scientific monograph series presenting publications related to regional threats assessments of groups of taxa in the Otago region. Most will be lists providing regional threat assessments of members of a plant or animal group (e.g., amphibians, bats, birds, indigenous vascular plants, selected species of fungi, reptiles), and leverages off national assessments for the New Zealand Threat Classification System within the regional context.

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brown tree frog, *Litoria ewingii*, Regionally Introduced and Naturalised. Photograph by Samuel Purdie

Frontispiece image credit
southern tree frog, *Ranoidea raniformis*, Regionally Introduced and Naturalised. Photograph by Samuel Purdie

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Executive Summary

This report is an update of the regional conservation status of amphibians in the Otago Region and supersedes an earlier version from 2024. Standardised methodology was followed to assess the regional threat status of amphibian taxa in Otago. Two amphibian taxa were assessed as Regionally Introduced and Naturalised (brown tree frog, *Litoria ewingii*, and southern tree frog, *Ranoidea raniformis*). An additional taxon was identified as Regionally Extirpated (Markham's frog, *Leiopelma markhami*).

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Introduction

Threat classifications play an important role in monitoring biodiversity and informing conservation actions. The New Zealand Threat Classification System (NZTCS) is a tool used to assign a threat status to candidate taxa (species, subspecies, varieties, and forma) in Aotearoa New Zealand (Rolfe et al. 2022). The classification system was developed to apply equally to terrestrial, freshwater, and marine biota (flora, fauna and fungi). The NZTCS scores taxa at the national scale against criteria based on an understanding of population state, size, and trend, while considering population status, impact of threats, recovery potential, and taxonomic certainty. The Department of Conservation | Te Papa Atawhai (DOC) administers the NZTCS in Aotearoa New Zealand, with national assessments used to inform conservation action, target resources, and monitor biodiversity trends and conservation effectiveness.

While DOC is tasked with managing indigenous taxa nationally, regional and district councils have statutory obligations to maintain indigenous biodiversity under the Resource Management Act 1991 (RMA), including to manage the habitats of threatened taxa. The regional threat status of taxa is particularly important in the context of the RMA and in conservation planning. A key requirement of managing the habitats occupied by taxa is to understand regional population sizes and distributions, and to monitor trends and management effectiveness.

This report is an update to, and supersedes, the regional conservation status assessment for amphibians in the Otago Region (Jarvie 2024). Regional threat assessments have been completed following a standardised methodology by Otago Regional Council for six taxonomic groups (amphibians, Jarvie 2024; bats, Jarvie et al. 2023a; birds, Jarvie et al. 2024a; indigenous vascular plants, Jarvie et al. 2025; reptiles, Jarvie et al. 2024a; selected species of mushroom fungi – non-lichenised agarics, boletes, and russuloid fungi, Jarvie and Cooper, 2024), Greater Wellington Regional Council for five taxonomic groups (birds, Crisp et al. 2024; indigenous freshwater fish, Crisp et al. 2022; indigenous vascular plants, Crisp 2020; reptiles, Crisp et al. 2023b; bats, Crisp et al. 2023b) and Auckland Council for five taxonomic groups (amphibians, Melzer et al. 2022a; reptiles, Melzer et al. 2022b; indigenous vascular plants, Simpkins et al. 2023; bats, Woolly et al. 2023; freshwater fish, Bloxham et al. 2023) as of April 2025. Regional threat assessments also provide a stronger foundation for assessing the threat status of taxa nationally. The methodology for the regional threat assessments leverages off national threat assessments as determined using the NZTCS (Rolfe et al. 2022), with thresholds for area of occupancy or species numbers adjusted for the land area in the

region (Appendix 1). National strongholds and additional regional qualifiers are also considered (Appendix 2).

Methods

The regional threat status of amphibians was assessed in April 2025. This assessment covers all amphibian taxa in the region, following standardised methodology for regional threat assessments as shown in Appendix 1, and using the list of regional- and national-qualifiers in Appendix 2 and Appendix 3, respectively. The regional boundary for Otago is shown in Appendix 4. The national threat assessments and national qualifiers were from Burns et al. (2025). All the taxa in this regional assessment were classified following Burns et al. (2025) as: 'taxonomically determinate', i.e., legitimately, and effectively published and generally accepted by relevant experts as distinct; and 'taxonomically indeterminate / unresolved', i.e., used loosely to include both undescribed entities which still require formal taxonomic research to confirm their validity and provide them with a formal name and, occasionally, described species whose taxonomic validity is in question.

Following the standardised methodology, amphibian taxa recognised in the NZTCS list (Burns et al. 2025) but not known to occur in Otago were first removed from consideration. The next step was to identify Nationally Threatened and At-Risk taxa that are present in the region. If more than 20% of the national population of native taxa are breeding or resident for more than half their life cycle in the region, they were assigned a National Stronghold status and the NZTCS criteria applied. In this exercise, the regional conservation status must not be of a lower threat status than the national status.

Regional thresholds were set at more than 2000 mature individuals present or occupancy of more than 1000 hectares. If taxa did not meet the threshold, they were assigned a regional threat status by applying the NZTCS criteria. If taxa meet the threshold and the population trend was ±10% stable or increasing, they were assigned the status Regionally Not Threatened. For Nationally Not Threatened and Non-Resident taxa, the regional population threshold was applied. If the population was not stable to increasing or decreasing by more than 10%, the NZTCS criteria were used to determine the regional threat status. Population trend criteria are applied based on current knowledge, representing trends over the next 10 years or 3 generations, whichever is longer.

Regional conservation assessments for amphibian taxa were completed in a locally operated dashboard using R v. 4.2.2 (R Core Team 2022) via the RStudio platform (Posit Team 2023). The main packages used for the dashboard were 'shiny' (Chang et al. 2021) and 'flexdashboard' (Iannone et al. 2020). Other packages used in the dashboard, data wrangling, included 'tidyverse' (Wickham et al. 2019), 'readxl' (Wickham and Bryan

2022), ‘sf’ (Pebesma 2018), ‘lubridate’ (Grolemund and Wickham 2011), ‘leaflet’ (Cheng et al. 2022), ‘leaflet.extras’ (Karambelkar and Schloerke 2018), ‘plotly’ (Sievert 2020), ‘janitor’ (Firke 2020), ‘ggplot2’ (Wickham 2016), and ‘terra’ (Hijmans 2022). The map layers used to view records in the dashboard were OpenStreetMap (OpenStreetMap Contributors 2017) and Esri World Imagery (Esri 2023).

Results

Two extant amphibian species were assessed in Otago as Regionally Introduced and Naturalised (brown tree frog, *Litoria ewingii*, and southern bell frog, *Ranoidea raniformis*: the national assessment for both species from the NZTCS are Introduced and Naturalised, Burns et al. 2025; Figure 1, Tables 1). An additional species was identified as having been in Otago during the Holocene but is now Regionally Extirpated (Markham's frog, *Leiopelma markhami*: the national assessment from the NZTCS is Extinct, Burns et al. 2025; Figure 1, Tables 1).

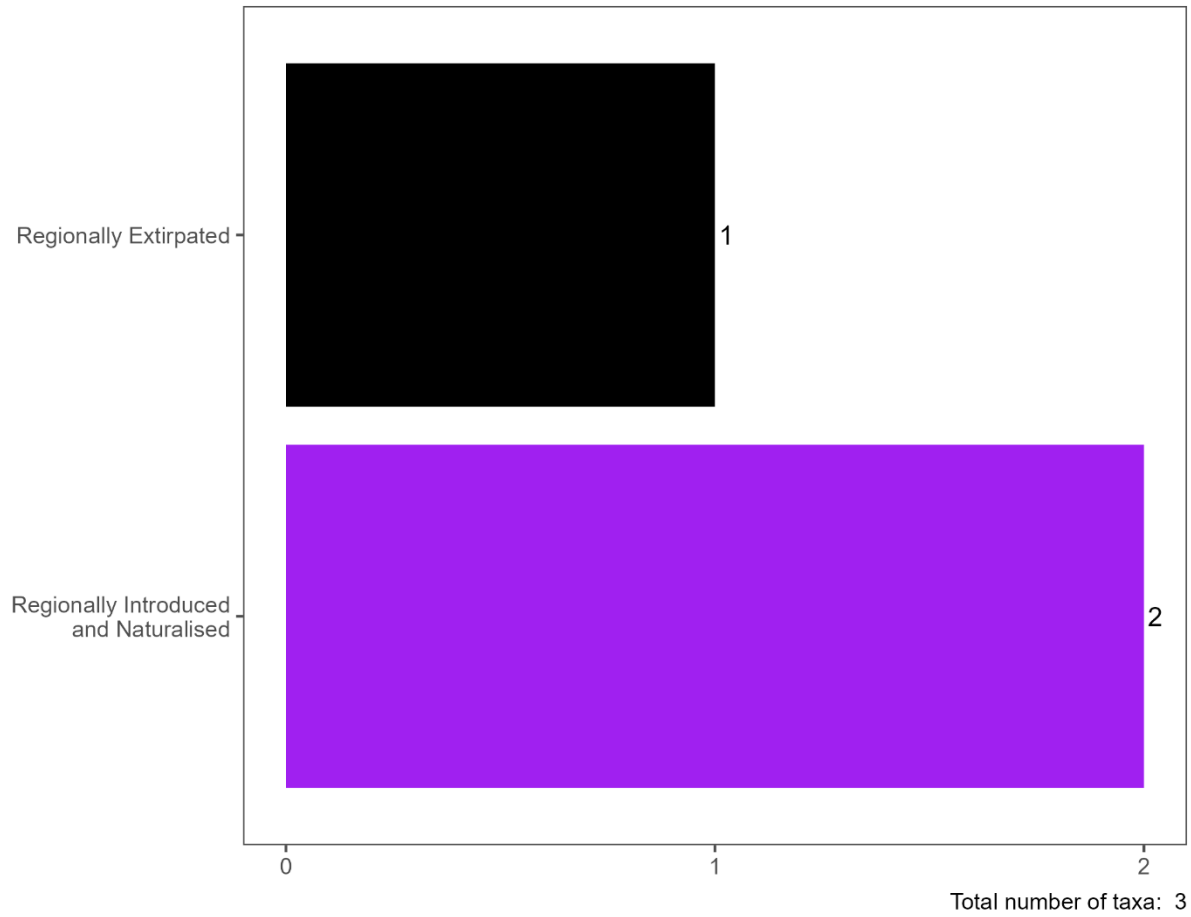

Figure 1: Conservation status of amphibians in Otago

Table 1: Conservation status of amphibians in Otago

Name and Authority	Common Name	Regional Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Conservation Status	National Qualifiers
REGIONALLY EXTIRPATED (1)													
TAXONOMICALLY DETERMINATE (1)													
Leiopelma markhami Worthy, 1987	Markham's frog	Regionally Extirpated										Extinct	
REGIONALLY INTRODUCED AND NATURALISED (2)													
TAXONOMICALLY DETERMINATE (2)													
Litoria ewingii Duméril & Bibron (1841)	brown tree frog											Introduced and Naturalised	
Ranoidea raniformis (Keferstein, 1867)	southern bell frog											Introduced and Naturalised	

Regional and national qualifiers: CD = Conservation Dependent; DPR = Data Poor Recognition; DPS = Data Poor Size; DPT = Data Poor Trend; De = Designated; EF = Extreme Fluctuations; NR = Natural Range Limit; NS = Natural State; NStr = Natural Stronghold; OL = One Location; PD = Partial Decline; RR = Range Restricted; SO = Secure Overseas; SO? = Secure Oversea?; S?O = Secure?Overseas; TO = Threatened Overseas' TO? = Threatened Overseas?; T?O = Threatened? Overseas; CI = Climate Impact; CRN = Conservation Research Needed; EW = Extinct in the Wild; INC = Increasing; PF = Population Fragmentation' PE = Possibly/Presumed Extinct; RE = Regional Endemic; Rel = Relict; RF = Recruitment Failure; Sp = Biologically Sparse

Observations of the green and golden bell frog (*Ranoidea aurea*) have occurred in Otago (Dale et al. 2025). However, while breeding is possible, there is no confirmed evidence for a 'naturalised' population in the Region, i.e., multi-generational with spread. If evidence for breeding and the spread of populations exists for the green and golden bell frog, do report it on community scientist platforms like iNaturalist.

Table 2: No verified naturalised populations in Otago

Name and Authority	Common Name	National Conservation Status	Notes
NOT VERIFIED (1)			
TAXONOMICALLY DETERMINATE (1)			
green and golden bell frog	*Ranoidea aurea* Lesson, (1829)	Introduced and Naturalised	While breeding is possible, there is no confirmed evidence for a 'naturalised' population, i.e., multi-generational with spread

Discussion

Regional threat assessments have already been completed by regional councils in Aotearoa New Zealand (Bloxham et al. 2024; Crisp 2020, Crisp et al. 2022, 2023a, 2023b, 2024; Jarvie 2024; Jarvie and Cooper 2024; Jarvie et al. 2023, 2024a, 2024b, 2025; Melzer et al. 2022a, 2022b; Simpkins et al. 2023). This report is an update to the regional assessment of the conservation status of amphibian species in Otago. Two amphibian species are currently present in the Otago, both of which are Regionally Introduced and Naturalised. An additional taxon was identified as Regionally Extirpated, with this taxon being globally extinct.

The extinct amphibian taxon Markham's frog, *Leiopelma markhami*, is known from Mt Nicholas Station, near Lake Whakatipu (Easton 2018). The age of this specimen is dated as 1,413 calendar years before present (where present is 2016; L. Easton. pers. comm. April 9, 2024). This specimen was radiocarbon dated from other material collected from the same-time averaged layer within the fossil deposits due to the small size of the frog fossils (Easton 2018). Although this radiocarbon date illustrates that an endemic frog taxon was present during the Holocene in Otago, they likely disappeared following the arrival of humans to Aotearoa New Zealand due to the introduction of mammalian predators and habitat loss (Worthy 1987, Easton 2018). More information on the distributions of extinct frogs in Aotearoa New Zealand by region can be found in Dale et al. 2025 (edited chapter in Jarvie and Monks, 2025).

Two extant amphibian species found in Otago are Regionally Introduced and Naturalised. Both these frog species were deliberately introduced to Aotearoa New Zealand from Australia. The southern bell frog (*Ranoidea raniformis*) was initially introduced to Aotearoa by the Canterbury Acclimatisation Society, in 1867, with the species now widespread across much of the country except for Stewart Island/Rakiura and some offshore islands. The brown tree frog (*Litoria ewingii*) was initially introduced to Greymouth, in 1875, and is now currently distributed throughout much of Aotearoa New Zealand, including Rakiura and Chatham Island/Rēkohu.

An additional amphibian species has been recorded in Otago, the green and golden bell frog (*Ranoidea aurea*). Although breeding of the green and golden bell frog is possible, there is no confirmed evidence for a ‘naturalised’ population, i.e., multi-generational with spread. Thus, it is not included as Regionally Introduced and Naturalised. The distributions of introduced frogs by region in Aotearoa New Zealand can be found in Dale et al. 2025.

Conservation translocations of native frogs/pepeketua (*Leiopelma* sp.) have so far not occurred in Otago, but this taxonomic group has been included in restoration plans, including for Orokonui Ecosanctuary – Te Korowai o Mihiwaka, near Ōtepoti Dunedin (Orokonui Ecosanctuary 2019). The translocation of native frog populations to extend the range of taxon in the wild is a preferred conservation option by the Department of Conservation – Te Papa Atawhai to aid the recovery of frog populations (Bishop et al. 2013). Although native frog habitat is thought to exist within the Orokonui Ecosanctuary (Easton et al. 2016), any translocation into the reserve would be as a surrogate for a species that might have been present in the region. Conservation translocation guidelines place great emphasis on feasibility and risk analysis as essential components of any conservation translocation (IUCN/SSC 2013). A critical aspect in planning for conservation translocations of native frogs to Otago would be the selection of suitable release sites that match the biotic and abiotic needs of the focal species under future climate scenarios (IUCN/SSC 2013).

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Thanks to Philippa Crisp and Roger Uys from Greater Wellington Regional Council and Sabine Melzer from Auckland Council for advice on the regional conservation status process, Pascale Michel from the Department of Conservation | Te Papa Atawhai (DOC) for advice on the national assessments and the regional conservation status process, Luke Easton from DOC for advice on the extinct frog taxon in Otago, Tobia Dale and Hadley Muller from Te Tari Mātai Kararehe | Department of Zoology, Ōtākou Whakaihu Waka | University of Otago for advice on distributions of introduced and naturalised frogs, Rod Hitchmough for advice on distributions of introduced and naturalised frogs, Mike Thorsen for posting on the community scientist platform iNaturalist on individuals of green and golden frogs found in Otago, Nathan Whitmore from Reproducible for the development of the dashboard for the locally-operated regional assessments, Samuel Purdie from Southern Lakes Sanctuary for providing the front cover, back cover and frontispiece images of extant amphibian taxon in Otago as well as for advice, Ciaran Campbell, Tim Ware and Alison Sammes from the Otago Regional Council for editorial advice, discussion on regional threat assessments, and web editorial support, as well as other Council staff that provided support and encouragement for these threat assessments.

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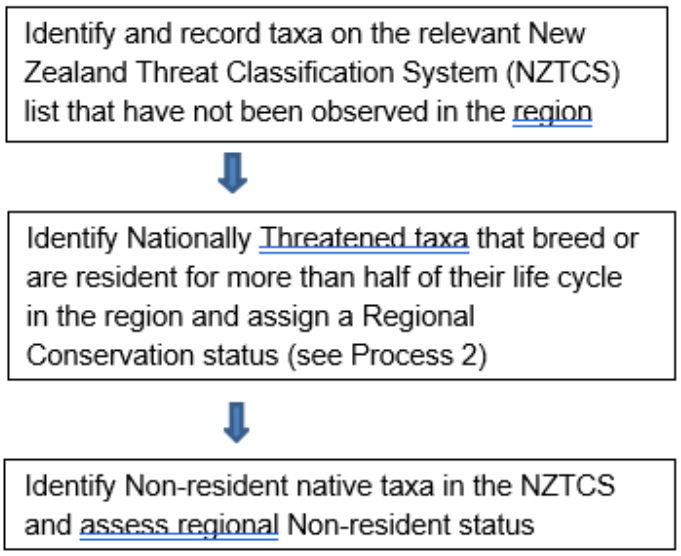
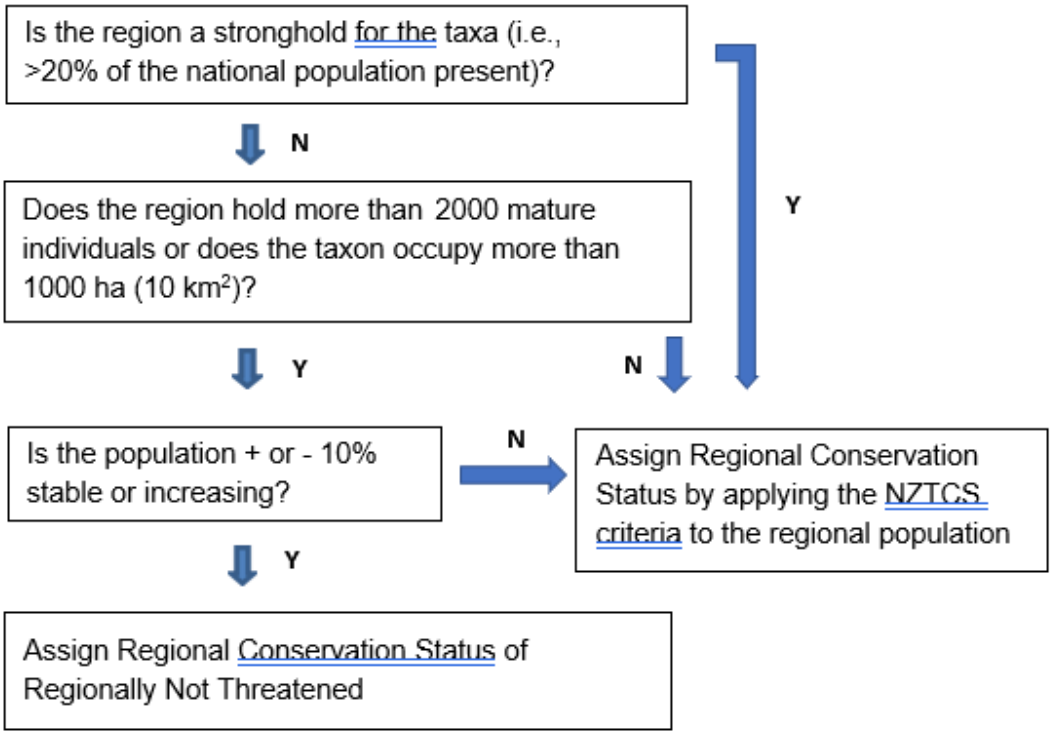
Appendix 1: Process for determining the regional threat status of taxa

Process 1: Determination of regional threat status



Process 2: Determination of strongholds and Regionally Not Threatened species



Appendix 2: List of Regional Qualifiers for Regional Conservation Threat Assessments

Code	Qualifier	Description
FR	Former Resident	Breeding population (existed for more than 50 years) extirpated from region but continues to arrive as a regional vagrant or migrant. FR and RN are mutually exclusive.
HR	Historical Range	The inferred range (extending in any direction) of the taxon in pre-human times meets its natural limit in the region.
IN	Introduced Native	Introduced to the region, though not known to have previously occurred in it.
NS	National Stronghold	More than 20% of the national population breeding or resident for more than half their life cycle in the region.
NR	Natural Range	The known range (extending in any direction) of the taxon meets it natural limit in the region.
RE	Regional Endemic	Known to breed only in the region.
RN	Restored Native	Reintroduced to the region after having previously gone extinct there.
TL	Type Locality	The type locality of the taxon is within the region. Ignore if the taxon is or has ever been regionally extinct

Appendix 3: List of National Qualifiers from the New Zealand Threat Classification System (Rolfe et al. 2022)

Code	Qualifier	Qualifier Type	Description
DPR	Data Poor: Recognition	Assessment Process Qualifier	Confidence in the assessment is low because of difficulties determining the identity of taxon in the field and/or in the laboratory. Taxa that are DPR will often be DPS and DPT. In such cases, the taxon is most likely to be Data Deficient.
DPS	Data Poor: Size	Assessment Process Qualifier	Confidence in the assessment is low because of a lack of data on population size.
DPT	Data Poor: Trend	Assessment Process Qualifier	Confidence in the assessment is low because of a lack of data on population trend.
DE	Designated	Assessment Process Qualifier	A taxon that the Expert Panel has assigned to what they consider to be the most appropriate status without full application of the criteria. For example, a commercial fish that is being fished down to Biomass Maximum Sustainable yield (BMSy) may meet criteria for 'Declining', however, it could be designated as 'Not Threatened' if the Expert Panel believes that this better describes the taxon's risk of extinction.
IE	Island Endemic	Biological Attribute Qualifier	A taxon whose naturally distribution is restricted to one island archipelago (e.g., Auckland Islands) and is not part of the North or South Islands or Steward Island/Rakiura. This qualifier is equivalent to the 'Natural' Population State value in the database.
NS	Natural State	Biological Attribute Qualifier	A taxon that has a stable or increasing population that is presumed to be in a natural condition, i.e., has not experienced historical human-induced decline.
RR	Range Restricted	Biological Attribute Qualifier	A taxon naturally confined to specific substrates, habitats, or geographic areas of less than 100 km^2 (100,000 ha), this is assessed by taking into account the area of occupied habitat of all sub-populations (and summing the areas of habitat if there is more than one sub-population), e.g., Chatham Island forget-me-not (*Myosotidium hortensia*) and Auckland Island snipe (*Coenocorypha aucklandica aucklandica*). This qualifier can apply to any 'Threatened' or 'At Risk' taxon. It is redundant if a taxon is confined to 'One Location' (OL)
Sp	Biologically Sparse	Biological Attribute Qualifier	The taxon naturally occurs within typically small and widely scattered subpopulations. This qualifier can apply to any 'Threatened' or 'At Risk' taxon.
NO	Naturalized Overseas	Population State Qualifier	A New Zealand endemic taxon that has been introduced by human agency to another country (deliberately or accidentally) and has naturalised there, e.g., *Olearia traversiourum* in the Republic of Ireland.

Continued on next page

List of National Qualifiers from the New Zealand Threat Classification System

Code	Qualifier	Qualifier Type	Description
OL	One Location	Population State Qualifier	Found at one location in New Zealand (geographically or ecologically distinct area) of less than 100,000 ha (1000 km2), in which a single event (e.g., a predator irruption) could easily affect all individuals of the taxon, e.g., L'Esperance Rock groundsel (*Senecio esperensis*) and Open Bay leech (*Hirudobdella antipodum*). 'OL' can apply to all 'Threatened', 'At Risk', 'Non-resident Native' – Coloniser and Non-resident Native – Migrant taxa, regardless of whether their restricted distribution in New Zealand is natural or human-induced. Resident native taxa with restricted distributions but where it is unlikely that all sub-populations would be threatened by a single event (e.g., because water channels within an archipelago are larger than known terrestrial predator swimming distances) should be qualified as 'Range Restricted' (RR).
SO	Secure Overseas	Population State Qualifier	The taxon is secure in the parts of its natural range outside New Zealand
SO?	Secure Overseas?	Population State Qualifier	It is uncertain whether a taxon of the same that is secure in the parts of its natural range outside New Zealand is conspecific with the New Zealand taxon.
S?O	Secure? Overseas	Population State Qualifier	It is uncertain whether the taxon is secure in the parts of its natural range outside New Zealand.
TO	Threatened Overseas	Population State Qualifier	The taxon is threatened in the parts of its natural range outside New Zealand.
T?O	Threatened Overseas?	Population State Qualifier	It is uncertain whether a taxon of the same name that is threatened in the parts of its natural range outside New Zealand is conspecific with the New Zealand taxon.
T?O	Threatened? Overseas	Population State Qualifier	It is uncertain whether the taxon is threatened in the parts of its natural range outside New Zealand.
CI	Climate Impact	Pressure Management Qualifier	The taxon is adversely affected by long-term climate trends and/or extreme climatic events. The following questions provide a guide to using the CI Qualifier: Is the taxon adversely affected by long-term changes in the climate, such as an increase in average temperature or sea-level rise? If NO = no Qualifier but needs monitoring and periodic re-evaluation because projected changes to the average climate and sea-level rise may adversely impact the taxon (including via changes to the distribution and prevalence of pests, weeds, and predators) in the future. If YES = CI Qualifier Is the taxon adversely affected by extreme climate events, such as a drought, storm, or heatwave? If No = no Qualifier but needs monitoring and periodic re-evaluation because projected changes to the climate are likely to increase the frequency and/or severity of these events in the future. If YES = CI Qualifier Use of the Climate Impact Qualifier would indicate the need for more in-depth research, ongoing monitoring of climate impacts, and potentially a climate change adaptation plan for the taxon

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List of National Qualifiers from the New Zealand Threat Classification System

Code	Qualifier	Qualifier Type	Description
CD	Conservation Dependent	Pressure Management Qualifier	The taxon is likely to move to a worse conservation status if current management ceases. The term 'management' can include indirect actions that benefit taxa, such as island biosecurity. Management can make a taxon CD only if cessation of the management would result in a worse conservation status. The influence of the benefits of management on the total population must be considered before using CD. The benefit of managing a single subpopulation may not be adequate to trigger CD, but may trigger Partial Decline (PD). Taxa qualified CD may also be PD because of the benefits of management.
CR	Conservation Research Needed	Pressure Management Qualifier	Causes of decline and/or solutions for recovery are poorly understood and research is required.
EW	Extinct In The Wild	Pressure Management Qualifier	The taxon is known only in captivity or cultivation or has been reintroduced to the wild but is not self-sustaining. Assessment of a reintroduced population should be considered only when it is self-sustaining. A population is deemed to be self-sustaining when the following two criteria have been fulfilled: it is expanding or has reached a stable state through natural replenishment and at least half the breeding adults are products of the natural replenishment, and it has been at least 10 years since reintroduction
EF	Extreme Fluctuations	Pressure Management Qualifier	The taxon experiences extreme unnatural population fluctuations, or natural fluctuations overlaying human-induced declines, that increase the threat of extinction. When ranking taxa with extreme fluctuations, the lowest estimate of mature individuals should be used for determining population size, as a precautionary measure.
INC	Increasing	Pressure Management Qualifier	There is an ongoing or forecast increase of > 10% in the total population, taken over the next 10 years or three generations, whichever is longer. This qualifier is redundant for taxa ranked as 'Recovering'.
PD	Partial Decline	Pressure Management Qualifier	The taxon is declining over most of its range, but with one or more secure populations (such as on offshore islands). Partial decline taxa (e.g., North Island kākā *Nestor meridionalis septentrionalis* and Pacific gecko *Dactylocnemis pacificus*) are declining towards a small stable population, for which the Relict qualifier may be appropriate.
PF	Population Fragmentation	Pressure Management Qualifier	Gene flow between subpopulations is hampered as a direct or indirect result of human activity. Naturally disjunct populations are not considered to be 'fragmented'.

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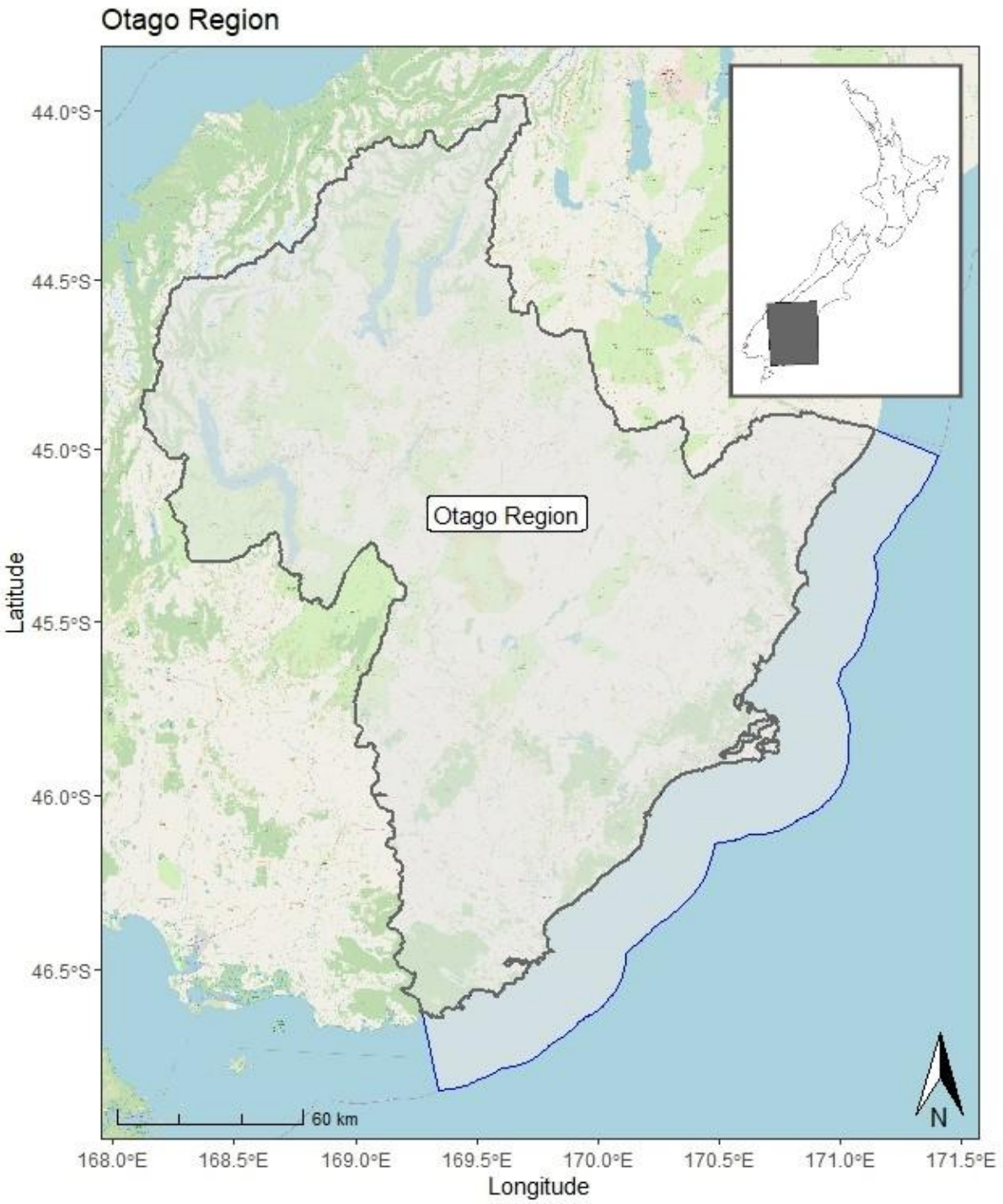
List of National Qualifiers from the New Zealand Threat Classification System

Code	Qualifier	Qualifier Type	Description
PE	Possibly/Presumed Extinct	Pressure Management Qualifier	A taxon that has not been observed for more than 50 years but for which there is little or no evidence to support declaring it extinct. This qualifier might apply to several Data Deficient and Nationally Critical taxa.
RF	Recruitment Failure	Pressure Management Qualifier	The age structure of the current population is such that a catastrophic decline is likely in the future. Failure to produce new progeny or failure of progeny to reach maturity can be masked by apparently healthy populations of mature specimens.
Rel	Relict	Pressure Management Qualifier	The taxon has declined since human arrival to less than 10% of its former range but its population has stabilised. The range of a relictual taxon takes into account the area currently occupied as a ratio of its former extent. Reintroduced and self-sustaining populations within or outside the former known range of a taxon should be considered when determining whether a taxon is relictual. This definition is modified from the definition of the At Risk – Relict category in the NZTCS manual (Townsend et al. 2008). The main difference is that trend is not included in the qualifier definition. This enables the qualifier to be applied to any taxon that has experienced severe range contraction, regardless of whether that contraction continues or has been arrested. This qualifier complements the 'Naturally Uncommon (NU)' qualifier which can be applied to taxa whose abundance has declined but which continue to occupy a substantial part of their natural range.



Appendix 4: Map of the Otago Region, showing the coastal marine area. Inset map shows Otago in relation to the remainder of Aotearoa New Zealand

Find out more:
www.orc.govt.nz/environment/biodiversity/regional-threat-assessments/
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Otago Regional Council