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Trait-based climate change vulnerability assessments of terrestrial taxa in Aotearoa New Zealand

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Cover: Tara / southern white-fronted terns (*Sterna striata aucklandorna*). *Photo: Peter Blok*

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Trait-based climate change vulnerability assessments of terrestrial taxa in Aotearoa New Zealand

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Abstract

Climate change vulnerability assessments (CCVAs) were undertaken for 1,145 terrestrial taxa of bats, birds, herpetofauna, vascular plants and invertebrates in Aotearoa New Zealand to identify which taxa are potentially the most vulnerable to climate change impacts. We used an established trait-based CCVA framework adapted to the Aotearoa New Zealand context to assess 16 traits under three dimensions of climate change vulnerability – sensitivity, low adaptive capacity and exposure – using expert elicitation. To be classified as Highly Vulnerable to climate change, a taxon needed to trigger 'higher vulnerability' for at least one trait under each vulnerability dimension. Exposure assessments that used the Intergovernmental Panel on Climate Change's (IPCC's) high-emission RCP8.5 scenario indicated that 351 (31%) of the taxa assessed will be Highly Vulnerable by the mid-21st century, increasing to 746 taxa (65%) by late century. By contrast, exposure assessments using the moderate-emission RCP4.5 scenario identified 153 (13%) Highly Vulnerable taxa by mid-century and 215 (19%) by late century. We also identified many Latent Risk taxa across all groups (taxa that are sensitive and have a lower adaptive capacity but are not yet exposed to climate change), emphasising the need for ongoing monitoring to detect if environmental changes are occurring sooner than predicted by modelling. Our study revealed critical data gaps, especially for invertebrates and vascular plants, and many groups of taxa were excluded due to a lack of available expertise to undertake the assessment. Nevertheless, the results of these assessments will assist the Department of Conservation Te Papa Atawhai in prioritising climate change adaptation, management and research actions for the taxa that are in the most critical need.

Keywords: adaptive capacity, Aotearoa New Zealand, climate change, climate change vulnerability assessment, conservation, exposure, sensitivity, traits, threatened species, threats

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1. Introduction

Aotearoa New Zealand's climate is already changing because of human-induced global climate change. The annual average land surface temperature has risen by 1.26°C since records began in 1909 (MfE and Stats NZ 2023). In the same period, the sea level has risen by 1.81 mm per year on average, or 18 cm per century, which in turn is increasing the frequency and magnitude of storm-related inundation and erosion on the country's coastlines. Climate change is also impacting other iconic landscapes, such as glaciers – between 1978 and 2020, the total glacier volumes are estimated to have decreased by a staggering 35% (Macara and Willsman 2021). Projected changes in Aotearoa New Zealand's climate vary depending on the region, but all regions are likely to experience increases in extreme rainfall events and most areas of the country are projected to have increased drought severity (MfE and Stats NZ 2023). A recent review of reported climate change impacts in Aotearoa New Zealand (Keegan et al. 2022) indicates that most measured impacts to date have been due to indirect effects (such as the exacerbation of invasive species impacts) and have occurred in the marine environment. However, direct effects, such as the impacts of drought on freshwater fish, may become prominent in the future.

Small populations of rare and threatened species are already vulnerable to extreme events such as erosion and floods, which are likely to increase in frequency in the future (Macinnis-Ng et al. 2021; Keegan et al. 2022). Aotearoa New Zealand has a high proportion of endemic species (that is species that are only found here) and globally unique species, such as tuatara (*Sphenodon punctatus*) – the last surviving member globally of a distinctive lineage of reptiles in the order Rhynchocephalia. Consequently, protecting Aotearoa New Zealand's species is important for the preservation of biodiversity globally. Many species are considered taonga to Māori, the indigenous people of Aotearoa New Zealand, meaning they hold special cultural significance and importance. Climate change may put some locally significant populations at high risk even if the overall taxon is not considered especially vulnerable.

Many of Aotearoa New Zealand's unique species are already facing extinction because of pressures such as habitat loss and invasive predators.[1] Climate change is likely to exacerbate and interact with existing pressures, as well as alter existing habitats, making them unsuitable for the species that depend on them. For example, many already threatened bird populations will likely only survive in increasingly restricted high-elevation refugia if introduced predators increase in numbers at low elevations and expand into new areas (Walker et al. 2019; Macinnis-Ng et al. 2021; Keegan et al. 2022).

Climate change is affecting nearly every aspect of the responsibilities of the New Zealand Department of Conservation Te Papa Atawhai (DOC). Direct effects include damage to infrastructure and natural habitats caused by rising sea levels and more frequent storm and flood events. Climate change also has indirect effects on the survival, distribution and abundance of species through different interlinked mechanisms. DOC's *Climate change adaptation action plan 2022–2025* (DOC 2020b) and its associated action tables, which were updated in 2022 (DOC 2023), outline the organisation's pathway to reducing the risks posed by a changing climate and increasing resilience to those changes, including what research and analysis DOC should focus on. One of the first steps in adaptation planning for biodiversity conservation is understanding which species are potentially the most vulnerable to climate-related environmental change. Vulnerability refers to the extent to which a species is susceptible to or unable to cope with the adverse effects of climate change (adapted from IPCC 2007[2]). Species can be considered highly vulnerable to climate change if they are

1 For an overview of Aotearoa New Zealand's biodiversity, see *Biodiversity in Aotearoa – an overview of state, trends and pressures 2020* (DOC 2020a).

2 The definition of 'vulnerability' provided in the Intergovernmental Panel on Climate Change's (IPCC's) Fourth Assessment Report (IPCC 2007) has since been updated (IPCC 2014), but the 2007 definition is commonly used in conservation and is used in the International Union for Conservation of Nature (IUCN) Red List (Foden and Young 2016).

exposed to large and/or rapid climate change driven alterations in their physical environment, are **sensitive** to those changes and have **low adaptive capacity** to respond to the changes (IPCC 2007; Fig. 1).

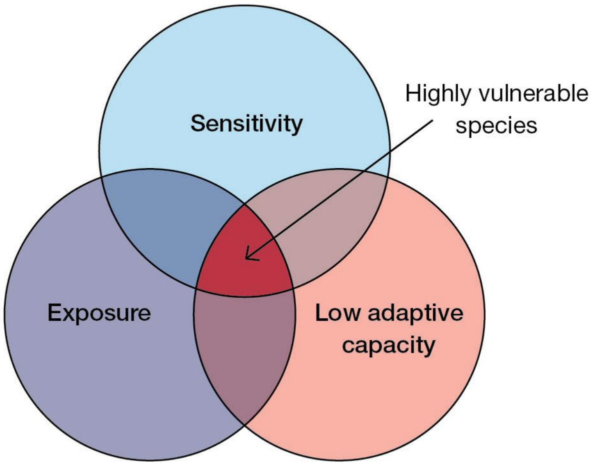

Figure 1. Three dimensions of vulnerability – sensitivity, low adaptive capacity and exposure (based on the definition in IPCC [2007]). Species with traits that cause them to have both sensitivity and low adaptive capacity and that are exposed to environmental climate change impacts are considered to be highly vulnerable to climate change. Source: Adapted from Foden et al. (2013), licensed by the authors for reuse (CC BY 4.0).

There are several ways to assess the potential vulnerability of species to climate change, with the most appropriate approach depending on the purpose of the assessment and factors such as data and resource availability (Pacifici et al. 2015). Climate change vulnerability assessments (CCVAs) generally use trait-based, correlative, mechanistic or combination approaches (Pacifici et al. 2015; Foden and Young 2016; Foden et al. 2019). Trait-based CCVAs are most commonly used by biodiversity conservation and management agencies because they are the least resource and data intensive approach. Correlative approaches can include the development of climate niche models, which predict the potential suitability of habitats in future climates. Mechanistic models can be used to predict the responses of species to climate change to assess their extinction risk. Both require knowledge and data on the requirements of species and their responses to different environmental variables. This report does not include a literature review of CCVAs in general, as there is a wealth of information and guidance already available (Williams et al. 2008; Glick et al. 2011; Pacifici et al. 2015; Foden and Young 2016; Foden et al. 2019).

Trait-based CCVAs use expert elicitation methods to provide relative ranks of vulnerability to climate change by quantifying the adaptive capacity, sensitivity and exposure of species to projected climate change impacts. This allows a relatively rapid assessment to be made without requiring extensive technical or modelling expertise. The basic resource requirements are biological data and distribution information for each species, climate projections, and subject matter expert knowledge. Trait-based CCVA frameworks have been used to assess a wide range of taxonomic groups, including amphibians (Zhao et al. 2022), birds (Carr et al. 2014), reptiles (Carr et al. 2014; Harper et al. 2022; Vaz-Canosa et al. 2022), freshwater fishes (Egan et al. 2020), marine fishes and invertebrates (Bueno-Pardo et al. 2021), marine mammals (Albouy et al. 2020), terrestrial invertebrates (Shank and Nixon 2015), and rare plants (Anacker et al. 2013; Molano-Flores et al. 2019).

2. Study purpose and scope

The purpose of this study was to identify which terrestrial threatened taxa in Aotearoa New Zealand are the most vulnerable to climate change. It was not possible to comprehensively assess all Aotearoa New Zealand native taxa at once, so we limited the assessments to terrestrial taxa in selected groups for which expert knowledge was available. The results of this study will be used to help with the prioritisation of climate change related research, adaptative management and adaptation planning. Results from these assessments may also be used to inform the use of the Climate Impact (CI) qualifier within the New Zealand Threat Classification System (NZTCS) (Rolfe et al. 2022).

2.1 Groups of fauna and flora assessed

In this study, we assessed all indigenous bird taxa that breed in Aotearoa New Zealand (including 95 seabird taxa and excluding Data Deficient taxa), all indigenous herpetofauna taxa (excluding Data Deficient taxa) and all bat taxa. We also assessed a subset of the vascular plant taxa and the terrestrial invertebrate taxa in some groups. This included all vascular plant and invertebrate taxa that were listed as Threatened or At Risk – Declining under the NZTCS as at 1 August 2022 (Table 1).

Table 1. Number of taxa assessed in each group of fauna and flora included in this study.

GROUP	NUMBER OF TAXA
Birds	**213**
Bats	**5**
Herpetofauna	**123**
Reptiles	120
Frogs	3
Terrestrial invertebrates	**243**
Spiders (Araneae)	5
Beetles (Coleoptera)	40
Butterflies and moths (Lepidoptera)	77
Wētā and grasshoppers (Orthoptera)	23
Land snails	
Architaenioglossa	12
Basommatophora	1
Stylommatophora	85
Vascular plants	**561**
Total	**1,145**

2.2 Definitions and scope

At the time of writing, the Threatened umbrella category under the NZTCS included the conservation statuses Nationally Critical, Nationally Endangered, Nationally Vulnerable and Nationally Increasing; and the At Risk category included the conservation statuses Declining, Naturally Uncommon, Relict and Recovering. We considered all Threatened and At Risk – Declining taxa (collectively referred to as 'threatened' taxa in this report) to be threatened with extinction, unless action is taken to manage them. All data were derived from the NZTCS database on 1 August 2022. Consequently, they do not account for any updates, such as new assessment reports or changes to taxonomic names, since then.

Geographically, the assessments were limited to native taxa that occur on the main island groups of Aotearoa New Zealand and their immediate outlying islands, including Rangitāhua / Kermadec Islands, Te Ika-a-Māui / North Island, Te Waipounamu / South Island, Stewart Island / Rakiura, Wharekauri / Chatham Islands, and the subantarctic island groups Snares Islands / Tini Heke, Moutere Mahue / Antipodes Islands, Moutere Hauriri / Bounty Islands, Maungahuka / Auckland Islands and Motu Ihupuku / Campbell Islands. The assessments did not include dependent territories (Tokelau and Ross Dependency) or two associated states (the Cook Islands and Niue).

The assessments included taxa that were classified as both taxonomically determinate and taxonomically unresolved under the NZTCS. Taxonomically determinate taxa are defined as taxa that are 'legitimately and effectively published and generally accepted by relevant experts as distinct' (Townsend et al. 2008), while taxonomically unresolved taxa are those that have not yet been formally described or taxa that have been formally described and given a scientific name but their distinctiveness is under debate. All conservation statuses given to taxonomically unresolved taxa are provisional. We use the term 'taxon / taxa' to describe species, subspecies, varieties and formae throughout this report regardless of the taxonomic status. We use the term 'group of taxa' to describe the groupings used in the five different assessments (Table 1). It should be noted that the taxa were grouped based on some key similarities, so taxa within a group may not be in the same taxonomic group – for example, frogs and reptiles are two distinct classes within the animal kingdom but share enough similar life history traits to be able to be assessed together for the purpose of a CCVA.

All the CCVAs were carried out based on what data and knowledge were readily available, and what was known about each taxon at the time of the assessment. For example, we assessed the exposure of taxa to the impacts of climate change by considering their current distributions, not their predicted future distributions; and when assessing sensitivity and low adaptive capacity, we only considered traits as they occur currently, not how they may or may not change in the future. It was also assumed that existing pressures will continue in the future – for example, we did not aim to predict what mitigation efforts under the Predator Free New Zealand 2050 programme[3] could achieve in the future.

2.3 Report structure

This report begins by describing the methods used to undertake the CCVAs. The key results of the CCVAs and a brief discussion for each assessed group are then provided. Case studies are used throughout the report to highlight vulnerable taxa and different climate change issues. The discussion outlines the key insights from the results, as well as caveats and limitations of the CCVAs. Finally, recommendations for future CCVAs of threatened taxa in Aotearoa New Zealand are provided.

3 www.doc.govt.nz/pf2050

3. Methods

3.1 Overview of the assessment framework

A trait-based CCVA system developed by Foden et al. (2013) was used in this study. This was originally developed as a rapid assessment framework to identify the world's most vulnerable bird, amphibian and coral species to climate change (Foden et al. 2013), but has since been established and widely used globally (Carr et al. 2014; Böhm et al. 2016; Harper et al. 2022; Vaz-Canosa et al. 2022).

The vulnerability of each taxon was assessed by subject matter experts against 16 vulnerability traits, including 7 traits that described potential sensitivity to climate change, 4 traits that described low adaptive capacity and 5 traits that described projected exposure to climate change conditions (see Tables 2–4 in sections 3.3–3.5). The following definitions were used, taken from Foden et al. (2013):

1. **Sensitivity:** 'The lack of potential for a species to persist *in situ*.'
2. **Low adaptive capacity:** 'A species' inability to avoid the negative impacts of climate change through dispersal and/or micro-evolutionary change.'
3. **Exposure:** 'The extent to which each species' physical environment will change.'

Values were attributed to each trait by the subject matter experts (see Tables 2–4 for definitions), and the data were then categorised as either 'higher vulnerability', 'lower vulnerability' or 'unknown vulnerability' based on pre-defined descriptions of the traits and thresholds. Some CCVA traits were adapted so that they were better suited to Aotearoa New Zealand's conditions, while others were modified where the datasets and models used by Foden et al. (2013) were not readily available and would have required significant modelling to reproduce. The attributes of each taxon were then analysed and categorised, and descriptive statistics were derived for the three dimensions (sensitivity, low adaptive capacity, exposure) and climate change vulnerability categories used by Foden et al. (2013) (see section 3.6 Analysis).

Initially, the modified framework and method was tested on birds before expanding the assessments to other groups of taxa, as birds had the best quality data and publicly available databases in Aotearoa New Zealand. Also, Foden et al.'s (2013) framework was used for birds, so it required less modification than for other groups, making this a logical place to start. Although Foden et al.'s (2013) CCVA included birds of Aotearoa New Zealand, it was felt that the assessments could be improved by utilising national databases, local expertise and the latest available climate projections developed for Aotearoa New Zealand.

Foden et al.'s (2013) analysis of birds and amphibians included 58 fewer taxa and had several limitations for the Aotearoa New Zealand context. Firstly, because they made global assessments, the assessments for widespread species were generalised across the species' ranges. For example, the kōtuku / white heron (*Ardea modesta*) is secure overseas with low vulnerability to climate change but is classified as Threatened – Nationally Critical under the NZTCS and considered a taonga to iwi in Aotearoa New Zealand. Foden et al.'s (2013) analysis also included numerous 'unknown' assessments for species that are well studied in Aotearoa New Zealand, which biased their conclusions towards species with lower vulnerability using their scoring system. In addition, some Aotearoa New Zealand taxa were missing, and others used older taxonomies, meaning that the pool of species used by Foden et al. (2013) was smaller. For example, eight kiwi taxa are now recognised compared with the four assessed by Foden et al. (2013), and two amphibian taxa have now been combined. Additionally, Foden et al. (2013) did not include subspecies in their assessment, but in Aotearoa

New Zealand, numerous subspecies are at risk of decline and extinction in the long term. Therefore, the inclusion of subspecies was considered important for the current assessments as climate change projections vary geographically, meaning that some subspecies will likely be highly vulnerable to climate change while others will not.

3.2 Expert elicitation process for conducting the CCVAs

Expert elicitation was used to assess all 16 vulnerability traits for each taxon. Expert elicitation is commonly used in conservation science due to a lack of published data (Martin et al. 2012) and was considered necessary for the Aotearoa New Zealand context because data are lacking on most traits for the majority of taxa in the published literature. Likewise, distribution maps and predictive models describing potential climate change vulnerabilities were unavailable in the literature for most taxa. Expert elicitation was also used to refine the assessment system for each group. Best practices (as described in Martin et al. [2012]) were followed in our expert elicitation process by providing the experts with training and support required for the job, recording all steps in the process, and reviewing and adjusting the approach as needed.

A separate CCVA was conducted for each group of taxa (Table 1), but the expert elicitation process for each group consisted of four key steps:

1. **Initial planning to develop draft definitions and thresholds for traits**

   Each group of taxa was assigned a lead, who was a subject matter expert for that group and could therefore ensure consistency within the assessment. The lead worked with the overall project lead to develop a draft set of trait definitions specific to the group based on Foden et al.'s (2013) methods (using the definitions and thresholds provided in Foden et al. [2013, supporting information S1]). As part of this process, the traits for which quantitative data were available, where they were available and where expert judgement would be used in lieu of published data were identified.

   The traits and trait definitions from the bird CCVA were used as a baseline for the other groups, but the thresholds were refined to assign higher or lower trait vulnerability scores where necessary. Thresholds in CCVAs are used to transform data entries to 'higher vulnerability' or 'lower vulnerability' scores in the analysis stage. As is often the case in CCVAs, Foden et al. (2013) used a '25% method' for most of their quantitative data, which means that the 25% of taxa with the highest or lowest data values (depending on the trait being assessed and whether high or low data values reflected vulnerability to climate change) were scored as being of high vulnerability. While this is an arbitrary threshold, there is some evidence that the 25% threshold captures genuine effects (Hossain et al. 2019). For birds, the thresholds were determined following some of the guidelines set in Foden et al. (2013). For the non-avian taxa, ecologically meaningful thresholds were set based on subject matter experts' knowledge of their general ecology and life histories.

2. **Workshops to finalise the assessment system**

   Two workshops were conducted with the subject matter experts of each group of taxa to collectively refine (Day 1) and test (Day 2) the assessment system. Before the workshops, all experts were emailed the workshop materials, which included the draft assessment system (provided as an Excel worksheet, with the draft definitions provided in a PowerPoint slide) and the report by Foden et al. (2013) that provided the framework.

3. **Assessment and review period**

Following the workshops, each taxon was assigned to an expert for assessment. Generally, this was the person who was considered to have the most up-to-date knowledge of the taxon. All assessments were completed independently within an agreed period on a shared scoring sheet (see Online Supplementary Information[4]).

Once the assessor had completed the assessment, another expert reviewed it. The reviewer did not have to be an expert on that taxon, but they did need to have a good understanding of the group of taxa in general. If the reviewer disputed an assessment, they would make comments and queries on the data entries they had feedback on. The assessor and reviewer then discussed, documented and resolved the differences, at which point the assessment of that taxon was considered finalised.

During the assessment period, weekly online drop-in sessions were run, where experts could call in to ask questions and discuss their assessments with the wider team. Feedback obtained during these weekly sessions allowed us to collectively improve the assessment system during the process – for example, by clarifying definitions, making the scoring sheet more intuitive to use and providing more instructions.

4. **Post-assessment**

After the assessment period had ended, additional workshops were run to identify lessons learned and receive feedback on all aspects of the process. Any suggestions for improvement were either implemented immediately or recorded and used to create internal CCVA guidelines to assist with future assessment work.

Once the initial data analysis had been completed, the outputs were shared and discussed with the expert group so that key messages could be workshopped. The aim was to identify and agree on key vulnerability factors for the group of taxa, data gaps and limitations of the study.

[4] www.doc.govt.nz/science-for-conservation-343

3.3 Assessing sensitivity traits

For all groups of taxa, seven traits belonging to four trait types related to the sensitivity dimension were assessed (Table 2). Each trait was described in a narrative and attributed a range of pre-defined values and thresholds that indicated 'higher vulnerability', 'lower vulnerability' or 'unknown vulnerability'. The basic assumptions underlying the inclusion of a trait were the same for each group, but the exact definitions, thresholds and data sources varied (see below).

Table 2. Trait types and traits included in the climate change vulnerability assessments (CCVAs) under the vulnerability dimension 'sensitivity'.

TRAIT TYPE	TRAIT	ASSUMPTION
Specialised habitat and / or microhabitat requirements	1. Habitat specialisation	Generalist taxa are likely to be more resilient to climate change because they will have a wider range of habitat options available to them.
	2. Dependence on a particular microhabitat or single location	Taxa that are confined to, and reliant on, small or specific areas or microhabitat types are more vulnerable to extinction because they are less adaptable or more vulnerable to one-off stochastic events.
Narrow environmental tolerances or thresholds that are likely to be exceeded due to climate change at any stage in the life cycle	3. Narrow temperature tolerance	Taxa with physiological tolerances or limits that are tightly coupled to specific environmental temperatures are likely to be particularly sensitive to climate change.
	4. Narrow precipitation tolerance	Taxa with physiological tolerances or limits that are tightly coupled to specific environmental precipitation levels are likely to be particularly sensitive to climate change.
Dependence on interspecific interactions that have the potential to be disrupted by climate change	5. Interactions with other taxa	Taxa that are dependent on functional interspecific interactions are likely to be more vulnerable to climate change if the interaction, contributing taxon or process cannot be substituted by another.
Rarity	6. Small population size	Taxa with small populations are inherently more vulnerable to extinction because of inbreeding depression, genetic bottlenecks, catastrophic events and a reduced capacity to recover quickly. This suggests that many rare taxa will face greater impacts from climate change than more common and / or widespread taxa.
	7. Small population size and heightened sensitivity to threatening processes	Taxa with fragmented subpopulations and / or some behavioural or physiological traits that are specific to a small population size are more vulnerable to climate change or processes exacerbated by climate change.

Trait 1: Habitat specialisation

Habitat specialisation was assessed based on the number of primary habitats that are of major importance for the taxon.[5] Primary habitats are defined as (1) the habitat(s) in which the taxon occurs regularly or (2) any habitat that is important for the survival of the taxon because it has an absolute requirement for the habitat at some point in its life cycle (e.g. for germination, breeding or overwintering). Any other habitat where the taxon occurs irregularly or infrequently, as a vagrant, or as only a small proportion of all individuals was not considered primary habitat.

For all groups except birds, the threshold for 'higher vulnerability' for this trait was if a taxon used just one primary habitat. Thus, any taxon that used two or more habitats was assigned the 'lower vulnerability' score, while the 'unknown vulnerability' score was assigned if this information was not known. For birds, the threshold for 'higher vulnerability' was if a taxon used two primary habitats in acknowledgement of the fact that the bird fauna is dominated by seabirds, which are equally dependent on their terrestrial breeding habitats and marine foraging habitats.

[5] This assessment was based on the 18 habitats listed in the IUCN Habitat Classification Scheme (version 3.1, 2012): www.iucnredlist.org/resources/habitat-classification-scheme.

Trait 2: Dependence on a particular microhabitat or single location

Microhabitat dependency was defined as occurring where a taxon is:

- restricted to a specific limited or patchy habitat type within a more extensive primary habitat (e.g. salt pan areas within wider grassland habitat);
- found in only a small proportion of what may be a more extensive habitat;
- found at a single location even if the habitat is present in other locations; or
- confined to the rarest and most restricted threatened ecosystem types (< 10,000 ha; Holdaway et al. 2012) (e.g. karst or ultramafic habitats).

This trait could apply to (but was not restricted to) taxa with a One Location (OL) qualifier under the NZTCS, which is applied to taxa that occupy one geographically or ecologically distinct area of less than 1,000 km^2 (100,000 ha) (Townsend et al. 2008). Single locations can be severely impacted by one-off events (e.g. predator irruptions or fire) that could easily affect all individuals in the population. In the Aotearoa New Zealand context, an invertebrate example is the Cromwell chafer beetle (*Prodontria lewisi*), which is now dependent on a single, small, protected reserve. This also applies to Lepidoptera with flightless females that occupy isolated sections of coastal dune or turf habitat, which include the Chrystalls Beach boulder copper butterfly (*Lycaena* sp. "Chrystalls Beach") and Foveaux looper moth (*Asaphodes frivola*).

For all groups, the threshold for 'higher vulnerability' for this trait was if a taxon scored a 'yes' for any of the dependencies listed above.

Traits 3 and 4: Narrow temperature tolerance and narrow precipitation tolerance

If projected changes in temperature or precipitation are likely to exceed physiological thresholds in at least one life stage for a taxon, the taxon was scored as having narrow tolerance, but if a taxon is likely to remain within physiological thresholds, it was scored as having medium or broad tolerance. Taxa with medium–broad tolerances still may incur some stress or become inactive during limiting conditions – for example, taxa that use torpor or dormancy to avoid hot / dry conditions, such as bats (McNab and O'Donnell 2018). Broad-tolerance taxa will thermoregulate when temperature thresholds are exceeded (e.g. taxa that are active in very cold climates and taxa with very broad thermal ranges). Only a handful of taxa have published studies on their physiological limits – for example, sex in tuatara is determined by incubation temperature, with higher temperatures causing a male bias (Mitchell et al. 2010). Therefore, for most taxa, the assessment was inferred from their known distribution and / or assumed climatic requirements.

For all groups, the threshold for 'higher vulnerability' for these two traits was if a taxon scored narrow tolerance.

Trait 5: Interactions with other taxa

Taxa are likely to be particularly sensitive to climate change if they are highly dependent on one or only a few specific resource taxa and are unlikely to be able to substitute these for other taxa – for example, plant taxa that are dependent on pollinators or seed dispersers that will be affected by climate change; *Corybas* orchids with their fungus gnat pollinators; *Peraxilla* mistletoes and their specific avian pollinators and seed dispersers; and parasitic invertebrates (including plant and animal parasitoids, ticks and lice) or host-specific herbivores or fungivores that feed on / in one species or genus. This trait did not include any negative interactions, such as interactions with invasive species (e.g. where invasive species are predators of, or compete with, the taxon being assessed) or how these may be impacted in the future. The trait captured current known dependencies that, if threatened, could directly affect survival of the taxon.

For all groups, the threshold for 'higher vulnerability' for this trait was if a taxon scored a 'yes' because it was dependent on another taxon for a particular functional interspecific interaction.

Trait 6: Small population size

The threshold for 'higher vulnerability' for small population size was set at ≤ 5,000 mature individuals or an area of occupancy of < 100 ha.[6] This aligns with the NZTCS, where taxa with these criteria are assigned to the Threatened umbrella category, reflecting their higher threat of extinction. The NZTCS sometimes gives a range for the population size rather than a specific estimate. Where this was the case, a precautionary principle was followed whereby the lower population estimate was used for all groups of taxa (e.g. a population range of 5,000–20,000 mature individuals was scored as the lower estimate of 5,000).

Trait 7: Small population size and heightened sensitivity to threatening processes

This trait acknowledges that some taxa with slightly larger population sizes than are used as a threshold for trait 6 can have additional behavioural or ecological traits that make them vulnerable to climate change. These vulnerabilities varied among groups, but the threshold for a 'higher vulnerability' score for this trait was if a taxon had ≤ 20,000 mature individuals or an area of occupancy of ≤ 1,000 ha in Aotearoa New Zealand AND scored a 'yes' for any of the following specific behaviours or features that increase their vulnerability:

- Small, fragmented subpopulations that have disrupted metapopulation dynamics (e.g. the robust grasshopper [*Brachaspis robustus*], Archey's frog [*Leiopelma archeyi*]).
- Skewed sex ratios (male to female ratio of ≤ 0.4 or ≥ 0.6), such as where one sex has become less common as a result of selective predation pressure.
- Emergence or breeding systems that require a high level of synchrony driven by environmental conditions (e.g. polygynous or polyandrous breeding systems; monocarpy such as in *Gentianella magnifica*; protogynous or protandrous breeding systems as displayed in Asteraceae; and dioecy as seen in *Coprosma wallii*).
- Declining and extremely fluctuating populations (> 10-fold fluctuations) (e.g. *Lepidium* spp.).
- Breeding systems where individuals congregate at particular sites and then disperse over a wide area.
- Cooperative, lekking or colonial breeding systems where individuals regularly or seasonally congregate at particular sites and then disperse over a wide area (e.g. lekking in lesser short-tailed bats [*Mystacina tuberculata*]; Toth et al. 2015).
- Higher adult mortality due to behavioural or physiological traits making adults more vulnerable to predation (e.g. the use of torpor in Aotearoa New Zealand bats means they cannot retreat from introduced mammalian predators; McGregor's skinks [*Oligosoma macgregori*] can only retreat to mouse-sized holes or larger because of their large body size).
- Taxa that congregate during migration or the non-breeding season (e.g. migratory birds at staging points and wintering sites) – at least 1% of the global population must be found at one or more sites to qualify.

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6 For many cryptic taxa, population size is unknown so the area of occupancy is used instead.

3.4 Assessing low adaptive capacity traits

For all groups of taxa, four traits belonging to two trait types related to the low adaptive capacity dimension were assessed (Table 3).

Table 3. Trait types and traits included in the climate change vulnerability assessments (CCVAs) under the vulnerability dimension 'low adaptive capacity'.

TRAIT TYPE	TRAIT	ASSUMPTION
Poor dispersibility	8. Limitations to dispersal	Limited dispersal ability due to intrinsic or extrinsic barriers will affect a taxon's ability to shift to alternative habitats if its current range becomes unsuitable, so it is unlikely to be able to keep up with a shifting climate in its local environment.
Poor evolvability	9. Low genetic diversity	Taxa with low genetic diversity generally have a reduced adaptability to new climatic conditions and a higher probability of extinction through inbreeding depression.
	10. Slow turnover of generations	Taxa with longer generation times have less potential to express evolutionary changes and adaptation at a population level.
	11. Low reproductive capacity	Taxa with low productivity have reduced opportunities for adaptation because fewer young are produced.

Trait 8: Limitations to dispersal

This trait was assessed by looking at whether a taxon had low dispersal rates due to intrinsic and / or extrinsic barriers. Intrinsic barriers include behavioural traits such as very high site fidelity. Extrinsic barriers may be geographic features such as unsuitable elevations (e.g. taxa confined to mountain ranges), oceans (e.g. for taxa on small islands), rivers or other impassable habitat types (e.g. open habitats, vegetated habitats, modified habitats such as roads / pasture / dams). Taxa with low adaptive capacity include (1) taxa in which at least one sex has poor mobility, limiting the ability to cross inhospitable habitats such as fragmented landscapes; and (2) island endemics with an inability to move between climate-vulnerable islands because the sea is a barrier.

For all groups, the threshold for 'higher vulnerability' for this trait was if a taxon scored a 'yes' for having an extrinsic or intrinsic barrier to dispersal.

Trait 9: Low genetic diversity

A taxon's potential to adapt is, at least in part, related to the genetic variation within the population. Low genetic diversity within a taxon can result from recent bottlenecks in population numbers and generally leads to lower levels of both phenotypic and genotypic variation. As a result, such taxa tend to have fewer novel characteristics that could facilitate adaptation to new climatic conditions. Relatively little has been published on the genetic diversity or relative diversity of taxa in Aotearoa New Zealand (e.g. Briskie and Mackintosh 2004; Gemmell et al. 2020), so the extent of the taxon's known range / population that had gone through a bottleneck was considered when assigning vulnerability. If only a small proportion of the population had been through a bottleneck, the taxon was considered to have 'lower vulnerability' (e.g. island-translocated wētā compared with the mainland source population). Many Aotearoa New Zealand plant genera, particularly recently evolved alpine taxa, have minimal genetic diversity but high phenotypic diversity. Similarly, polyploidy is common in the Aotearoa New Zealand flora, and taxa with polyploidy may be buffered against the impact of genetic bottlenecks because they have access to multiple copies of genes. Plant taxa that are predominantly clonal are assessed under this trait, as these are assumed to have lower genetic diversity.

For all groups, the threshold for 'higher vulnerability' for this trait was if a taxon scored a 'yes' for having low genetic diversity.

Trait 10: Slow turnover of generations

Evidence suggests that evolutionary adaptation is possible in relatively short time frames (e.g. 5 to 30 generations). For most taxa with long generation lengths, such as many perennial plants, the generation time is likely to be too slow to have any serious minimising effect on climate change impacts. In these assessments, estimated generation times were used where available – for example, for most bird taxa, longevity data were obtained from the New Zealand Bird Banding Database or the estimates of Bird et al. (2020). Otherwise, slow maturation rates were used as a proxy.

The threshold for a slow turnover of generations (generation times) varied among groups of taxa. For birds and bats, the threshold for 'higher vulnerability' was a generation time ≥ 6 years (following Foden et al. [2013] for birds). By contrast, the threshold for plants was a slow maturation rate or a generation length ≥ 5 years, the threshold for herpetofauna was a generation length ≥ 8 years (based on the definition from Townsend et al. [2008]) and the threshold for invertebrates was a slow maturation rate or a generation length > 1 year.

Trait 11: Low reproductive capacity

Low productivity has consequences for adaptability because fewer young are produced, further reducing the potential for genetic adaptation (e.g. due to a reduced rate at which advantageous novel genotypes can accumulate in the population or taxon).

Low reproductive capacity was scored as 'yes', 'no' or 'unknown' against explicit thresholds. The thresholds varied among groups of taxa because reproductive strategies and fecundity rates vary dramatically among groups.

For birds and bats, the threshold for 'higher vulnerability' was defined as taxa that produce low numbers of young or have a low number of breeding events per season (mean clutch size ≤ 2 or number of broods / year ≤ 1). This was an arbitrary threshold, representing the c. 25% of taxa with the lowest productivity (Foden et al. 2013).

For plants, the threshold for 'higher vulnerability' was defined as taxa with low seed production (< 1,000 seeds per adult plant or patch in cases where discrete individuals cannot be resolved) over a 5-year period. Experts needed to take account of non-seeding males in dioecious species, which equates to < 2,000 seeds for each female if the sex ratio is 50:50. The number of propagules produced over 5 years will account for factors like dormancy (e.g. fish-guts plant [*Chenopodium detestans*]) and masting (e.g. beech trees [Nothofagaceae]).

For herpetofauna, the threshold for 'higher vulnerability' was defined as taxa that produce a low number of offspring relative to other members of the same family (≤ 4 offspring / cycle).

For invertebrates, the threshold for 'higher vulnerability' was defined qualitatively as taxa that produce low number of eggs relative to comparable taxa (e.g. a beetle that lays only a few individual eggs compared with one that lays multiple batches of eggs over a season).

3.5 Assessing exposure traits

For all groups of taxa, five traits belonging to three trait types related to the exposure dimension were assessed (Table 4).

Table 4. Trait types and traits included in the climate change vulnerability assessments (CCVAs) under the vulnerability dimension 'exposure'.

TRAIT TYPE	TRAIT	ASSUMPTION
Sea level rise	12. Exposure to sea level inundation and increased storm surges	Taxa that mainly occur in inundation- or storm-surge-exposed coastal habitats during one or more critical seasons or life stages will be impacted by climate change.
Changes in temperature	13. Extent of distributional range exposed to changes in temperature (under two emissions scenarios and two time frames: RCP4.5 mid-century, RCP4.5 late century, RCP8.5 mid-century, RCP8.5 late century)	Taxa will be impacted if they are exposed to significant increases / decreases in mean temperature across >75% of their distributional range during one or more critical seasons or life stages.
	14. Extent of distributional range exposed to temperature extremes (under two emissions scenarios and two time frames)	Taxa will be impacted if they are exposed to significant increases in the frequency, duration or intensity of temperature extremes (cold or hot) across >75% of their distributional range during one or more critical seasons or life stages.
Changes in precipitation	15. Extent of distributional range exposed to changes in precipitation (under two emissions scenarios and two time frames)	Taxa will be impacted if they are exposed to significant changes in annual mean rainfall or snowfall across >75% of their distributional range during one or more critical seasons or life stages.
	16. Extent of distributional range exposed to precipitation extremes (under two emissions scenarios and two time frames)	Taxa will be impacted if they are exposed to precipitation extremes across >75% of their distributional range during one or more critical seasons or life stages.

Trait 12: Exposure to sea level inundation and increased storm surges

Research has shown that the sea level around Aotearoa New Zealand will rise by 5–10% more than the global average rise projected by the IPCC (Ackerley et al. 2013; Kopp et al. 2014). Areas within Aotearoa New Zealand will also be affected differently by vertical land movement and local changes in tides (e.g. estuaries and tidal streams), which need to be factored into thinking about potential impacts, as it is the local sea level rise relative to the landmass that needs to be adapted to, not just the rise in ocean levels. However, there has been little mapping of potential impacts on the habitats of flora and fauna in Aotearoa New Zealand (but see Tait and Pearce 2019). Therefore, in the current assessments, the presence / absence of taxa in habitat types predicted to be influenced by sea level inundation and increased storm surges was used to score exposure (yes / no), using the sub-categories of the IUCN habitat classifications 12 Marine Intertidal and 13 Marine Coastal / Supratidal (see trait 1).

If a taxon's major habitat types include habitats that are vulnerable to inundation (mangroves, intertidal salt marshes, coastal fresh water, brackish or saline lakes and lagoons, marine lakes, coastal caves, intertidal shorelines, some sea cliffs, some coastal turfs, low-lying rocky offshore islands, or coastal sand dunes) for any critical parts of the taxon's life cycle, it was classified as having 'higher vulnerability'. Note that exposure to conditions that may cause flooding is addressed under traits 15 and 16.

Trait 13: Extent of distributional range exposed to changes in temperature

Experts assessed the exposure of a taxon by comparing its current known distribution with the mapped projected changes in mean temperature (https://ofcnz.niwa.co.nz/#/nationalMaps).

If more than 75% of the taxon's range was estimated to be exposed (yes / no), the 'higher vulnerability' score was triggered for the exposure trait. Taxa that are restricted to islands for which there are no temperature projections were scored as 'unknown vulnerability' unless there were projections for nearby landmasses. Projections from the closest mainland point were frequently used – for example, for Manawatāwhi / Three Kings Islands, the experts utilised projections for the Far North, and for the subantarctic islands, information was inferred from projections developed for the Campbell Islands (Macara and Gibson 2025). The information adequacy score (see section 3.6 Analysis) was generally considered 'low' whenever there were no climate change projections for a particular area and so information needed to be inferred from another (similar) location with projections.

For birds and bats, 'substantial' changes in mean temperature were defined as > 2.5°C (an arbitrary threshold representing the mean temperature change for c. 25% of taxa with the greatest projected changes; Foden et al. 2013). The ranges of birds include major at-sea foraging areas, so this trait included areas with projected sea surface temperature increases (> 2.5°C) where these could be derived from the literature. For the other groups of taxa, 'substantial' changes were defined as > 1.5°C. This was based on (1) an expectation that these groups are more sensitive to temperature increases than birds, and (2) published literature showing that range shifts and local extinctions have already occurred in the Northern Hemisphere over the past century in response to temperature increases as little as 0.8°C (e.g. Parmesan et al. 1999).

Representative concentration pathways (RCPs) are used to identify different future climate scenarios based on trajectories of greenhouse gas concentrations. RCP4.5 is a moderate emissions scenario where greenhouse gas concentrations keep increasing until mid-century and then plateau due to global greenhouse gas mitigation efforts. RCP8.5 is considered a high emissions scenario, where it is assumed that there are no further policies in place to curb greenhouse gas emissions and greenhouse gas concentrations keep increasing on the current trajectory. Compared with pre-industrial times (1850–1900), the global surface temperature change for the end of the 21st century (2090) is projected to exceed 1.5°C under RCP4.5 and 2°C under RCP8.5 (IPCC 2013).

It is best practice to use at least two climate scenarios in CCVAs, always including a high emissions scenario and a scenario that represents a low or moderate emissions future (Foden and Young 2016). Therefore, for this trait and traits 14–16, two emissions scenarios (RCP 4.5 and RCP8.5) and two time frames (mid-century [2040] and late century [2090]) were considered, and assessments of potential vulnerability were made for each combination (RCP4.5 mid-century, RCP4.5 late century, RCP8.5 mid-century, RCP8.5 late century). Both time frames compared average projected changes to the historical data from 1986 to 2005. Six-model-averages of Global Climate Models from the IPCC Fifth Assessment Report (IPCC 2013) were downscaled to Aotearoa New Zealand by NIWA (MfE 2018). The latest downscaled climate projections for Aotearoa New Zealand based on the IPCC's Sixth Assessment Report (IPCC 2021) were released in 2024,[7] with further updates that include the very high emissions Shared Socioeconomic Pathway 5–8.5 (SSP5-8.5) due to be released in 2025.

Assessing the exposure of taxa to climate change impacts by conducting spatial analysis was out of scope for this project, as most of the assessed taxa did not have existing, up-to-date occurrence records readily available for spatial analysis. Due to the large number of taxa assessed (1,145) and resource limitations, it was not realistic to complete the distribution mapping first. To estimate the accuracy of our method, spatial analysis was undertaken for two climate traits (*13: Extent of distributional range exposed to changes in temperature* and *15: Extent of distributional range exposed to changes in precipitation*) for herpetofauna and the outputs were compared with the results of the expert assessment method. Spatial occurrence records had already been created for most of the taxa in this group

[7] https://environment.govt.nz/facts-and-science/climate-change/climate-change-projections/; https://niwa.co.nz/climate-and-weather/climate-change-scenarios-new-zealand

(van Winkle et al. 2018), making this task feasible. For the spatial analysis, the occurrence records were overlapped with climate change projections to identify taxa for which a predicted increase of >1.5°C or a ±15% change in precipitation was predicted across >75% of their range. The spatial analysis was conducted for projections in all seasons, for RCP4.5 and RCP8.5, and for the mid- and late century. The results of the spatial analysis were very similar to the expert assessment method, but in 16 cases it was determined that the expert assessment method was more accurate because of more up-to-date knowledge being available on current distributions.

Trait 14: Extent of distributional range exposed to temperature extremes

The greatest effects of climate change are likely to be first experienced as changes in extremes rather than changes in mean conditions. A variety of NIWA predictions were used to qualitatively evaluate 'substantial' projected increases in the frequency, duration or intensity of temperature extremes (cold or hot) across >75% of a taxon's range during one or more critical seasons in its life cycle. Aotearoa New Zealand models express extremes as increases in the number of hot days (exceeding 25°C) or frost days (0°C or colder). For example, Northland is predicted to have a considerable increase of 40–90 hot days by 2090 under RCP8.5. Assessments of potential vulnerability were made for each emissions scenario and time frame described under trait 13 (i.e. RCP4.5 mid-century, RCP4.5 late century, RCP8.5 mid-century, RCP8.5 late century).

Trait 15: Extent of distributional range exposed to changes in precipitation

Changes in the amount of precipitation in Aotearoa New Zealand are predicted to exhibit both positive and negative trends depending on the region. Aotearoa New Zealand models express these as percentage increases (e.g. West Coast) or decreases (e.g. Northland) in annual rainfall. Predicted reductions in snowfall[8] are likely to directly influence alpine taxa and indirectly affect taxa downstream because of changes in the pattern of snowmelt. Taxa were scored as having 'higher vulnerability' if they were predicted to be exposed to substantial (±15%) changes in annual mean rainfall or snowfall over >75% of their distributional range. Experts assessed the exposure of a taxon by comparing its current known distribution with the mapped projected changes in precipitation (https://ofcnz.niwa.co.nz/#/nationalMaps). If more than 75% of the taxon's range was estimated to be exposed, the 'higher vulnerability' score was triggered for the exposure trait. Assessments of potential vulnerability were made for each emissions scenario and time frame described under trait 13 (i.e. RCP4.5 mid-century, RCP4.5 late century, RCP8.5 mid-century, RCP8.5 late century).

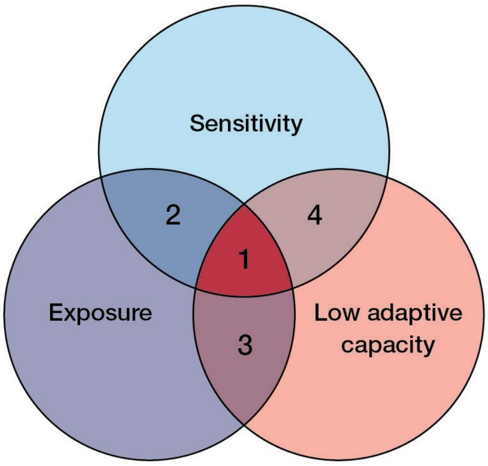
Trait 16: Extent of distributional range exposed to precipitation extremes

Substantial (extreme) increases or decreases in the duration and intensity of precipitation result in an increased frequency and magnitude of flooding and associated significant erosion and slip events at one extreme, and drought at the other. Extremes are likely to influence taxa more during critical life history stages or seasons. Taxa were scored as having 'higher vulnerability' if they were predicted to be exposed to substantial changes in precipitation over >75% of their distributional range. Aotearoa New Zealand models express the rainfall changes as 1-in-50-year rainfall events (%) and increases in the number of heavy rain (>25 mm) days. Drought results from an interaction between temperature and precipitation extremes, so consideration was given to the number of hot days (exceeding 25°C), the potential evapotranspiration deficit (mm) and the frequency of annual dry days (<1 mm rainfall). Consideration was also given to the scale of the variable, with the top and bottom 20–30% of the scale extremes being used to score 'higher vulnerability'. Assessments of potential vulnerability were made for each emissions scenario and time frame described under trait 13 (i.e. RCP4.5 mid-century, RCP4.5 late century, RCP8.5 mid-century, RCP8.5 late century).

8 Annual and seasonal snowfall projections for RCP4.5 and RCP8.5 were developed for DOC by NIWA. These were not published in the Ministry for the Environment's *Climate change projections for New Zealand* (MfE 2018).

3.6 Analysis

Taxa were classified into vulnerability categories following the method described in Foden et al. (2013). A taxon that had at least one trait above the pre-determined 'higher vulnerability' threshold triggered the 'higher vulnerability' score for that vulnerability dimension. For example, a record of '1 habitat' under sensitivity trait *1: Habitat specialisation* was transformed into a 'higher vulnerability' score based on the threshold, thus triggering H (higher vulnerability) for the sensitivity dimension. To qualify for being assessed as Highly Vulnerable to climate change, taxa needed to have at least one 'higher vulnerability' score in *all three vulnerability dimensions* (sensitivity, low adaptive capacity and exposure) (Fig. 2). The remaining taxa were considered lower vulnerability but could then be further categorised based on which vulnerability dimensions were triggered (Table 5). Management actions were then recommended for categories where at least two dimensions were triggered (Fig. 2).



1 Highly Vulnerable
At greatest risk
Specific research and/or interventions generally needed

2 Potential Adapters
May be at risk
Monitor and plan precautionary adaptive responses

3 Potential Persisters
May not be at risk
Monitor population trends as a precaution

4 Latent Risk
Not currently at risk
Monitor environmental variables and if predictions worsen, re-assess

Figure 2. Climate change vulnerability framework used in the analysis. Combinations of the three vulnerability dimensions were used to classify taxa into four risk groups with recommended management actions. These were (in order of decreasing level of risk): 1. Highly Vulnerable, 2. Potential Adapters, 3. Potential Persisters and 4. Latent Risk. Source: Adapted from Foden et al. (2013), licensed by the authors for reuse (CC BY 4.0).

Table 5. Vulnerability categories ordered from greatest to least concern. H = higher vulnerability triggered for the dimension, L = lower vulnerability triggered for the dimension. Source: Adapted from Foden et al. (2013), licensed by the authors for reuse (CC BY 4.0).

VULNERABILITY CATEGORY	SENSITIVITY	LOW ADAPTIVE CAPACITY	EXPOSURE
Highly Vulnerable	H	H	H
Potential Adapters	H	L	H
Potential Persisters	L	H	H
Latent Risk	H	H	L
Sensitive Only	H	L	L
Exposed Only	L	L	H
Low Adaptive Capacity Only	L	H	L
Low Vulnerability	L	L	L

This method provided a binary output for each taxon, whereby each taxon was classified as having either higher vulnerability (Highly Vulnerable) or lower vulnerability (all other categories). However, it was noted that if most taxa were placed in the Highly Vulnerable category, it may not be particularly useful for prioritisation (Harper et al. 2022). Therefore, the analysis was refined to improve the granularity of the Highly Vulnerable category to make it more appropriate for prioritisation purposes. To do this, an additive scoring method was used, following Harper et al. (2022), whereby all traits that were triggered for 'higher vulnerability' scored 3, while traits that were assigned as 'lower vulnerability' or 'unknown vulnerability' scored 0. The trait scores were then summed for each taxon in each group (except bats, which only included five taxa) and divided by the total number of traits (16). This allowed a quantile value to be assigned to each taxon classified as Highly Vulnerable based on the additive score: 1 = additive score is in the lower quartile; 2 = additive score is in the 2nd quartile; 3 = additive score is in the 3rd quartile; 4 = additive score is in the upper quartile. If two or more taxa had the exact same score, and these ended up in different quantiles due to an arbitrary split in the analysis, the taxon in the lower quantile was moved into the higher quantile. The quantiles were then re-named for prioritisation purposes as follows:

4 = Priority 1
3 = Priority 2
2 = Priority 3
1 = Priority 4

For each trait assessed, experts scored the quality of the information using information adequacy categories (Table 6). Each information adequacy category was assigned a score from 0 to 3 to allow an overall confidence score to be calculated for each taxon. The maximum overall confidence score was 16 traits × 3 (max. score) = 48.

Table 6. Information adequacy categories and their definitions and scores.

INFORMATION ADEQUACY CATEGORY	DEFINITION	CONFIDENCE SCORE
Unknown	There were no data available to help predict how this trait might influence vulnerability (trait scored as 'unknown vulnerability')	0
Low	There were few data or little relevant ecological knowledge available to predict how this trait might influence vulnerability	1
Medium	There were some good quality data available but with knowledge gaps, limiting predictions of how this trait might influence vulnerability	2
High	There were good quality data and a good understanding of the taxon's ecology available to predict how this trait might influence vulnerability	3

Following Foden et al.'s (2013) method, two imputations were used to deal with 'unknown vulnerability' data entries:

- **Optimistic assessment method:** all unknown data were replaced with 'lower vulnerability' scores.
- **Pessimistic assessment method:** all unknown data were replaced with 'higher vulnerability' scores.

To identify the most vulnerable taxa, the list was limited to those taxa that were classified as Highly Vulnerable under the RCP8.5 emissions scenario in the near future (mid-century) using the optimistic assessment. The RCP8.5 scenario was chosen over RCP4.5 because, based on the global climate change mitigation policies and actions currently in place, the world is on a trajectory to a median warming of 2.7°C above pre-industrial levels,[9] which is more plausible under the high-emission RCP8.5 scenario. The optimistic assessment method was used because with the pessimistic assessment method, many of the most vulnerable taxa were those with the greatest number of 'unknown' scores, lowering our certitude in the results. Overall confidence scores were also used to assess our level of confidence in the final list of most vulnerable taxa. Summary results using the optimistic and pessimistic assessment methods are provided in Appendices 1 and 2, respectively.

All analyses were performed using R Statistical Software (v4.2.3; R Core Team 2022). Venn diagrams were plotted with the ggvenn package (v0.1.10), and the tidyverse (v2.0.0), readxl (v1.4.2), writexl (v1.4.2) and rlang (v1.1.0) packages were also used.

[9] The predicted median warming is based on the nationally determined contributions (NDCs) of 191 countries that were in place as at 30 July 2021. NDCs are the efforts by the countries that are Parties to the Paris Agreement to reduce their national greenhouse gas emissions. These findings are detailed in the latest NDC synthesis report (UNFCCC 2021). See also https://climateactiontracker.org/global/cat-thermometer/.

4. Climate change vulnerability assessment of bats

All remaining Aotearoa New Zealand bat taxa, including the Threatened – Nationally Critical long-tailed bat (*Chalinolobus tuberculatus*) shown here, are likely to be vulnerable to climate change.
Photo: Colin O'Donnell

4.1 Introduction

We conducted a CCVA for all five recognised indigenous bat taxa in Aotearoa New Zealand. According to the latest NZTCS assessment at the time of writing (O'Donnell et al. 2023), two (40%) of these taxa were classified as Threatened, one (20%) as At Risk – Declining, one (20%) as At Risk – Recovering and one (20%) as Data Deficient.

4.2 Results

There were no differences in the overall numbers of Highly Vulnerable taxa between the optimistic and pessimistic assessment methods (Fig. 3). By mid-century, only the greater short-tailed bat (*Mystacina robusta*) was classified as Highly Vulnerable under both the moderate-emission RCP4.5 and high-emission RCP8.5 scenarios (Figs 3 and 4A), although the remaining taxa were classified as Latent Risk (Fig. 4A). However, by late century, the northern and southern lesser short-tailed bats (*M. tuberculata aupourica* and *M. t. tuberculata*, respectively) and the greater short-tailed bat were classified as Highly Vulnerable to climate change under the RCP4.5 scenario (Fig. 3), while all five taxa were classified as Highly Vulnerable under the RCP8.5 scenario (Figs 3 and 4B).

Experts recorded a high level of information adequacy in assessing almost all traits and all taxa of bats, with the exception of the Data Deficient greater short-tailed bat, which had the lowest overall confidence score (Table 7) and gaps in knowledge pertaining especially to adaptive capacity traits (Fig. 5). The trait that triggered 'higher vulnerability' most frequently was *7: Small population size and heightened sensitivity to threatening processes* (all five taxa) (Fig. 5).

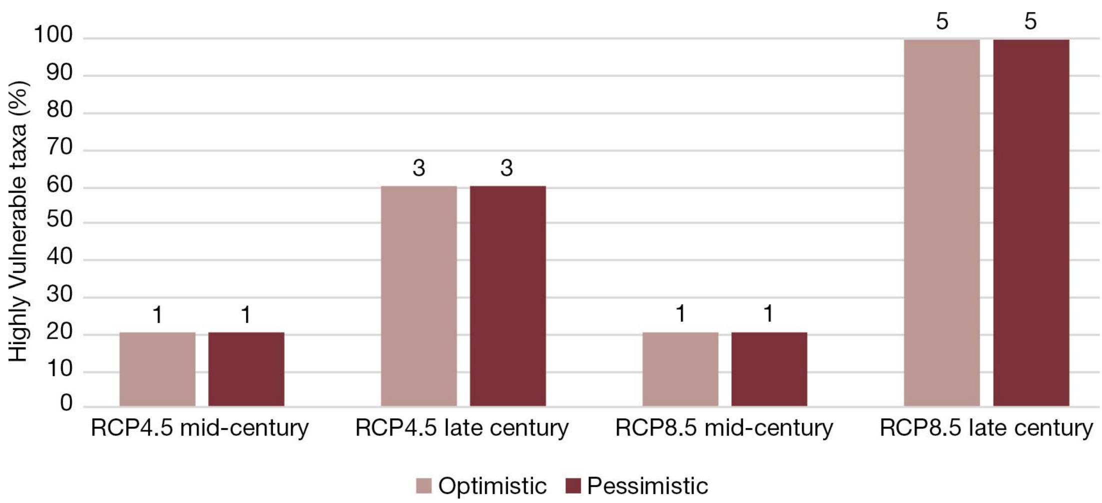


Figure 3. Percentages of bat taxa in Aotearoa New Zealand that were classified as Highly Vulnerable under each emissions scenario (RCP4.5 or RCP8.5), time frame (mid- or late century) and assessment method (optimistic or pessimistic). Trait values scored as 'unknown vulnerability' were replaced with 'lower vulnerability' for the optimistic assessment and 'higher vulnerability' for the pessimistic assessment. Thus, the optimistic assessment gives an estimate of the minimum number of Highly Vulnerable taxa, while the pessimistic assessment gives an estimate of the maximum number.

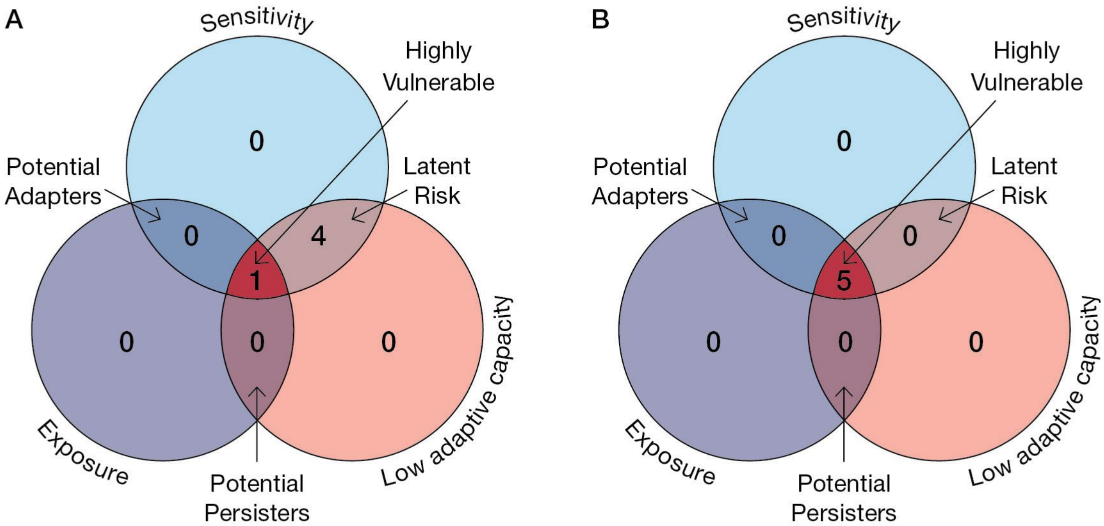


Figure 4. Number of bat taxa in Aotearoa New Zealand in each of the three climate change vulnerability dimensions (sensitivity, low adaptive capacity, exposure) and four climate change vulnerability categories (Highly Vulnerable, Potential Adapters, Potential Persisters and Latent Risk) by (A) mid-century and (B) late century under the RCP8.5 emissions scenario using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores).

Table 7. Confidence scores for the five bat taxa under the RCP8.5 emissions scenario by mid-century using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores). The higher the confidence score, the better the data used by experts to assess the taxon. Note that the scientific names of taxa were derived from the New Zealand Threat Classification System (NZTCS) database on 1 August 2022 and so do not account for any changes since then.

SCIENTIFIC NAME	COMMON NAME	CONFIDENCE SCORE (MAX. = 48)
Mystacina tuberculata rhyacobia	Central lesser short-tailed bat	43
Chalinolobus tuberculatus	Long-tailed bat	42
Mystacina tuberculata tuberculata	Southern lesser short-tailed bat	41
Mystacina tuberculata aupourica	Northern lesser short-tailed bat	39
Mystacina robusta	Greater short-tailed bat	24

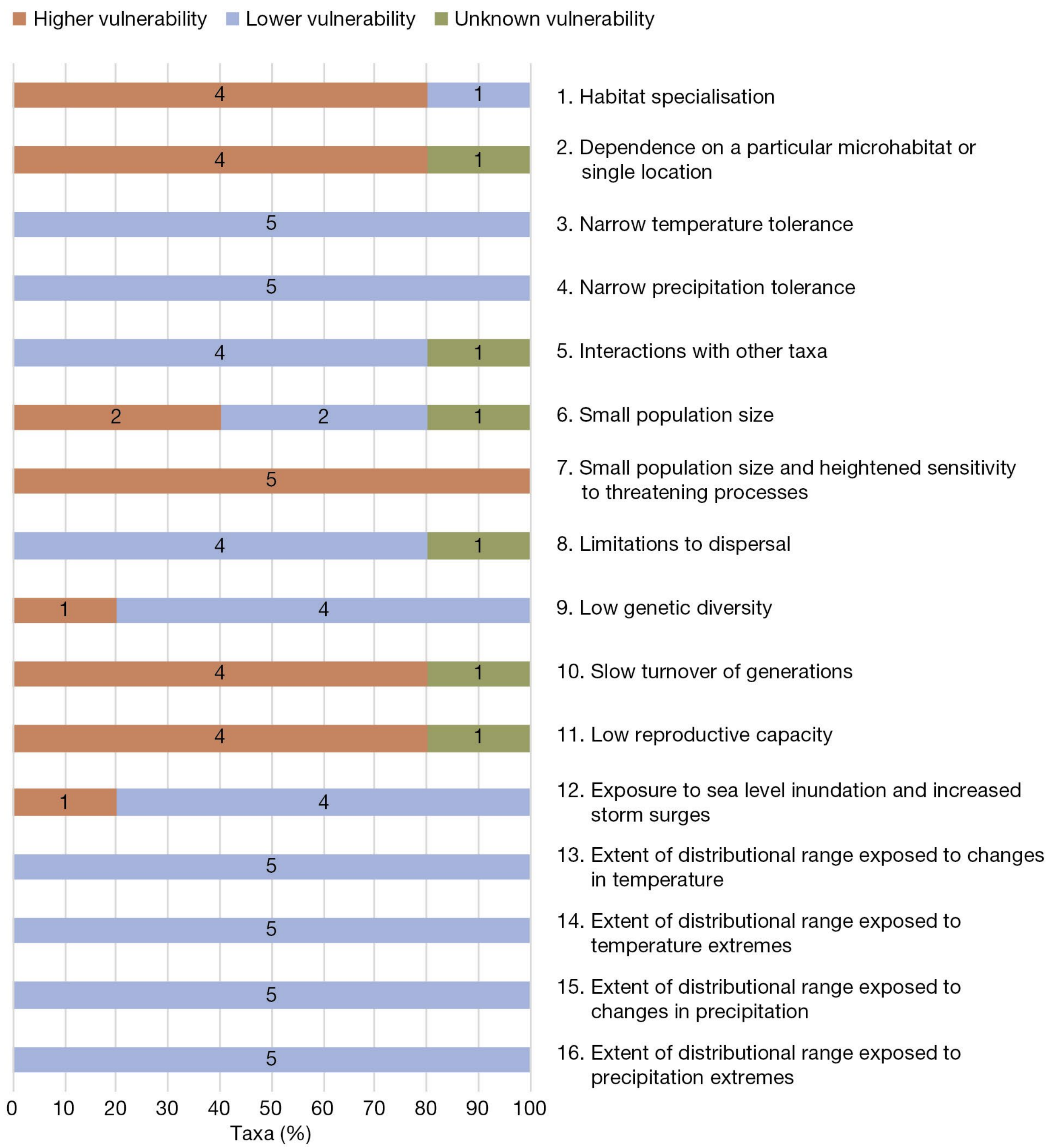


Figure 5. Number of bat taxa in Aotearoa New Zealand triggering ‘higher vulnerability’, ‘lower vulnerability’ or ‘unknown vulnerability’ scores for each trait (sensitivity dimension traits 1–7, low adaptive capacity dimension traits 8–11 and exposure dimension traits 12–16). Results are shown for the RCP8.5 emissions scenario by mid-century.

4.3 Discussion

All bat taxa in Aotearoa New Zealand appear to be vulnerable to climate change, but the distribution of each taxon had a large influence on the predicted timing of this vulnerability. The taxa with wider distributions (the long-tailed bat [*Chalinolobus tuberculatus*] and central lesser short-tailed bat [*Mystacina tuberculata rhyacobia*]) had some parts of their ranges (potential refugia) registering lower exposure to temperature and precipitation thresholds, while other parts were exposed to projected extremes by the end of the century. By contrast, taxa with more limited distributions are likely to be more vulnerable to extremes in local conditions. For example, the northern lesser short-tailed bat is confined to just two populations in Northland, where hotter, drier conditions are projected to occur with climate change (MfE 2018). Even though the population on Te Hauturu-o-Toi / Little Barrier Island is large, probably numbering > 2,000 bats, a high proportion of the taxon's population may be impacted if conditions become unfavourable there. The other population is in Ōmahuta Forest on the mainland and is a small remnant, perhaps numbering as few as c. 300 individuals, so these bats are vulnerable to a wide range of threats, such as predation by invasive mammals, alongside climate change.

All five bat taxa exhibit many traits that indicate they are likely to be sensitive to climate change and have low adaptive capacity to change. These traits already make these taxa highly vulnerable to decline and help explain why their recovery from current pressures, such as predation by introduced species, habitat loss and disturbance, is challenging conservation managers (O'Donnell et al. 2010). The additional pressure of being exposed to climate change from mid- to late century will only exacerbate current pressures unless effective management solutions are found.

Increases in mean and extreme temperatures and precipitation will likely adversely affect bats. Bats can be vulnerable to water loss (Gearhart et al. 2020), and with average temperature increases projected to exceed 4°C in some parts of Aotearoa New Zealand by the end of the century under the high-emission RCP8.5 scenario, taxa like the northern lesser short-tailed bat potentially will need to deal with increased metabolic stress caused by possible drought conditions. Aotearoa New Zealand bats have some capacity to reduce energy loss by adopting a state of torpor (a kind of 'hibernation mode') (e.g. Czenze et al. 2017). However, the amount of time they can do this for without using up their fat stores and negatively influencing survival is likely limited.

Warming may also have other consequences. For example, predator impacts on bats are likely to increase with milder winters (Walker et al. 2019) due to the increased survival of predators, making predator control more challenging. Additionally, if litter layers within the forest dry out more frequently, this could affect the numbers of soil and litter invertebrates, limiting food supplies, and increased flooding and erosion in waterways as a result of more frequent precipitation extremes may affect aquatic invertebrates, which are also an important food resource for bats in Aotearoa New Zealand. Another potential risk is the loss of roost trees to drought, which will reduce the amount of suitable available habitat for shelter. If foraging or roosting habitats are compromised, bats may need to increase their commuting times. Such factors may all contribute to increased energetic costs and stress, reducing survival.

Warmer temperatures may also bring potential benefits for Aotearoa New Zealand bats, however. For example, the activity of long-tailed bats increases with increased night-time temperatures because there is a linear relationship between temperature and the number of flying invertebrates, the primary food source for bats in Aotearoa New Zealand (O'Donnell 2000). Thus, if food abundance increases and breeding seasons are longer because of warmer temperatures, particularly in the shoulder seasons of spring and autumn, young bats may enter winter in better condition and survival may be higher. However, a recent study in Europe found that bats breeding at younger ages and earlier in the summer because of warmer temperatures had a reduced life-time survival (Mundinger et al. 2022). Therefore, it is important that the interactions between the potential positive and negative impacts of climate change are closely monitored over time.

Other climate change effects are more speculative and will require ongoing research and monitoring to determine their impacts. For example, an increased frequency of storm events may result in more wind-throw events, resulting in an increased mortality of tree roosts and potentially direct mortality of bats; more frequent mast seeding may influence the longevity and senescence of forest trees; and drought events, particularly in the northernmost forests, could potentially reduce food availability (O'Donnell et al. 2023). Dietary shifts could be monitored through research involving DNA metabarcoding methods (Ling et al. 2023).

The next step needed to build on this CCVA is to determine what, if any, additional conservation management and monitoring will be required in the near future to aid the ongoing survival of bats in Aotearoa New Zealand and to prioritise research that addresses important knowledge gaps.

5. Climate change vulnerability assessment of indigenous breeding birds

Shorebirds like these tūturiwhatu / northern New Zealand dotterels (*Charadrius obscurus aquilonius*) are vulnerable to sea surges and storms. Through hard work from the Department of Conservation, iwi and volunteers, this taxon's conservation status under the New Zealand Threat Classification System has improved from Threatened – Nationally Vulnerable to Threatened – Nationally Increasing. However, additional pressures from climate change events could undo this conservation gain. *Photo: Mithuna Sothieson*

5.1 Introduction

A total of 491 bird taxa have been recorded in Aotearoa New Zealand since first human contact (Robertson et al. 2021). We conducted a CCVA for 213 indigenous taxa that breed in Aotearoa New Zealand, excluding 62 Extinct taxa, 2 Data Deficient taxa, 177 Non-resident Native taxa (including 143 vagrants, 24 international migrants and 10 recent colonisers), 35 Introduced and Naturalised taxa, and 2 Not Threatened taxa.[10] According to the latest NZTCS assessment at the time of writing (Robertson et al. 2021), 80 (38%) of the 213 taxa assessed were classified as Threatened, 98 (46%) as At Risk (27 of which were At Risk – Declining) and only 35 (16%) as Not Threatened.

5.2 Results

Most bird taxa were perceived to exhibit a wide range of traits that render them potentially vulnerable to climate change. The proportion of birds in the Highly Vulnerable category increased from c. 20% by both mid- and late century under the RCP4.5 emissions scenario to > 30% by mid-century and > 60% by late century under the RCP8.5 emissions scenario, with only minor differences between the optimistic and pessimistic assessment methods (Fig. 6). By late century, 134–137 taxa (63–64% of taxa) were classified as Highly Vulnerable under the RCP8.5 scenario (Fig. 6). Furthermore, a high proportion of taxa (63 taxa, 30%) were recorded as being at Latent Risk by mid-century under the RCP8.5 scenario, and all of these had moved to the Highly Vulnerable category by late century (Fig. 7).

Of the 71 taxa that were classified as Highly Vulnerable by mid-century under the RCP8.5 scenario using the optimistic assessment method (Table 8), most were seabirds (48 taxa, 68%), followed by smaller groupings of shorebirds (11 taxa, 15%), wetland birds (7 taxa, 10%) and forest or open country birds (5 taxa, 7%). The largest group of vulnerable birds (30 taxa, 42%) was in the top priority, and this group entirely consisted of seabirds and shorebirds with the exception of one island endemic forest bird (the karure / black robin [*Petroica traversi*]) and one wetland bird (the pāteke / brown teal [*Anas chlorotis*]). Similarly, the second priority group (15 taxa, 21%) consisted almost entirely of seabirds and shorebirds (10 taxa, 67%), with two threatened wetland taxa (the kōtuku / white heron [*Ardea modesta*] and matuku-hūrepo / Australasian bittern [*Botaurus poiciloptilus*]) and three forest taxa (the kākāriki karaka / orange-fronted parakeet [*Cyanoramphus malherbi*], Forbes' parakeet [*C. forbesi*] and koekoeā / long-tailed cuckoo [*Eudynamys taitensis*]) also listed. The third priority group (25 taxa, 35%) was again largely represented by seabirds (18 taxa, 72%), while the fourth priority group only included one taxon (the weweia / New Zealand dabchick [*Poliocephalus rufopectus*]). Experts recorded high information adequacy (overall confidence score ≥ 40) for the vulnerability traits of most of these Highly Vulnerable bird taxa (51 taxa, 72%; Table 8), reflecting decades of investment in the study of Aotearoa New Zealand birds.

Thirty-five (16%) of the 213 taxa included in this CCVA were classified as Not Threatened under the NZTCS at the time of writing (Robertson et al. 2021). Of these, only one taxon (the tākapu / Australasian gannet [*Morus serrator*]) was assessed as Highly Vulnerable by mid-century under the RCP8.5 scenario (Appendix 1). However, 93% and 97% of the Not Threatened taxa were given 'higher vulnerability' scores for traits in at least one of the sensitivity, low adaptive capacity or exposure dimensions by mid- and late century, respectively, under the RCP8.5 scenario. Only seven taxa were considered not vulnerable for any dimension by late century: the spur-winged plover (*Vanellus miles novaehollandiae*), warou / welcome swallow (*Hirundo neoxena neoxena*), riroriro / grey warbler (*Gerygone igata*), tauhou / silvereye (*Zosterops lateralis lateralis*), korimako / bellbird (*Anthornis melanura*

[10] Mallard x grey duck hybrids and the black swan (*Cygnus atratus*).

melanura), tūī (*Prosthemadera novaeseelandiae novaeseelandiae*) and kōtare / New Zealand kingfisher (*Todiramphus sanctus vagans*).

Aotearoa New Zealand birds are well researched and monitored compared with many other taxa. Experts recorded high certainty for most traits and taxa (Table 8), but gaps in knowledge were more evident for low adaptive capacity traits (low genetic diversity and low reproductive capacity; Fig. 8). The traits that most frequently triggered 'higher vulnerability' in birds were *6: Small population size*, *10: Slow turnover of generations* and *11: Low reproductive capacity* (Fig. 8).

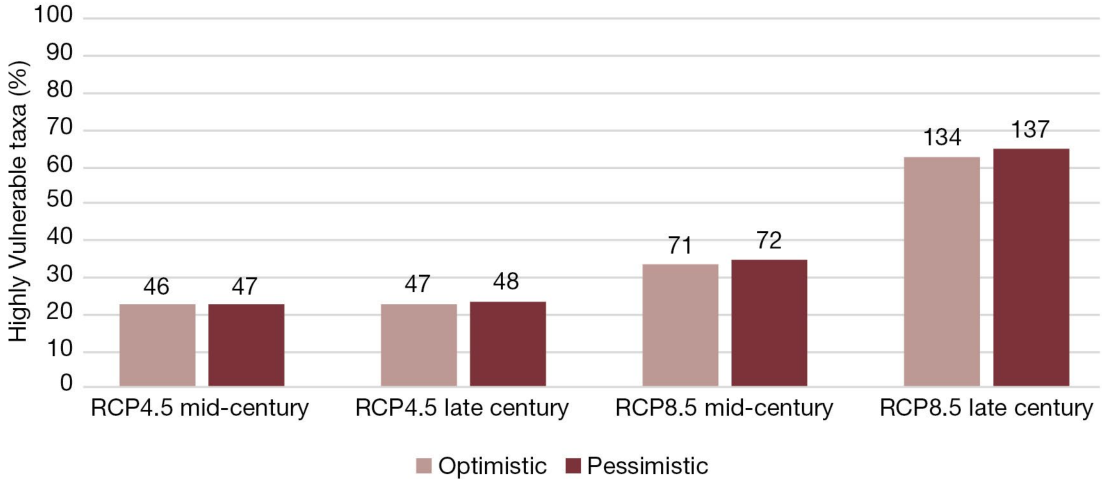


Figure 6. Percentages of indigenous bird taxa in Aotearoa New Zealand that were classified as Highly Vulnerable under each emissions scenario (RCP4.5 or RCP8.5), time frame (mid- or late century) and assessment method (optimistic or pessimistic). Trait values scored as 'unknown vulnerability' were replaced with 'lower vulnerability' for the optimistic assessment and 'higher vulnerability' for the pessimistic assessment. Thus, the optimistic assessment gives an estimate of the minimum number of Highly Vulnerable taxa, while the pessimistic assessment gives an estimate of the maximum number.

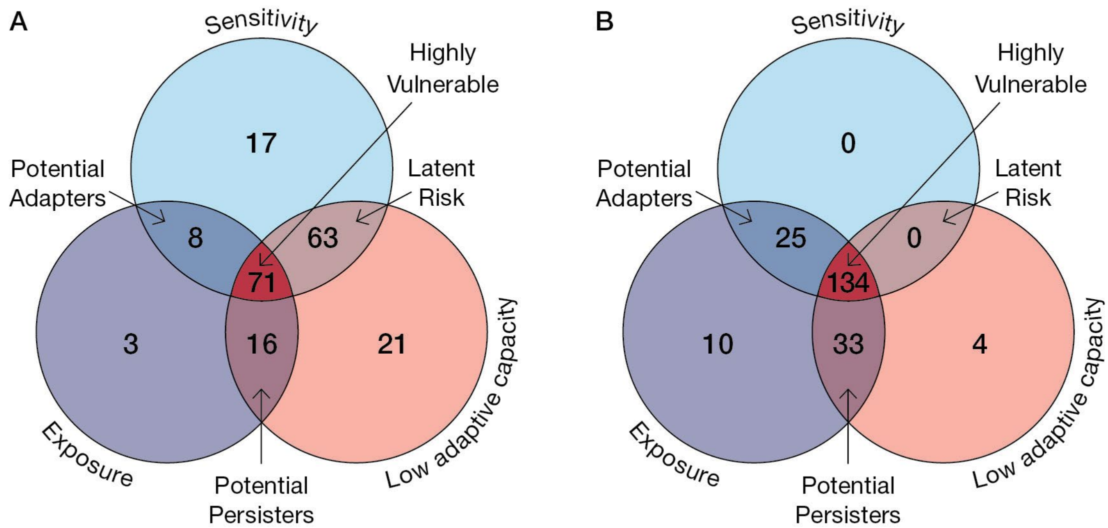


Figure 7. Number of indigenous bird taxa in Aotearoa New Zealand in each of the three climate change vulnerability dimensions (sensitivity, exposure, low adaptive capacity) and four climate change vulnerability categories (Highly Vulnerable, Potential Adapters, Potential Persisters and Latent Risk) by (A) mid-century and (B) late century under the RCP8.5 emissions scenario using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores). A total of 14 and 7 taxa have been excluded from A and B, respectively, as they had 'lower vulnerability' scores on all three dimensions and were therefore classified as Low Vulnerability.

Table 8. Priorities and confidence scores for the 71 bird taxa that were classified as Highly Vulnerable by mid-century under the RCP8.5 emissions scenario using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores). The higher the priority of the taxon, the more traits triggered the 'higher vulnerability' score and therefore the greater the concern. The higher the confidence score, the better the data used by experts to assess the taxon. Note that the scientific names of taxa were derived from the New Zealand Threat Classification System (NZTCS) database on 1 August 2022 and so do not account for any changes since then. Māori names are based on New Zealand Birds Online: www.nzbirdsonline.org.nz.

SCIENTIFIC NAME	COMMON NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE (MAX. = 48)	BIRD CLASSIFICATION
Anarhynchus frontalis	Ngutu pare / wrybill	1	47	Shorebird
Charadrius obscurus obscurus	Tūturiwhatu / southern New Zealand dotterel	1	47	Shorebird
Himantopus novaezelandiae	Kakī / black stilt	1	46	Shorebird
Anas chlorotis	Pāteke / brown teal	1	46	Wetland bird
Chlidonias albostriatus	Tarapirohe / black-fronted tern	1	45	Shorebird
Thalassarche eremita	Toroa / Chatham Island mollymawk	1	44	Seabird
Eudyptes filholi	Tawaki piki toka / eastern rockhopper penguin	1	44	Seabird
Morus serrator	Tākapu / Australasian gannet	1	44	Seabird
Megadyptes antipodes	Hoiho / yellow-eyed penguin	1	44	Seabird
Thinornis novaeseelandiae	Tuturuatu / shore plover	1	43	Shorebird
Eudyptes sclateri	Tawaki nana hī / erect-crested penguin	1	42	Seabird
Sternula nereis davisae	Tara iti / New Zealand fairy tern	1	42	Shorebird
Petroica traversi	Karure / black robin	1	42	Forest bird
Pelecanoides whenuahouensis	Kuaka Whenua Hou / Whenua Hou diving petrel	1	41	Seabird
Diomedea antipodensis antipodensis	Toroa / Antipodean wandering albatross	1	41	Seabird
Thalassarche chrysostoma	Toroa / grey-headed mollymawk	1	41	Seabird
Procellaria parkinsoni	Tāiko / black petrel	1	41	Seabird
Diomedea antipodensis gibsoni	Toroa / Gibson's wandering albatross	1	41	Seabird
Phoebetria palpebrata	Toroa pango / light-mantled sooty albatross	1	41	Seabird
Leucocarbo carunculatus	Kawau pāteketeke / king shag	1	40	Seabird
Leucocarbo ranfurlyi	Bounty Island shag	1	38	Seabird
Eudyptula minor iredalei	Kororā / northern blue penguin	1	37	Seabird
Thalassarche salvini	Toroa / Salvin's mollymawk	1	37	Seabird
Leucocarbo chalconotus	Matapo / Otago shag	1	35	Seabird
Leucocarbo colensoi	Kawau o Motu Maha / Auckland Island shag	1	34	Seabird
Fregetta maoriana	Takahikare-raro / New Zealand storm petrel	1	34	Seabird
Leucocarbo onslowi	Papua / Chatham Island shag	1	32	Seabird
Leucocarbo stewarti	Mapo / Foveaux shag	1	31	Seabird
Pachyptila crassirostris flemingi	Lesser fulmar prion	1	30	Seabird
Pterodroma neglecta neglecta	Pia koia / Kermadec petrel "summer"	1	29	Seabird
Procellaria westlandica	Tāiko / Westland petrel	2	48	Seabird
Ardea modesta	Kōtuku / white heron	2	46	Wetland bird

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Table 8 continued

SCIENTIFIC NAME	COMMON NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE (MAX. = 48)	BIRD CLASSIFICATION
Diomedea epomophora epomophora	Toroa / southern royal albatross	2	44	Seabird
Cyanoramphus malherbi	Kākāriki karaka / orange-fronted parakeet	2	44	Forest bird
Haematopus chathamensis	Tōrea tai / Chatham Island oystercatcher	2	43	Shorebird
Puffinus huttoni	Kaikōura tītī / Hutton's shearwater	2	43	Seabird
Anous minutus	White-capped noddy	2	42	Seabird
Botaurus poiciloptilus	Matuku-hūrepo / Australasian bittern	2	42	Wetland bird
Cyanoramphus forbesi	Forbes' parakeet	2	42	Forest bird
Pterodroma mollis	Soft-plumaged petrel	2	42	Seabird
Eudyptula minor albosignata	Kororā / white-flippered blue penguin	2	40	Seabird
Coenocorypha pusilla	Chatham Island snipe	2	40	Shorebird
Thalassarche bulleri bulleri	Toroa / southern Buller's mollymawk	2	40	Seabird
Eudynamys taitensis	Koekoeā / long-tailed cuckoo	2	39	Forest bird
Stictocarbo featherstoni	Kawau o Rangihaute / Pitt Island shag	2	35	Seabird
Pterodroma pycrofti	Pycroft's petrel	3	48	Seabird
Pterodroma cookii	Tītī / Cook's petrel	3	48	Seabird
Puffinus gavia	Pakahā / fluttering shearwater	3	47	Seabird
Nestor notabilis	Kea	3	46	Open country bird
Thalassarche impavida	Toroa / Campbell Island mollymawk	3	46	Seabird
Haematopus unicolor	Tōrea pango / variable oystercatcher	3	45	Shorebird
Hydroprogne caspia	Taranui / Caspian tern	3	45	Seabird
Anas superciliosa	Pārera / grey duck	3	45	Wetland bird
Puffinus assimilis haurakiensis	Totorore / North Island little shearwater	3	45	Seabird
Pachyptila crassirostris crassirostris	Fulmar prion	3	44	Seabird
Charadrius obscurus aquilonius	Tūturiwhatu / northern New Zealand dotterel	3	43	Shorebird
Platalea regia	Kōtuku ngutupapa / royal spoonbill	3	43	Wetland bird
Eudyptes pachyrhynchus	Tawaki / Fiordland crested penguin	3	42	Seabird
Daption capense australe	Karetai hurukoko / Snares Cape petrel	3	42	Seabird
Eudyptula novaehollandiae	Australian little penguin	3	42	Seabird
Procellaria cinerea	Kuia / grey petrel	3	42	Seabird
Onychoprion fuscatus serratus	Sooty tern	3	42	Seabird
Puffinus elegans	Subantarctic little shearwater	3	42	Seabird
Anas aucklandica	Tētē kakariki / Auckland Island teal	3	37	Wetland bird
Eudyptula minor minor	Kororā / southern blue penguin	3	37	Seabird
Sterna vittata bethunei	Antarctic tern	3	36	Seabird
Sterna striata aucklandorna	Tara / southern white-fronted tern	3	35	Seabird

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Table 8 continued

SCIENTIFIC NAME	COMMON NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE (MAX. = 48)	BIRD CLASSIFICATION
Phaethon rubricauda	Amokura / red-tailed tropicbird	3	35	Seabird
Charadrius bicinctus exilis	Pohowera / Auckland Island banded dotterel	3	33	Shorebird
Pterodroma aff. *neglecta* "winter"	Pia koia / Kermadec petrel "winter"	3	32	Seabird
Poliocephalus rufopectus	Weweia / New Zealand dabchick	4	39	Wetland bird

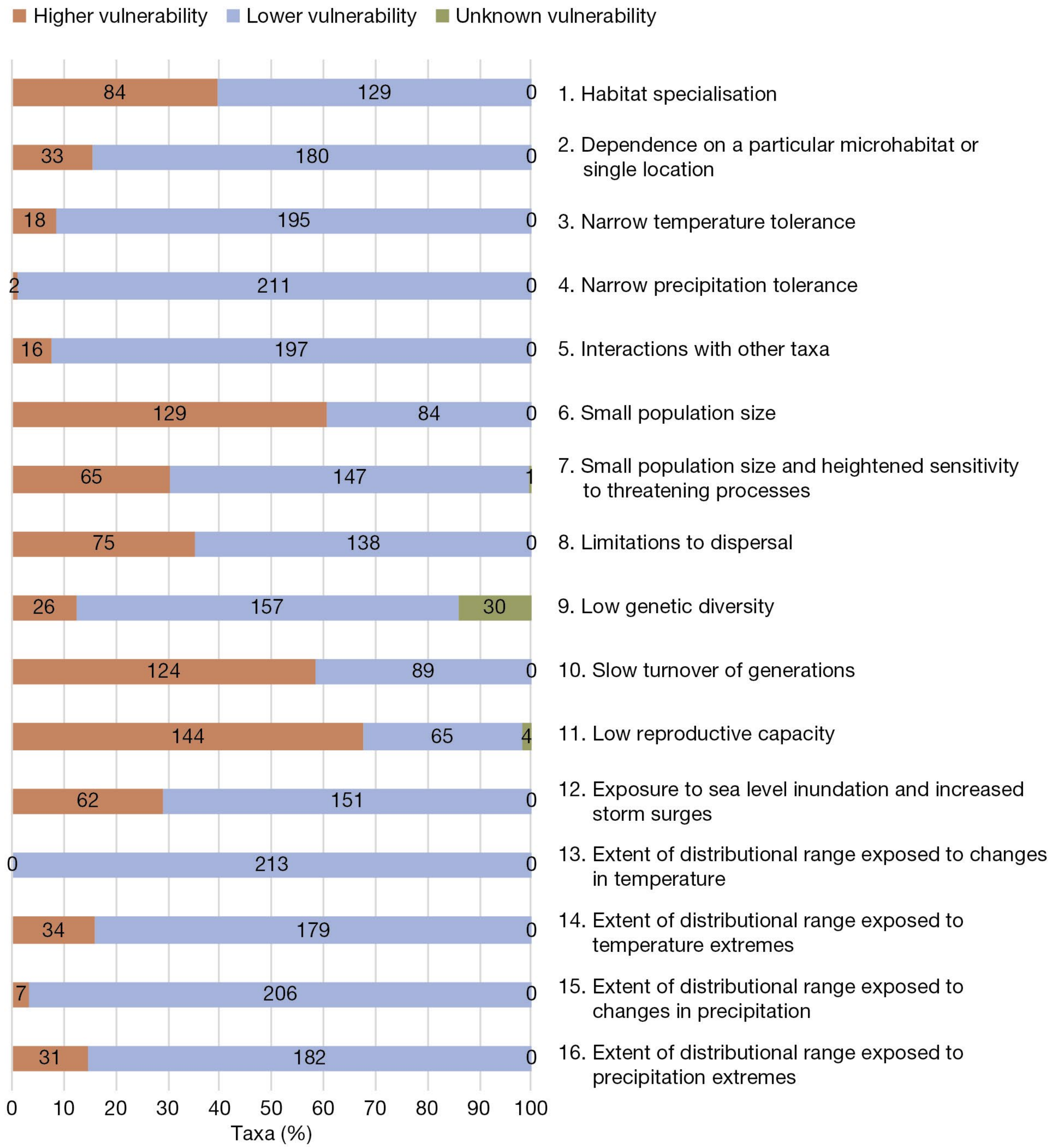


Figure 8. Number of indigenous bird taxa in Aotearoa New Zealand triggering 'higher vulnerability', 'lower vulnerability' or 'unknown vulnerability' scores for each trait (sensitivity dimension traits 1–7, low adaptive capacity dimension traits 8–11 and exposure dimension traits 12–16). Results are shown for the RCP8.5 emissions scenario by mid-century.

5.3 Discussion

The ecology of Aotearoa New Zealand birds is relatively well known compared with most other groups of taxa, so high information adequacy was recorded for most traits and taxa. Therefore, there was a high degree of certainty in the prediction that many bird taxa will be highly vulnerable to climate change. Most bird taxa exhibit multiple traits that indicate sensitivity to climate change and (with a few exceptions) have low adaptive capacity to change. These traits explain why a high proportion of bird taxa are already threatened by existing pressures and, consequently, why the additional pressures caused by climate change from mid- to late century will cause a greater threat to these populations unless adaptive management solutions are implemented in a timely manner. For example, climate warming is likely to affect the abundance of introduced mammalian predators because of a greater food abundance and wider habitat suitability, which in turn may result in even higher predation rates on threatened taxa in a wide range of habitats (Christie 2014; Walker et al. 2019).

It is not surprising that most of the traits that triggered 'higher vulnerability' scores for climate change reflected habitat specialisation, low population sizes, limitations to dispersal, slow reproductive rates and low productivity – characteristics that already challenge conservation managers in their attempts to recover taxa. Low genetic diversity was scored as 'unknown' for 30 taxa (14%), signalling a need for research to determine whether these taxa have been through significant genetic bottlenecks.

Marine bird taxa and to a lesser extent shorebird and wetland bird taxa contributed the largest proportion of vulnerable taxa. They not only dominated the Highly Vulnerable taxon lists for the RCP8.5 emissions scenario by mid- and late century but were also dominant under the RCP4.5 emissions scenario. For marine taxa, the CCVA traits mainly focused on their terrestrial vulnerability, as marine projections under climate change for the region are still coarse and detailed data on foraging areas and changes to these under climate change are lacking for most taxa (Dunstan et al. 2018; Roberts and Hendriks 2022). Nonetheless, the terrestrial-based traits still identified considerable vulnerabilities in this group.

5.3.1 Marine bird taxa

Climate change is likely to affect both the feeding and breeding habitats of marine bird taxa, as highlighted in case study 1. Foraging efficiency and feeding areas will likely be impacted by changes in sea surface temperatures and upwelling. Such threats are likely to impact both neritic feeders such as shags, gulls and terns (Mills et al. 2008; Whitehead et al. 2019) and pelagic feeders such as albatrosses, petrels and shearwaters (Gonzalez et al. 2023). Reproduction will likely be the first demographic parameter to be impacted by climate change, with increasing environmental stress affecting breeding success, as well as changes in nesting habitat and an increasing frequency and severity of storm events and sea level rise impacting nesting sites (e.g. Chilvers and Hiscock 2019; Momberg et al. 2023; Olin et al. 2024). Numerous seabird taxa (41 taxa) only breed in Aotearoa New Zealand's territorial waters, and many at single or a limited number of locations, so there are unlikely to be many alternatives available if their breeding grounds become unsuitable, further elevating their vulnerability.

5.3.2 Shorebird and wetland bird taxa

Shorebird and wetland bird taxa were often assessed as being vulnerable to climate change because they occupy breeding and feeding habitats in coastal areas that will be directly impacted by sea level rise (see case study 2) or riverine habitats that will be subject to increasing precipitation and likely storm events and flooding (Death et al. 2016; Tait and Pearce 2019). Such taxa are already under pressure because 90% of wetlands in Aotearoa New Zealand have been lost and rivers are being degraded by numerous threats (Ausseil et al. 2011; O'Donnell et al. 2017). If populations of introduced mammalian predators increase as predicted (Lundquist et al. 2011), these too will impact shorebirds and wetland birds.

5.3.3 Forest and open country bird taxa

Only five (2%) of the taxa that were assessed as Highly Vulnerable under the RCP8.5 emissions scenario by mid-century occupy forest and open country habitats: the alpine kea (*Nestor notabilis*), the forest-dwelling koekoeā / long-tailed cuckoo, the kākāriki karaka / orange-fronted parakeet and two island endemics – Forbes' parakeet and the karure / black robin. Consequences of climate change for these taxa include increased predation as the ranges of introduced predators expand to higher altitudes, or effects on the ranges and breeding attempts of these birds due to an increasing frequency of storm events and erosion within their habitats. Island endemics are especially vulnerable, as they cannot change their distributions naturally as conditions change. Forest and open country taxa generally use a greater range of habitat types and tend to be more widespread geographically than seabirds, wetland birds and shorebirds, allowing potential resilience to some climate change consequences. These taxa may be impacted in parts of their range but not others, but the consequences for a taxon as a whole are more difficult to predict.

5.3.4 Not Threatened bird taxa

This assessment also included 35 taxa that were classified as Not Threatened under the NZTCS at the time of writing (Robertson et al. 2021). Although only one taxon in this group was assessed as Highly Vulnerable overall, most scored 'higher vulnerability' for at least one vulnerability dimension, indicating that there is also significant cause for concern for this group of birds. Therefore, these taxa, which are currently common and widespread, also require comprehensive monitoring programmes to ensure that an early alert system is in place if they too begin exhibiting negative responses to climate change. Alongside threatened taxa, this group of birds is likely to be exposed to increasing pressures such as predation by introduced mammals and seasonal shifts in food availability.

5.3.5 Predicting the consequences of climate change on birds

The large number of bird taxa that the assessment signalled as Highly Vulnerable to climate change, even by mid-century, confirms that climate change will have a substantial impact on birds. While we can speculate on some likely consequences of this for the productivity and survival of bird taxa in different habitat types in a general sense, we have not yet analysed or predicted the specific consequences for productivity and survival and subsequent impacts on population trajectories for each taxon. Additionally, this trait-based assessment did not assess the cumulative effects of the potential climate change impacts combined with existing threats to any taxa.

The results presented here should be interpreted with caution, as they likely underestimate potential climate change impacts on birds. The taxon vulnerability lists provided in this report are intended as a broad guide to taxa that are likely to be impacted by climate change and thus provide a framework for prioritising which taxa require management plans at the earliest opportunity (i.e. those with the greatest vulnerabilities and those that are predicted to be impacted earlier). However, any taxon that triggered 'higher vulnerability' for any of the dimensions of vulnerability (sensitivity, low adaptive capacity, exposure) may be significantly affected by climate change even though it is not classified as Highly Vulnerable overall. For example, while the four obligate alpine taxa assessed in the CCVA (Kaikōura tītī / Hutton's shearwater [*Puffinus huttoni*], kea, pīwauwau / southern rock wren [*Xenicus gilviventris rineyi*] and pīwauwau / northern rock wren [*X. gilviventris*]) all occupy similar environments when breeding, only kea and Hutton's shearwater were ranked as Highly Vulnerable because their longer generation times indicated that they would be less adaptable to change. However, while both rock wren taxa were classified as Potential Adapters, they also triggered sensitivity traits and will be exposed to climate change. Consequently, conservation planners should not be complacent about taxa that only trigger some vulnerabilities. Indeed, single traits may be sufficient to result in highly significant impacts – for example, rock wrens suffer considerable predation by introduced mammals (Weston et al. 2018), so if predation risk increases as a consequence of climate-induced increases in the numbers and distribution of predators (see earlier discussion), the results may be catastrophic for long-term population viability.

There are also likely to be other pressures on threatened bird taxa resulting from climate change that the trait analysis approach did not expose. For example, changed environmental conditions may favour the emergence or expression of new diseases (e.g. avian malaria) or greater disease transmission through the appearance of better vectors for disease (e.g. Alley and Gartrell 2019; Filion et al. 2023); the occurrence of algal blooms may increase the frequency and magnitude of botulism outbreaks (Rolton et al. 2022); and changes in fishing effort may cause ocean fisheries to move south, resulting in increased bycatch of Aotearoa New Zealand taxa (Erauskin-Extramiana et al. 2019).

The next step needed to build on this CCVA is to determine what, if any, additional conservation management can be implemented in the future to assist taxa in adapting to the increased pressures of climate change, and what research is needed to support the development of these strategies. The information gathered in this assessment provides a rich data source for practitioners to take the next steps towards prioritising further work on the most vulnerable taxa, examining whether conservation efforts are planned for the right places with future climate changes in mind, gaining more knowledge of taxon vulnerabilities, and initiating longer term monitoring to provide early alerts to new vulnerabilities and, where possible, develop early management responses (e.g. Garnett and Franklin 2014).

Case study 1: The seabird capital of the world is under threat from climate change

Aotearoa New Zealand is a global hotspot for nesting penguins, albatrosses, petrels, shearwaters, gulls, terns, shags and gannets, with 95 taxa of breeding seabirds assessed. Unfortunately, the results of the CCVA made it clear that Aotearoa New Zealand is also a hotspot for high climate change vulnerability for these taxa, with 50 (53%) of them being classified as Highly Vulnerable by mid-century and 68 (72%) by late century under the RCP8.5 emissions scenario.

Numerous taxa only breed on one island (e.g. the pokotiwha / Snares penguin [*Eudyptes robustus*], toroa / Chatham Island mollymawk [*Thalassarche eremita*] and kuaka Whenua Hou / Whenua Hou diving petrel [*Pelecanoides whenuahouensis*]), meaning they have nowhere else to go if climatic conditions change drastically. Although many southern islands are not predicted to be exposed to dramatically higher temperatures, increased precipitation and storm events are likely to have significant impacts – for example, through the erosion of nesting sites. Indeed, the only nesting colony of Whenua Hou diving petrels has already lost significant amounts of sand dunes since 2002 due to increasing storm surge events. Furthermore, even a small increase in average air temperature may increase heat stress on cold-adapted taxa such as penguins and albatrosses. By contrast, taxa that breed on northern islands such as Rangitāhua / Kermadec Islands, Manawatāwhi / Three Kings Islands and the islands off Northland will be exposed to much higher air temperature extremes, adding stressors to breeding and food supplies. This will impact surface-nesting seabirds the most. Innovative management responses will be needed to address this range of climate change threats. For example, trials have shown that adding sun shelters near nests can protect tara iti / New Zealand fairy tern (*Sternula nereis davisae*) chicks from heat stress on hot summer days.

Erosion of nesting habitat on Codfish Island / Whenua Hou. *Photo: Johannes Fischer*

Sea surface temperatures are projected to increase significantly, leading to changes in currents and marine productivity, which in turn will affect the food supplies of many seabirds. Sedentary taxa such as the kawau pāteketeke / king shag (*Leucocarbo carunculatus*) are vulnerable to these warming seas affecting food supplies in the outer Marlborough Sounds, adding to existing problems with sedimentation after heavy rainfall events. Further south, albatrosses are needing to fly much farther to find food for their chicks, which can reduce breeding success.

Toroa / Gibson's wandering albatross (*Diomedea antipodensis gibsoni*). *Photo: Colin O'Donnell*

Case study 2: Tara iti / New Zealand fairy terns are vulnerable to rising sea levels and increased storm surges

The critically endangered tara iti / New Zealand fairy tern (*Sternula nereis davisae*) is Aotearoa New Zealand's rarest indigenous breeding bird, with an adult population of only 40 birds in total and < 15 breeding pairs. These birds breed on the shifting sands of just three or four Northland beaches but are highly mobile around upper Te Ika-a-Māui / North Island coastlines outside the breeding season.

Tara iti and their nest sites are already threatened by avian and mammalian predators, disturbance by humans and vehicles, and coastal development impacts. Breeding success is also frequently affected by natural environmental factors. High spring tides and storm surges, especially if backed by onshore wind, can inundate nests, and adverse weather can reduce the birds' foraging ability, causing the desertion of eggs or the death of chicks. Mobile sand can also cover nests.

Climate change will intensify these threats. Increases in the frequency and magnitude of storm surges are especially concerning. Climate projections also indicate significant warming in Northland for tara iti breeding habitats, with projected increases in mean temperature of more than 1°C by mid-century and 4°C by late century under the RCP8.5 emissions scenario. The numbers of hot days are also projected to increase by up to 30 days by 2040 and up to 90 days by 2090 (RCP8.5). These temperature changes are likely to increase overheating and put additional stress on adults, chicks and eggs.

Tara iti / New Zealand fairy tern (*Sternula nereis davisae*). *Photo: Malcolm Pullman*

6. Climate change vulnerability assessment of herpetofauna

Woodworthia geckos, like this one at Macraes Flat, rely on rock crevices as daytime retreats and to control their body temperatures. Warming temperatures increase the risk of these retreats becoming too hot and no longer providing suitable protection. *Photo: Sabine Bernert*

6.1 Introduction

There were 142 extant herpetofauna taxa recorded in Aotearoa New Zealand and listed in the NZTCS at the time of the writing. We conducted a CCVA for all 120 indigenous terrestrial reptile taxa (72 skinks, 47 geckos and the tuatara) and 3 native frog taxa, excluding those that are Data Deficient. Migrant, Vagrant, and Introduced and Naturalised taxa were not assessed. According to the latest NZTCS assessments (Burns et al. 2018; Hitchmough et al. 2021), 50 (41%) of the assessed herpetofauna were classified as Threatened, 51 (41%) as At Risk – Declining and 22 (18%) as one of the lower At Risk statuses (Recovering, Relict or Naturally Uncommon) or Not Threatened.

6.2 Results

Overall, there was very little change in the number of Highly Vulnerable taxa over time when using the RCP4.5 emissions scenario, with 10 (8%) and 12 (10%) of the herpetofauna taxa being categorised as Highly Vulnerable by mid- and late century, respectively, using both the pessimistic and optimistic assessment methods. However, when using the RCP8.5 emissions scenario, the number of Highly Vulnerable herpetofauna taxa increased from 15–17 (12–14%) by mid-century to 75–77 (61–63%) by late century (Fig. 9), as all taxa classified as Latent Risk move to the Highly Vulnerable category (Fig. 10). A complete list of the Highly Vulnerable taxa under the RCP8.5 emissions scenario by mid-century is provided in Table 9.

Experts recorded high certainty for most traits and taxa (Table 9), but gaps in knowledge were more evident for the traits that indicate low adaptive capacity (*9: Low genetic diversity*, *10: Slow turnover of generations* and *11: Low reproductive capacity*) (Fig. 11).

The most commonly triggered sensitivity trait was *7: Small population size and heightened sensitivity to threatening processes* (65 taxa, 53%). The most commonly triggered low adaptive capacity trait was *11: Low reproductive capacity*, with nearly all taxa (93 taxa, 76%) triggering a higher score. There were no 'unknown' scores for any of the exposure traits, reflecting the relatively well known distributions of Aotearoa New Zealand herpetofauna (Fig. 11).

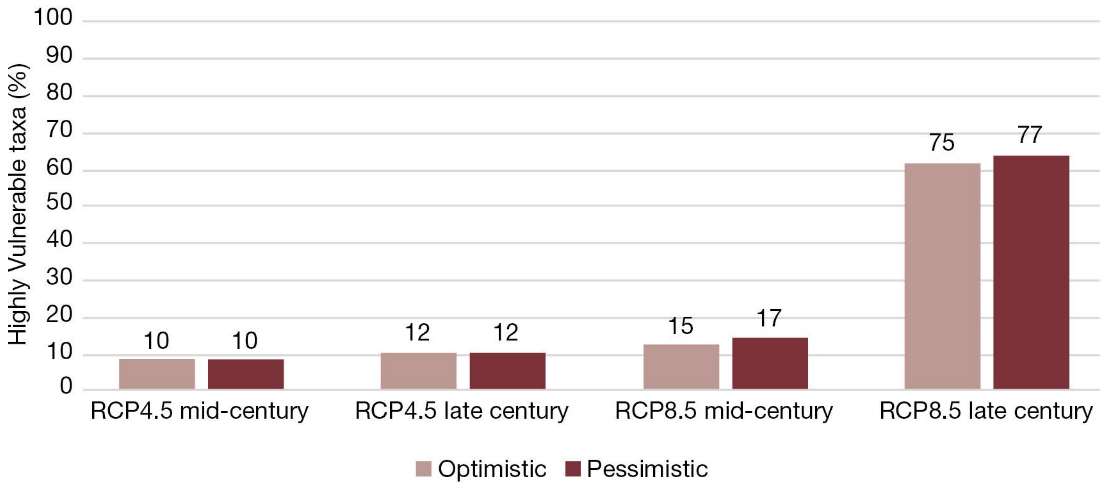


Figure 9. Percentages of indigenous herpetofauna taxa in Aotearoa New Zealand that were classified as Highly Vulnerable under each emissions scenario (RCP4.5 or RCP8.5), time frame (mid- or late century) and assessment method (optimistic or pessimistic). Trait values scored as 'unknown vulnerability' were replaced with 'lower vulnerability' for the optimistic assessment and 'higher vulnerability' for the pessimistic assessment. Thus, the optimistic assessment gives an estimate of the minimum number of Highly Vulnerable taxa, while the pessimistic assessment gives an estimate of the maximum number.

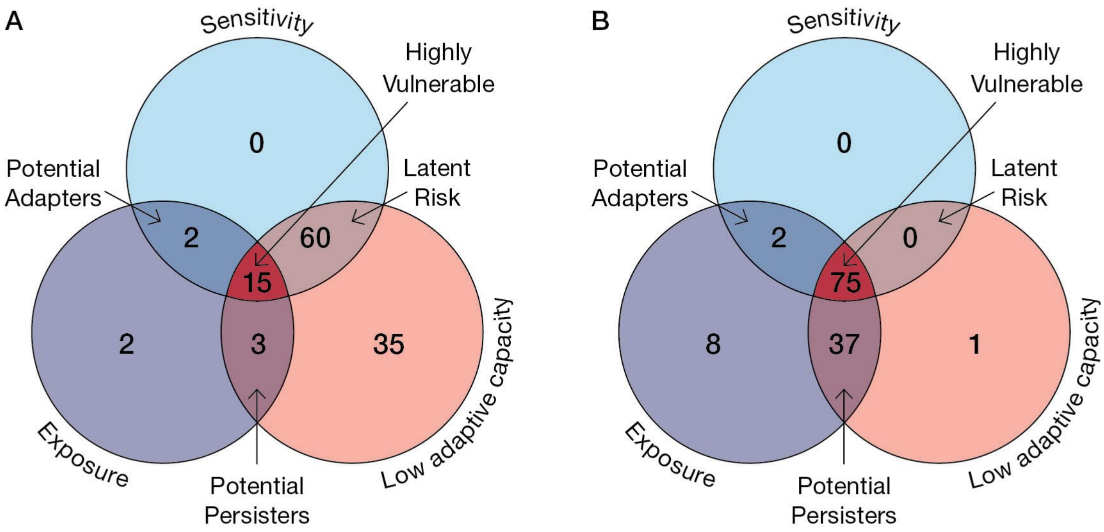


Figure 10. Number of indigenous herpetofauna taxa in Aotearoa New Zealand in each of the three climate change vulnerability dimensions (sensitivity, low adaptive capacity, exposure) and four climate change vulnerability categories (Highly Vulnerable, Potential Adapters, Potential Persisters and Latent Risk) by (A) mid-century and (B) late century under the RCP8.5 emissions scenario using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores). Six taxa have been excluded from (A) as they had 'lower vulnerability' scores across all three dimensions and were therefore classified as Low Vulnerability.

Table 9. Priorities and confidence scores for the 15 herpetofauna taxa that were classified as Highly Vulnerable by mid-century under the RCP8.5 emissions scenario using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores). The higher the priority of the taxon, the more traits triggered the 'higher vulnerability' score and therefore the greater the concern. The higher the confidence score, the better the data used by experts to assess the taxon. Note that the scientific names of taxa were derived from the New Zealand Threat Classification System (NZTCS) database on 1 August 2022 and so do not account for any changes since then.

SCIENTIFIC NAME	COMMON NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE (MAX. = 48)
Mokopirirakau galaxias	Hura te ao gecko	1	42
Oligosoma salmo	Kapitia skink	1	41
Oligosoma aff. *infrapunctatum* "cobble"	Cobble skink	1	29
Mokopirirakau "Roys Peak"	Orange-spotted gecko	2	41
Woodworthia aff. *maculata* "Muriwai"	Muriwai gecko	2	38
Oligosoma tekakahu	Te Kakahu skink	2	34
Oligosoma taumakae	Taumaka skink	2	30
Oligosoma aff. *chloronoton* "West Otago"	Lakes skink	3	38
Oligosoma prasinum	Mackenzie skink	3	35
Oligosoma acrinasum	Fiordland skink	3	33
Oligosoma hardyi	Hardy's skink	3	31
Oligosoma suteri	Egg-laying skink	4	39
Oligosoma aff. *infrapunctatum* "Southern North Island"	Kupe skink	4	35
Oligosoma aff. *inconspicuum* "Humboldt"	Humboldt skink	4	34
Oligosoma aff. *infrapunctatum* "Hokitika"	Hokitika skink	4	20

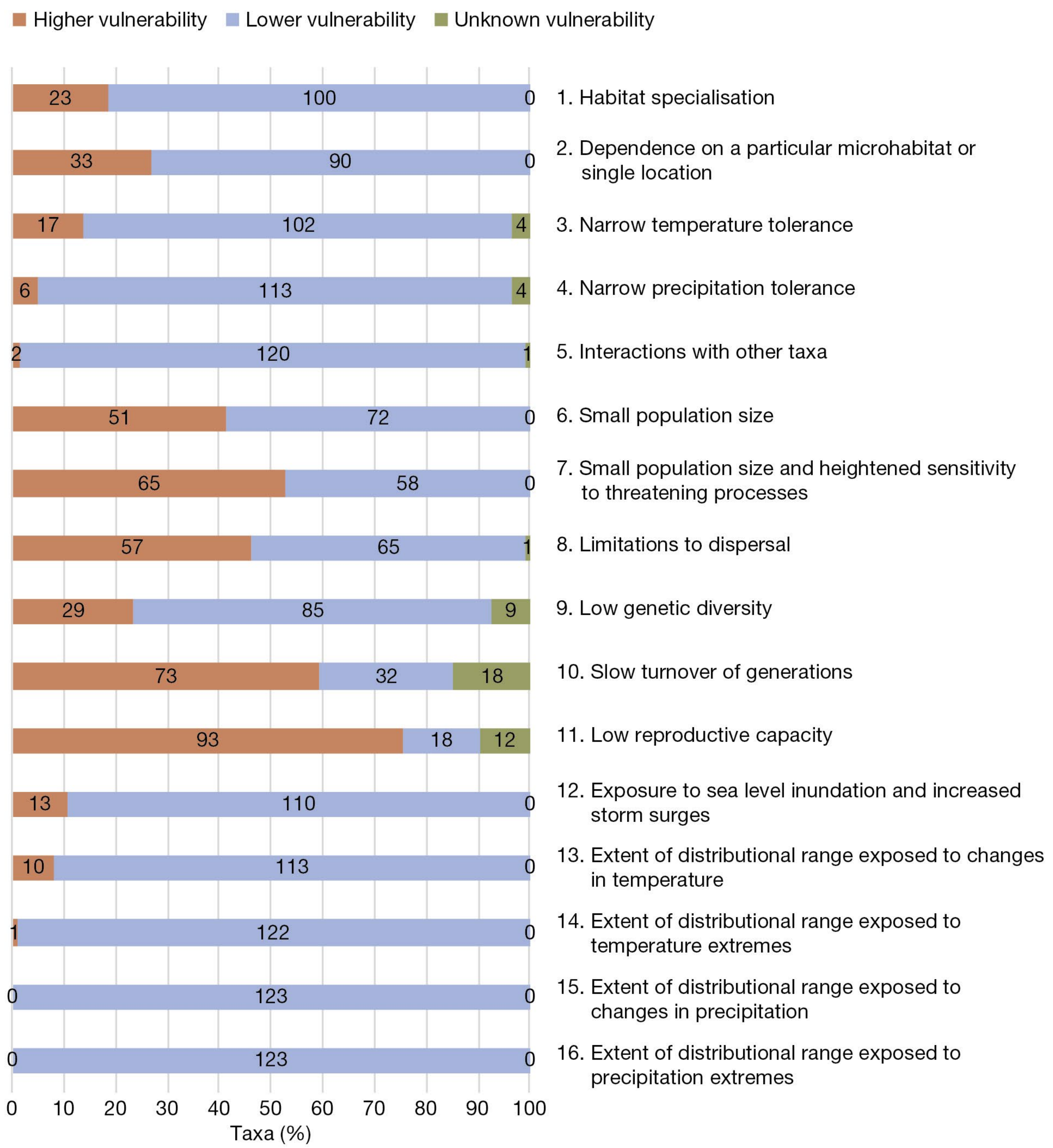


Figure 11. Number of indigenous herpetofauna taxa in Aotearoa New Zealand triggering ‘higher vulnerability’, ‘lower vulnerability’ or ‘unknown vulnerability’ scores for each trait (sensitivity dimension traits 1–7, low adaptive capacity dimension traits 8–11 and exposure dimension traits 12–16). Results are shown for the RCP8.5 emissions scenario by mid-century.

6.3 Discussion

Many of Aotearoa New Zealand's reptile and frog taxa have been reduced to small, highly fragmented populations which, in many cases, have limited or no means of dispersal. Furthermore, taxa often exhibit long generation times and / or low reproductive capacities (Cree 1994). This was evident in this assessment where the small population size and low adaptive capacity traits were most frequently triggered for 'higher vulnerability'. These characteristics make populations vulnerable to existing pressures such as introduced predators and habitat loss and explain why most herpetofauna taxa are already classified as Threatened (Burns et al. 2018; Hitchmough et al. 2021). The increasing impacts of climate change from mid- to late century will lead to additional threats to populations, with over 60% of herpetofauna taxa assessed being predicted to be Highly Vulnerable by late century.

6.3.1 Alpine and coastal lizards

The 15 Highly Vulnerable lizards that were identified under the RCP8.5 emissions scenario by mid-century are a mix of alpine and coastal taxa, reflecting the projected impacts of climate change on warming of the alpine zone, increased storm surges and sea level rise.

The colder period of the year will be shorter and less extreme, likely leading to an increased abundance of introduced predators at higher elevations for longer periods. There will also be a greater diversity of mammalian predators in alpine lizard habitats, with mice (*Mus musculus*), hedgehogs (*Erinaceus europaeus*), stoats (*Mustela erminea*) and potentially increased numbers of rats (*Rattus* spp.) occurring unless effective management solutions are found (O'Donnell et al. 2017; Walker et al. 2019). There will also be a change in vegetation composition and range (Richardson et al. 2005), altering the types of food and shelter available. Aotearoa New Zealand's alpine lizard taxa are often already living at or near the tops of mountains and mountain ranges, so they will not be able to move to higher elevations to avoid warming temperatures and the associated effects on their habitats and predators.

Coastal reptile taxa will be impacted by increased storm surge events and rising sea levels and, like alpine taxa, will often have nowhere to move to due to their inland habitats having already been lost or made unsuitable through development (see case study 3).

6.3.2 Direct effects of climate change

Exposure to changing mean and extreme temperatures and precipitation levels is predicted to increase over the ranges of more taxa over time, resulting in over 60% of all herpetofauna taxa being likely to be Highly Vulnerable to climate change by late century. Many herpetofauna taxa are vulnerable to evaporative water loss and are reliant on moisture and water sources to prevent desiccation (e.g. the chevron skink [*Oligosoma homalonotum*] and Hochstetter's frog [*Leiopelma hochstetteri*]), so hotter, drier summers and periods of drought will impact these taxa directly. Frog taxa that rely on small, forested streams for breeding may also experience contractions in habitat as streams shrink in size and the riparian habitat becomes drier, and a higher occurrence of fires will lead to habitat destruction and the death of animals. Conversely, flood events will cause destruction of the riparian habitats on which many taxa depend (see case study 4). For rock-dwelling lizards such as the Korero gecko (*Woodworthia* "Otago / Southland large"), higher temperatures may cause individuals to abandon rock crevices that are relied on as daytime retreats and for thermoregulation (Chukwuka 2020).

Some herpetofauna taxa have life history stages with clear physiological thresholds, so climate change will have direct consequences for their persistence. For example, the tuatara has evolved temperature-dependant sex determination and needs a range of nest temperatures to produce offspring of both sexes (Mitchell et al. 2010; Grayson et al. 2014). Likewise, it appears that some subalpine gecko taxa need cold winters to allow gravid females to keep their reproductive systems active for successful embryo development (D van Winkel, pers. comm., 2023).

6.3.3 Adaptive capacity

Although very few 'unknown' scores were recorded for herpetofauna traits, more research and monitoring of the reproductive biology of some taxa is needed to improve knowledge and assist in making predictions around their potential for adaptive capacity. When the pessimistic assessment method was used, two additional taxa to those listed in Table 9 appeared in the Highly Vulnerable list: the long-toed skink (*Oligosoma longipes*) and Roamatimati skink (*Oligosoma* aff. *longipes* "southern"). There were no data available for traits *10: Slow turnover of generations* and *11: Low reproductive capacity* for these taxa, but based on their conservation statuses (Threatened – Nationally Vulnerable and At Risk – Declining, respectively) and overall rankings in the list, it may be conservative to also consider these taxa as Highly Vulnerable for climate change related prioritisation purposes.

6.3.4 Planning for the future

A high proportion of Aotearoa New Zealand's herpetofauna taxa are already threatened with extinction due to pressures such as habitat loss and introduced predators (Burns et al. 2018; Hitchmough et al. 2021; Macinnis-Ng et al. 2021). Therefore, the additional and interacting pressures from the impacts of climate change may tip some taxa over the edge (see case study 3). The best approach for mitigating the impacts of climate change on taxa (e.g. by providing and protecting habitats or assisting dispersal) is largely unknown due to the sensitivity of taxon habitat requirements and the length of time it takes to measure success due to the long generation times. Therefore, research that will lead to mitigation actions against climate change is essential for robust conservation planning.

Case study 3: Skinks saved days before habitat is washed away by a storm surge – but what now?

The cobble skink (*Oligosoma* aff. *infrapunctatum* “cobble”) was first discovered in 2008 on the West Coast of Te Waipounamu / the South Island, where it was confined to small, sparse areas of specialised habitat of cobble beach. This habitat is likely to have provided some protection from mammalian predators that were impacting other skink taxa in the surrounding area.

Residential and farming areas also occur along this wild coastline, where they are being subjected to coastal erosion and storms. The beach was modified to protect these areas of human use, but this in turn reduced the natural system of maintaining the cobble habitat, trapping the skinks in an ever-reducing area that was increasingly vulnerable to coastal impacts.

Cobble skinks (*Oligosoma* aff. *infrapunctatum* “cobble”) in their natural habitat. *Photo: Richard Gibson / Auckland Zoo*

Eight years after its discovery, the cobble skink population was found to have declined and its habitat had reduced. With only a few known animals remaining, it was decided that something had to be done, so 38 surviving cobble skinks were caught and taken into captivity at Auckland Zoo. Two days later, a storm hit the coast and the cobble skink habitat was completely gone.

While conservationists have since found new potentially suitable habitat for a release site as well as an additional population of cobble skinks, the increasing frequency of storm events means that management of this specialised coastal species will continue to be extremely challenging and complex.

The cobble skink was assessed as Highly Vulnerable by mid-century under the RCP8.5 emissions scenario. This case study demonstrates how short-range endemics with specialised habitat requirements that are already under pressure may be tipped to extinction with the additional impacts of climate change. It also highlights the complexities involved in mitigating these impacts when saving a taxon if there is nowhere left for it to go.

Case study 4: Single extreme weather events can push taxa to the brink

At the end of January 2023, regions in the upper Te Ika-a-Māui / North Island of Aotearoa New Zealand were exposed to two heavy rainfall events that led to widespread, catastrophic floods and landslides.

Stream habitat destroyed by slip.
Photo: John Heaphy

Hochstetter's frog (*Leiopelma hochstetteri*).
Photo: Tara Murray

The Bay of Plenty contains habitat that is critical to a genetically distinct population of the declining Hochstetter's frog (*Leiopelma hochstetteri*). These frogs inhabit just two tributary streams, one of which supports the bulk of the population, which is estimated at 100–200 frogs.

During the January floods, the slip shown in the photograph to the left, which was likened to a lahar, came down the main tributary and destroyed at least 500 m of the best habitat, which was densely populated by frogs. This caused the already small remaining frog population to be split into two. Furthermore, the cliff above the site is now unstable, and any additional slip event is likely to destroy the remaining habitat, putting this frog population at risk of being unable to recover.

Hochstetter's frog was assessed as being at Latent Risk by mid-century and Highly Vulnerable by late century under the RCP8.5 emissions scenario, but this case study demonstrates how small populations are at significant risk from single extreme weather events. This highlights the importance of monitoring the environment of Latent Risk taxa and ensuring that management actions consider the vulnerability of small populations to the predicted consequences of climate change.

7. Climate change vulnerability assessment of selected invertebrates

The robust grasshopper (*Brachaspis robustus*) was assessed as Highly Vulnerable to climate change. Predicted increases in temperature across its range are likely to impact the recovery of this Threatened – Nationally Endangered species because it needs a cold winter to develop its eggs. *Photo: Tara Murray*

7.1 Introduction

We conducted a CCVA for 243 invertebrate taxa in Aotearoa New Zealand. At the time of writing, the New Zealand Organisms Register[11] listed 35,282 invertebrate taxa as occurring in the wild in Aotearoa New Zealand, including just over 20,000 insects and spiders. However, most taxa are poorly studied and only c. 12% have been assigned a conservation status under the NZTCS. Therefore, in this assessment, we chose to focus on taxa that had been assessed as Threatened or At Risk – Declining in five of the better-known, predominantly terrestrial groups: spiders (Araneae, 5 taxa), beetles (Coleoptera, 40 taxa), butterflies and moths (Lepidoptera, 77 taxa), wētā and grasshoppers (Orthoptera, 23 taxa), and land snails (Architaenioglossa, 12 taxa; Basommatophora, 1 taxon; Stylommatophora, 85 taxa). An additional 46 taxa that fitted these criteria (12 beetles, 3 moths and 31 land snails) were excluded from the assessment because there was insufficient information to make an assessment or they were considered taxonomically indistinct. According to the latest NZTCS threat assessments at the time of writing (Leschen et al. 2012; Mahlfeld et al. 2012; Hoare et al. 2017; Barker et al. 2021; Sirvid et al. 2021; Walker et al. 2021; Trewick et al. 2022), 79 (33%) of the assessed taxa were Threatened – Nationally Critical, 61 (25%) were Threatened – Nationally Endangered, 58 (24%) were Threatened – Nationally Vulnerable, 2 (1%) were Threatened – Nationally Increasing and 43 (18%) were At Risk – Declining.

7.2 Results

All the assessed invertebrates were found to be vulnerable to climate change for at least one trait dimension (sensitivity, low adaptive capacity or exposure). The proportion of invertebrate taxa identified as Highly Vulnerable ranged from 6% to 98% depending on the emissions scenario and assessment method applied (Fig. 12). For the RCP4.5 emissions scenario, the number of Highly Vulnerable taxa ranged from 15 to 48 taxa (6–20%) by mid-century, rising to 20 to 57 taxa (8–23%) by late century. Under RCP8.5, the numbers were even higher, with 40 to 89 taxa (16–37%) being identified as Highly Vulnerable by mid-century and 164 to 239 taxa (67–98%) by late century.

Using the optimistic assessment method, where 'unknown vulnerability' scores were replaced with 'lower vulnerability' scores, 128 taxa (53%) were classified as Latent Risk by mid-century under the RCP8.5 emissions scenario (Fig. 13A) and all but four of these moved to Highly Vulnerable by late century as they triggered at least one exposure trait threshold (Fig. 13B). All 124 of the taxa that moved from Latent Risk to Highly Vulnerable triggered the threshold for predicted exposure to mean temperature increases of ≥1.5°C across >75% of their range (trait 13, Fig. 14). Exposure to increased temperature extremes, and changes in mean precipitation and precipitation extremes (traits 14–16) also increased but to a lesser extent, with each of these triggering the 'higher vulnerability' threshold for an additional 44%, 19% and 16% of taxa, respectively.

In the sensitivity dimension, most taxa triggered the 'higher vulnerability' threshold for traits *1: Habitat specialisation* (163 taxa, 67%), *2: Dependence on a particular microhabitat or single location* (128 taxa, 53%), *6: Small population size* (188 taxa, 77%) and *7: Small population size and heightened sensitivity to threatening processes* (153 taxa, 63%) (Fig. 14A). Sensitivity to temperature was unknown for 50% of taxa, which included all 98 land snail taxa but only 23 insect and spider taxa. Less than one-third of the taxa assessed had a narrow or unknown precipitation tolerance, with the largest group being the Lepidoptera (49 of 77 taxa), as little is known about their ecological needs with respect to precipitation and humidity.

[11] https://nzor.org.nz (accessed May 2024).

Trait 8: *Limitations to dispersal* was the most frequently triggered low adaptive capacity trait (69% of assessed taxa), with this being triggered for 80% of beetle taxa, 78% of wētā and grasshopper taxa, 22% of moth taxa, 60% of spider taxa (three out of five) and 99% of land snail taxa (97 out of 98; this trait was scored 'unknown' for *Chaureopa roscoei*). A low reproductive rate and slow turnover of generations were also common (> 40% of taxa triggered the 'higher vulnerability' threshold for each), but for almost 90% of taxa there were insufficient data to determine if they suffer from low genetic diversity.

The 40 taxa that were assessed as Highly Vulnerable by mid-century under the RCP8.5 emissions scenario using the optimistic assessment method (Table 10) included representatives of all five invertebrate groups, although *Powelliphanta* taxa were notably absent among the land snails. Larger proportions of wētā and grasshoppers (43%) and beetles (43%) were represented than spiders (20%), moths and butterflies (13%), and land snails (2%). However, this was strongly influenced by the availability of data on which to make the assessments (i.e. the large number of traits scored as 'unknown'), and these proportions changed to 52% of wētā and grasshoppers, 58% of beetles, 80% of spiders, 51% of moths and butterflies, and 11% of land snails when the pessimistic assessment method was used (i.e. where 'unknown vulnerability' scores were replaced with 'higher vulnerability' scores) (Table 11). Knowledge gaps were lowest for exposure traits and highest for low adaptive capacity traits, particularly with respect to genetic diversity and reproductive capacity.

Experts recorded high information adequacy (overall confidence score ≥ 40) in their trait assessments for just 29 taxa (12%), including 25% and 15% of Highly Vulnerable taxa under the optimistic and pessimistic assessment methods, respectively (Tables 10 and 11).

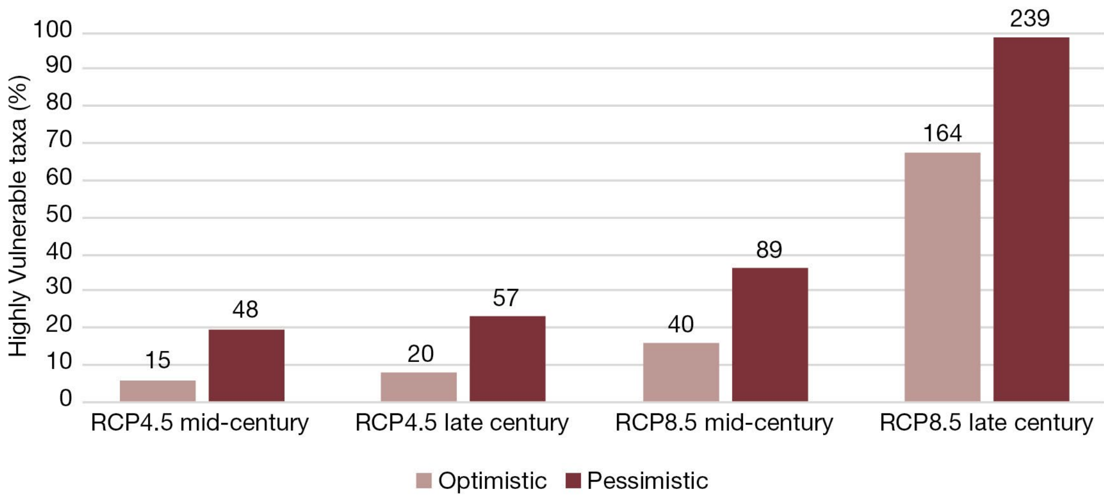


Figure 12. Percentages of the assessed invertebrate taxa in Aotearoa New Zealand that were classified as Highly Vulnerable under each emissions scenario (RCP4.5 or RCP8.5), time frame (mid- or late century) and assessment method (optimistic or pessimistic). Trait values scored as 'unknown vulnerability' were replaced with 'lower vulnerability' for the optimistic assessment and 'higher vulnerability' for the pessimistic assessment. Thus, the optimistic assessment gives an estimate of the minimum number of Highly Vulnerable taxa, while the pessimistic assessment gives an estimate of the maximum number.

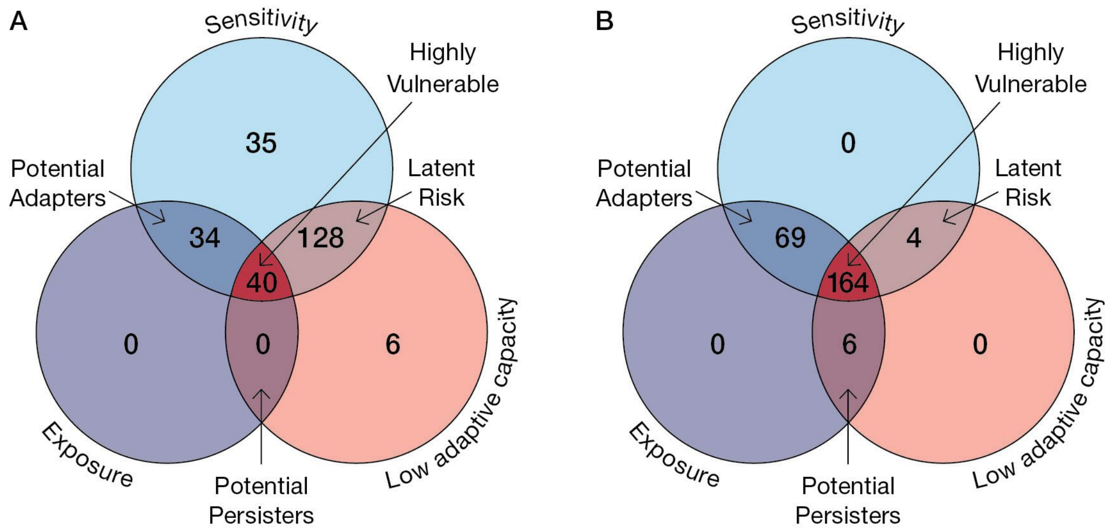


Figure 13. Number of assessed invertebrate taxa in Aotearoa New Zealand in each of the three climate change vulnerability dimensions (sensitivity, low adaptive capacity, exposure) and four climate change vulnerability categories (Highly Vulnerable, Potential Adapters, Potential Persisters and Latent Risk) by (A) mid-century and (B) late century under the RCP8.5 emissions scenario using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores).

Table 10. Priorities and confidence scores for the 40 invertebrate taxa that were classified as Highly Vulnerable by mid-century under the RCP8.5 emissions scenario using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores). The higher the priority of the taxon, the more traits triggered the 'higher vulnerability' score and therefore the greater the concern. The higher the confidence score, the better the data used by experts to assess the taxon. Note that the scientific names of taxa were derived from the New Zealand Threat Classification System (NZTCS) database on 1 August 2022 and so do not account for any changes since then (e.g. the name *Brachaspis robustus* is used here for the robust grasshopper, which was renamed *Sigaus robustus* in 2023 [Trewick et al. 2023]).

SCIENTIFIC NAME	COMMON NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE (MAX. = 48)
Deinacrida talpa	Paparoa giant wētā	1	45
Hadramphus tuberculatus	Canterbury knobbled weevil	1	45
Kupea electilis	Kupe's grass moth	1	42
Kiwaia sp. "Cloudy Bay"	Mat daisy jumper	1	41
Asaphodes frivola	Remuremu looper moth	1	41
Brachaspis robustus	Robust grasshopper	1	40
Orocrambus sophistes	Snout moth	1	40
Deinacrida pluvialis	Southern Alps giant wētā	1	38
Geodorcus ithaginis	Mokohinau stag beetle	1	37
Hadramphus spinipennis	Coxella weevil	1	36
Stigmella sp. "*Olearia*"	Pigmy moth	1	24
Kiwaia jeanae	Kaitorete jumper moth	2	40
Prodontria lewisi	Cromwell chafer beetle	2	40
Geodorcus sororum	Stag beetle	2	39
Mecodema pulchellum	Ground beetle	2	38
Orocrambus fugitivellus	Snout moth	2	38
Orocrambus "Mackenzie Basin"	Snout moth	2	37
Mecodema strictum	Ground beetle	2	36
Kiwaia "plains jumper"	Plains jumper moth	2	35
Sigaus australis "central arid"	Central arid alpine grasshopper	2	34
Deinacrida tibiospina	Mt Arthur wētā	2	32
Sigaus homerensis	Homer grasshopper	2	29
Succinea archeyi	Amber snail	2	29

Continued on next page

Table 10 continued

SCIENTIFIC NAME	COMMON NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE (MAX. = 48)
Wainuia clarki	Land snail	2	29
Bembidion tillyardi	Back Beach beetle	2	29
Brullea antarctica	Ground beetle	3	40
Hemiandrus "furoviarius"	Tekapo ground wētā	3	39
Neanops pritchardi	Ground beetle	3	27
Orthoglymma wangapeka	Ground beetle	3	27
Holcaspis abdita	Ground beetle	3	24
Sigaus minutus	Minute grasshopper	4	36
Zecillenus chalmeri	Ground beetle	4	33
Gadira leucophthalma	Beaked moss moth	4	33
Megadromus sp. 8 "Omeo Hut" (Omeo Hut, Otago, CMNZmega08)	Ground beetle	4	30
Hemiandrus (CMNZ 2000.121.21115) "Cromwell"	Cromwell ground wētā	4	29
Zecillenus embersoni	Ground beetle	4	28
Brachaspis nivalis "lowland"	Snow grasshopper	4	27
Holcaspis n. sp. 1 (McKenzie, Canterbury, CMNZholc00)	Ground beetle	4	24
Duvaliomimus (*Duvaliomimus*) *crypticus*	Ground beetle	4	23
Periegops keani	Six-eyed spider	4	23

Table 11. Priorities and confidence scores for the 89 invertebrate taxa that were classified as Highly Vulnerable by mid-century under the RCP8.5 emissions scenario using the pessimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'higher vulnerability' scores). The higher the priority of the taxon, the more traits triggered the 'higher vulnerability' score and therefore the greater the concern. The higher the confidence score, the better the data used by experts to assess the taxon. Note that the scientific names of taxa were derived from the New Zealand Threat Classification System (NZTCS) database on 1 August 2022 and so do not account for any changes since then.

SCIENTIFIC NAME	COMMON NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE (MAX. = 48)
Deinacrida talpa	Paparoa giant wētā	1	45
Kiwaia sp. "Cloudy Bay"	Mat daisy jumper	1	41
Lycaena ianthina	Milford boulder copper butterfly	1	39
Deinacrida pluvialis	Southern Alps giant wētā	1	38
Hadramphus spinipennis	Coxella weevil	1	36
Pyrgotis sp. "*Olearia*"	Leafroller moth	1	35
Dichromodes "Gore Bay"	Gore Bay looper moth	1	35
Dichromodes "Cloudy Bay"	Looper moth	1	35
Arctesthes titanica	Looper moth	1	34
Stathmopoda sp. "*Olearia*"	Moth	1	32
Xanthorhoe frigida	Looper moth	1	31
Izatha psychra	Lichen tuft moth	1	31
Notoreas perornata "Waiho Flats"	Pimelea looper moth	1	31
Bembidion tillyardi	Back Beach beetle	1	29
Neanops pritchardi	Ground beetle	1	27
Scythris sp. "stripe"	Moth	1	26
Stigmella sp. "*Olearia*"	Pigmy moth	1	24
Duvaliomimus (*Duvaliomimus*) *crypticus*	Ground beetle	1	23
Cytora hirsutissima	Land snail	1	23

Continued on next page

Table 11 continued

SCIENTIFIC NAME	COMMON NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE (MAX. = 48)
Holcaspis bathana	Ground beetle	1	23
Delouagapia tasmani	Land snail	1	23
Climocella pukanui	Land snail	1	22
Fectola melchior	Land snail	1	22
Delos sp. 1 (NMNZ M.029346)	Land snail	1	20
Delos sp. 13 (NMNZ M.029345)	Land snail	1	20
Migas taierii	Trapdoor spider	1	17
Maloides cavernicola	Three-clawed spider	1	15
Charopidae sp. 130 (NMNZ M.127912) *Phacussa* "kingae"	Land snail	1	13
Hadramphus tuberculatus	Canterbury knobbled weevil	2	45
Kupea electilis	Kupe's grass moth	2	42
Asaphodes frivola	Remuremu looper moth	2	41
Lycaena sp. "Chrystalls Beach boulder"	Chrystalls Beach boulder copper butterfly	2	41
Orocrambus sophistes	Snout moth	2	40
Brachaspis robustus	Robust grasshopper	2	40
Kiwaia jeanae	Kaitorete jumper moth	2	40
Meterana "Foveaux Strait"	Moth	2	40
Notoreas edwardsi	Pimelea looper moth	2	37
Orocrambus "Mackenzie Basin"	Snout moth	2	37
Notoreas casanova	Pimelea looper moth	2	37
Kiwaia "plains jumper"	Plains jumper moth	2	35
Arctesthes avatar	Avatar moth	2	34
Notoreas perornata "Cape Campbell"	Pimelea looper moth	2	33
Notoreas perornata "ND/AK"	Pimelea looper moth	2	33
Notoreas perornata "TK/NN"	Pimelea looper moth	2	33
"*Pseudocoremia*" *cineracia*	Looper moth	2	33
Deinacrida tibiospina	Mt Arthur wētā	2	32
Pyrausta comastis	Snout moth	2	31
Notoreas perornata "Cape Turnagain"	Pimelea looper moth	2	30
Notoreas perornata "Castlepoint"	Pimelea looper moth	2	30
Sporophyla oenospora	Snout moth	2	30
Sigaus homerensis	Homer grasshopper	2	29
Succinea archeyi	Amber snail	2	29
Xylotoles costatus	Pitt Island longhorn beetle	2	29
Periegops keani	Six-eyed spider	2	23
Stathmopoda albimaculata	Moth	2	21
Holcaspis bidentella	Ground beetle	2	21
Punctidae sp. 36 (NMNZ M.088229) *Phrixgnathus* "wallacei"	Land snail	2	18
Maniho centralis	Forest spider	2	13
Geodorcus sororum	Stag beetle	3	39
Orocrambus fugitivellus	Snout moth	3	38
Mecodema pulchellum	Ground beetle	3	38
Geodorcus ithaginis	Mokohinau stag beetle	3	37
Mecodema strictum	Ground beetle	3	36
Sigaus australis "central arid"	Central arid alpine grasshopper	3	34

Continued on next page

Table 11 continued

SCIENTIFIC NAME	COMMON NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE (MAX. = 48)
Zecillenus chalmeri	Ground beetle	3	33
Notoreas perornata "WA/WN"	Pimelea looper moth	3	32
Horelophus walkeri	Beetle	3	31
Placostylus (*Basileostylus*) *bollonsi*	Pūpūharakeke	3	30
Megadromus sp. 8 "Omeo Hut" (Omeo Hut, Otago, CMNZmega08)	Ground beetle	3	30
Wainuia clarki	Land snail	3	29
Hemiandrus (CMNZ 2000.121.21115) "Cromwell"	Cromwell ground wētā	3	29
Zecillenus embersoni	Ground beetle	3	28
Orthoglymma wangapeka	Ground beetle	3	27
Brachaspis nivalis "lowland"	Snow grasshopper	3	27
Maoricrambus oncobolus	Snout moth	3	25
Holcaspis abdita	Ground beetle	3	24
Holcaspis falcis	Ground beetle	3	21
Australothis volatilis	Owlet moth	4	43
Prodontria lewisi	Cromwell chafer beetle	4	40
Brullea antarctica	Ground beetle	4	40
Hemiandrus "furoviarius"	Tekapo ground wētā	4	39
Sigaus minutus	Minute grasshopper	4	36
Austrocidaria arenosa	Looper moth	4	34
Gadira leucophthalma	Beaked moss moth	4	33
Geodorcus capito	Chatham Island stag beetle	4	31
Phaulacridium otagoense	Short-horned grasshopper	4	31
Pachyrhamma delli	Cave wētā	4	28
Stathmopoda campylocha	Moth	4	25
Holcaspis n. sp. 1 (McKenzie, Canterbury, CMNZholc00)	Ground beetle	4	24

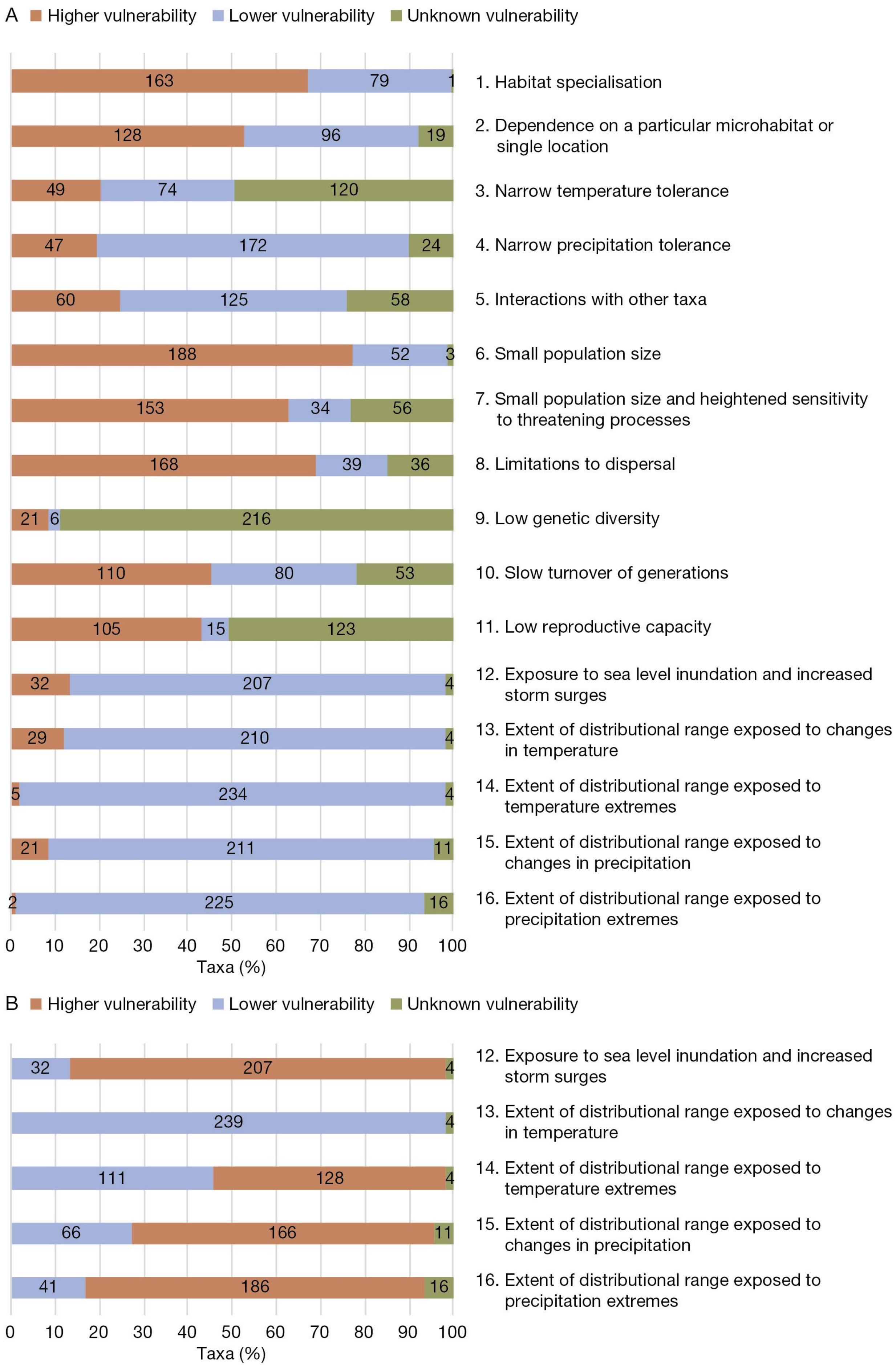


Figure 14. Number of the assessed invertebrate taxa in Aotearoa New Zealand triggering 'higher vulnerability', 'lower vulnerability' or 'unknown vulnerability' scores for each trait (sensitivity dimension traits 1–7, low adaptive capacity dimension traits 8–11 and exposure dimension traits 12–16). Results are shown for the RCP8.5 emissions scenario by (A) mid-century and (B) late century (only exposure traits changed between the two time frames, so only these are shown).

7.3 Discussion

A high proportion of the invertebrate taxa assessed were predicted to be vulnerable to climate change, but these results must be viewed in the context that the taxa assessed were a subset of all indigenous invertebrates in Aotearoa New Zealand and the data on which these assessments were made were extremely limited for some taxa (see case study 5). The substantial difference in the number of taxa that were assessed as Highly Vulnerable to climate change between the optimistic and pessimistic assessment methods clearly reinforces the extent of the knowledge gaps for the invertebrate fauna. Similarly, even where experts were able to score taxa as having 'higher vulnerability' or 'lower vulnerability' for given traits, the information adequacy was often low. Our analysis highlights key knowledge gaps that must be filled before we can confidently understand the vulnerability of most invertebrate taxa to climate change.

7.3.1 Traits driving vulnerability

Based on the knowledge available, we found that habitat specialisation, small fragmented populations and limitations to dispersal are key factors affecting the vulnerability of invertebrates to climate change. Narrow temperature and precipitation tolerances (traits 3 and 4) each triggered 'higher vulnerability' for only around 20% of the taxa assessed, although temperature tolerance was identified as a significant knowledge gap for at least half the assessed taxa. Since invertebrates are ectotherms,[12] changes in mean and extreme temperatures could have a significant impact on their survival, growth, reproduction and phenology. Many insects and spiders have the capacity to respond positively to an increase in temperature, as this can speed up their rate of development, potentially increasing the number of generations produced annually – a significant cause for concern with regard to introduced pest insects (e.g. Harris and Barker 2007; Mansfield et al. 2021). However, Aotearoa New Zealand has many cold-adapted invertebrate taxa and there are almost no data on the upper temperature thresholds these taxa can tolerate. Alpine specialists, which include the most strongly cold-adapted taxa, may suffer not just from higher mean and extreme temperatures but also from reductions in the number of frost days, which can be essential for successful egg hatching (see case study 6).

For most taxa (84%), we had sufficient data to assess the five exposure traits for the RCP8.5 emissions scenario. This is likely because the taxa that were included in the CCVA were those assessed as Threatened or At Risk – Declining under the NZTCS based on some knowledge of their distributions. However, for around 40% of these taxa, exposure scores were coupled with low information adequacy scores for traits 13–16 (see Online Supplementary Information[13]).

Under the RPC8.5 emissions scenario, 74 taxa triggered the 'higher vulnerability' threshold for exposure by mid-century, with similar proportions triggering this threshold for sea level rise / coastal inundation and changes in mean temperature and precipitation. By late century, however, all but four taxa (98%) were predicted to be exposed to significant changes in at least one climate variable, and all but one taxon moved from Latent Risk to Highly Vulnerable based on exposure to an increased mean temperature. As noted above, sensitivity to temperature was identified as a key knowledge gap for invertebrate taxa, so it is critical that we take steps to better understand which taxa are truly sensitive to higher temperatures and what actions, if any, can be taken to mitigate exposure.

We also identified critical gaps in our understanding of the adaptive capacity of most invertebrate taxa. Dispersal limitations can be estimated with reasonable certainty for many taxa (e.g. island endemics, alpine land snails) based on their ability to fly and / or degree of isolation – although, paradoxically, some moths can be extremely sedentary and confined

[12] Ectotherms are animals that rely on the external environment to regulate their body temperature.

[13] www.doc.govt.nz/science-for-conservation-343

to small areas even if fully winged and apparently without physical limits to dispersal. Similarly, even if the life history of a taxon has not been confirmed, we can estimate the generation time based on the ecology of related taxa. By contrast, our understanding of variation in the reproductive capacity of invertebrates is extremely poor, and knowledge of genetic diversity, mutation rates and instances of bottleneck events are almost non-existent.

7.3.2 Geographical regions of greatest vulnerability

Our results were generally in agreement with those of previous Aotearoa New Zealand studies that have predicted that taxa associated with alpine, coastal and braided river habitats will be most at risk from climate change impacts (Macinnis-Ng et al. 2021; Keegan et al. 2022). Few of the taxa that were assessed as Highly Vulnerable were associated with forested environments. However, this could also reflect the fact that most of the taxa that have been classified as Threatened or At Risk – Declining and therefore included in this analysis are associated with more vulnerable, non-forested environments. For the moths in particular, all taxa that were assessed as Highly Vulnerable are endemic to the eastern South Island, inhabiting coastal and inland non-forest environments, and none are North Island endemics or forest taxa. For the land snails, many of the Highly Vulnerable taxa are endemic to offshore islands (e.g. Manawatāwhi / Three Kings Islands, Chatham Islands and Bounty Islands).

Unsurprisingly, all 32 of the assessed taxa that are restricted to coastal environments were classified as Highly Vulnerable with respect to exposure to inundation and / or storm surges (see case study 7). This comprised 20 moth taxa and 2 butterfly taxa (the Chrystalls Beach boulder copper butterfly and Milford boulder copper butterfly [*Lycaena ianthina*]) that are associated with coastal plant communities, as well as the amber snail (*Succinea archeyi*), the katipō (*Latrodectus katipo*), the six-eyed spider (*Periegops keani*) from the Aldermen Islands and six beetle taxa. The beetles included the Nelson-endemic Back Beach beetle (*Bembidion tillyardi*) and the more widespread *Brullea antarctica*, both of which live just above the high-tide mark, as well as the large stag beetle *Geodorcus sororum*, which is known only from a single island of 40 m elevation located 19 km from the main Chatham Island.

Most of the 29 taxa that triggered the threshold for exposure to temperature changes of ≥ 1.5°C by mid-century (trait 13) were moths, beetles and grasshoppers with distributions that are restricted to the dry inland regions of the South Island (e.g. Mackenzie Country and Central Otago), as well as the Southern Alps giant wētā (*Deinacrida pluvialis*) and the land snail *Wainuia clarki* from the Central North Island. As noted previously, however, by late century almost all taxa triggered this trait. By contrast, only 8% of taxa triggered the threshold for exposure to significant changes in precipitation (trait 15). This included taxa that are restricted to alpine areas which are predicted to receive higher rainfall (e.g. the Homer grasshopper [*Sigaus homerensis*] and four wētā taxa). Similarly, six of the seven beetle taxa that triggered the precipitation threshold are carabids and five are from the Nelson region, which is predicted to receive higher autumn and winter rainfall. These and other similar fossorial, ground-dwelling taxa could be significantly impacted by both wetter and drier soils impeding their ability to burrow into the ground or move about their environment.

7.3.3 Indirect effects of climate change

The assessment framework applied here focused solely on vulnerability to climate change, intentionally excluding potential indirect effects and avoiding any attempt to predict how taxa might respond to climate change (e.g. behaviourally) or climate-driven changes in their interactions with other taxa (except where interactions represent dependencies, e.g. specific host plants). However, these factors will undoubtedly influence how taxa are affected and so will need to be considered as conservation managers move towards determining how to mitigate future threats. For invertebrates, the year-round survival of introduced mammalian predators and / or their range expansion into new environments, particularly alpine and subalpine areas, are well recognised as important potential indirect effects, and there is some evidence that this is already occurring (Walker et al. 2019; Keegan et al. 2022). Similarly, expansion in the ranges of pest plants and invertebrates (e.g. paper wasps, ants), as well as new incursions could have significant impacts (Keegan et al. 2022).

For most invertebrate taxa, there are critical gaps in our ability to predict how temperature-induced changes in their phenology and distribution will influence their interactions with essential food plants, competitors, predators, and invertebrates and pathogens that act as their natural enemies. For herbivorous invertebrates, particularly moths and butterflies, changes in temperature, precipitation and atmospheric carbon dioxide are all expected to have indirect effects on species survival and fitness through their effects on plant growth and chemistry (Bidart-Bouzat and Imeh-Nathaniel 2008; Murray et al. 2013; Chen et al. 2019; Karthik et al. 2021). The interactions between these factors and the direct effects of temperature on invertebrates is even less well understood (Murray et al. 2013; Abarca and Spahn 2021; Bhagarathi and Gyanpriya 2023).

7.3.4 Predicting climate change impacts for invertebrates

Only a fraction of Aotearoa New Zealand's invertebrate taxa have been assessed within the NZTCS, and only those currently classified as Threatened or At Risk – Declining in five relatively well-known groups were included in this CCVA due to a lack of experts or data for the others – and even within these groups, not all taxa have been assessed using the NZTCS. In some cases, taxa that are restricted to environments which are predicted to be at greatest risk from climate change impacts, such as alpine habitats, are extremely poorly known (e.g. spiders) or have been intentionally left out of NZTCS assessments because until recently they have been considered safe from key threats such as introduced predators and pest plants (e.g. Lepidoptera). Furthermore, there is extremely high regional endemism in the Aotearoa New Zealand invertebrate fauna (Kuschel 1975), so there are likely many taxa whose entire distributions may occur within regions of Aotearoa New Zealand that are predicted to be exposed to substantial changes in temperature, rainfall, relative humidity, frost days and other parameters related to climate change. Consequently, many more taxa would likely be predicted to be vulnerable to climate change if assessed using this CCVA framework. However, the vast number of invertebrate taxa and the paucity of knowledge on their individual ecological needs and environmental limitations mean that it will take considerable time to assess all taxa using a CCVA framework such as this. In the interim, some ecosystem-level predictions could be made based on our results. It would be prudent to assume that the results for the small number of taxa assessed here can be used as proxies for many more unassessed taxa in related groups (e.g. taxa in the same genus or family) that occupy the same or very similar habitats.

Case study 5: The 'known unknowns'

Only a small proportion of terrestrial invertebrate taxa were included in this assessment, and we have very limited knowledge about some of these.

Land snails had the highest proportion of taxa with traits scored as 'unknown' across multiple dimensions, yet we considered their inclusion valuable as representative examples.

Aotearoa New Zealand boasts an extremely diverse endemic land snail fauna that includes several hundred undescribed taxa. The distribution and population status of most taxa is poorly known, and many have not yet been assessed using the New Zealand Threat Classification System (NZTCS) or have been listed as Data Deficient. For example, there are many alpine-restricted taxa with narrow ecological and geographical distributions that were not covered in the present study because their conservation status has not yet been assessed but which are likely to be highly vulnerable to the effects of climate change. There is also next to no information on the physiological tolerances of most taxa.

The inclusion of 98 land snail taxa in this climate change vulnerability assessment (CCVA) shows how this type of assessment can be successfully used to generate a better understanding of the relative vulnerability of taxa despite having imperfect data for them.

Hochstetter's land snail (*Powelliphanta hochstetteri hochstetteri* yellow based). *Photo: KJ Walker*

Case study 6: The diminishing real estate model and the plight of an alpine wētā

The alpine regions of Aotearoa New Zealand are cold and windy environments where solar radiation is high and the reproductive season is short. Alpine invertebrate taxa are highly endemic and have specialised traits that set them apart from lower elevation relatives. Paradoxically, the greatest threat to alpine communities is not the harsh environment but quite the opposite – warmth.

Current global atmospheric temperature anomalies show an average warming of 2.0°C since records began in the 1850s, with the average surface air temperature having risen from 15°C to 17°C in 2023 (www.ncei.noaa.gov/access/monitoring/global-temperature-anomalies/mean; accessed October 2023). Similarly, in Aotearoa New Zealand, the annual average land surface temperature has risen by 1.26°C since records began in 1909 (MfE and Stats NZ 2023).

Alpine ecosystems are among the most vulnerable and are in the greatest need of an adaptation plan. One sub-group of critically threatened alpine invertebrates includes the flightless subalpine and alpine taxa that persist just above the timber line on low-latitude and low-elevation mountain ranges. These taxa are most at risk of running out of alpine habitat as the environment warms – a loss of ecological real estate (Chinn and Chinn 2020). An additional threat is the encroachment of different species or higher densities of predators, as warmer temperatures may allow them to move to high elevations and persist year round.

The Paparoa giant wētā (*Deinacrida talpa*) is found in very low numbers and confined to the few high-elevation cirque basins of the Paparoa Range in northern Westland. Fortunately, the mountains are protected by national park status, but this does not protect against climate change, and the wētā here are probably already in trouble as they have little vertical range to occupy. Habitat is crucial – the wētā occupy dens, which consist of tunnels they dig into alpine mat-forming plants, usually forming a gallery between the plants' root networks and rocks.

Climate-related conservation action for these wētā could include determining the range and population structure, investigating the predator situation, and potentially identifying recipient mountain ranges within the ecological district for translocation. There is also a need to collect abiotic data on vertical changes in the mean temperature in the Paparoa Range, as well as biotic data on the optimal thermal conditions of known wētā populations in the wild.

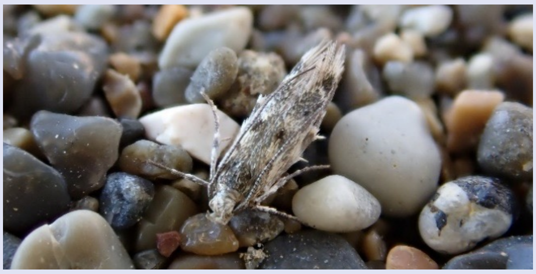
The Paparoa giant wētā (*Deinacrida talpa*) (top) and its typical alpine habitat in the Paparoa Range, north Westland (bottom). *Photos: Warren Chinn*

Case study 7: Diminishing coastal habitat

Unfortunately, the story of the cobble skink (*Oligosoma* aff. *infrapunctatum* "cobble") described in case study 3 is not unique. Coastal habitats of Aotearoa New Zealand are also home to a variety of highly specialised invertebrates, such as moths, spiders, beetles, flies and snails. Many of these are regional endemics with naturally small ranges and specific host-plant or microhabitat requirements that are maintained by the physical processes which define the coastal environment.

Back Beach beetle (*Bembidion tillyardi*). *Photo: Andy MacDonald*

Amber snail (*Succinea archeyi*). *Photo: © Euan Brooks CC BY 4.0, published with permission*



Mat daisy jumper (*Kiwaia* sp. "Cloudy Bay"). *Photo: Robert Hoare*

Mat daisy jumper (*Kiwaia* sp. "Cloudy Bay") habitat, which is squeezed between the sea and natural and human-induced barriers such as farmland and roads. *Photo: Robert Hoare*

In this assessment, we identified at least 12 (optimistic assessment) and up to 32 (pessimistic assessment) invertebrate taxa that are vulnerable to coastal inundation. Coastal turf moth examples include the mat daisy jumper (*Kiwaia* sp. "Cloudy Bay") in Marlborough, Kupe's grass moth (*Kupea electilis*) and the Kaitorete jumper moth (*Kiwaia jeanae*) in Canterbury, and the Remuremu looper moth (*Asaphodes frivola*) in Southland. Beetle examples include the Back Beach beetle (*Bembidion tillyardi*), which is known from the intertidal zone of just a few small beaches and inlets near Nelson, and the more widespread sand-burrowing ground beetle *Brullea antarctica*, which lives on beaches and foredunes above the high-tide mark. Land snails include the tiny amber snail (*Succinea archeyi*), which is restricted to seaward areas on a handful of small coastal dune fields in northern and eastern Northland and the Coromandel where it feeds primarily on blue-green algal mats and spinifex (*Spinifex sericeus*).

The mat daisy jumper is a prime example of a taxon for which climate change is already having an impact and compounding other threats. This moth has an incredibly limited dispersal ability and is thought to be restricted to a single host plant, and its habitat is shrinking because of natural succession, which is being accelerated by weed invasion. At the original discovery site, Rārangi, this tiny moth has already gone through what was probably a climate change driven local extinction following die-off of its host plant (*Raoulia* sp.) over several severe drought years (Eric Edwards, Department of Conservation, pers. comm., 2023). Fortunately, it was subsequently detected at another site. This taxon is likely a glacial relict that is adapted to a much colder and windier climate than currently prevails. The fact that is has managed to cling on in a very limited range shows that it has some adaptive ability to persist, but given the nature and small size of its remaining habitat, this will be stretched to breaking point under many climate change scenarios.

8. Climate change vulnerability assessment of selected vascular plants

With warmer temperatures, tree lines like this one at Twelve Mile Creek are likely to expand, leading to the loss of species-rich alpine habitats into often less-diverse subalpine forest. *Photo: Eiji Kitai*

8.1 Introduction

Of the 2,758 indigenous extant vascular plants that were assessed for their conservation status using the NZTCS in 2017 (de Lange et al. 2018), we assessed a subset of 561 Threatened and At Risk – Declining plants for their vulnerability to climate change. This partial assessment of the vascular flora of Aotearoa New Zealand focused on the most threatened plants as a priority. Of the plants included in this assessment, 213 were classified as Threatened – Nationally Critical, 76 as Threatened – Nationally Endangered, 114 as Threatened – Nationally Vulnerable and 158 as At Risk – Declining.

8.2 Results

The number of taxa that were assessed as Highly Vulnerable increased from a minimum of 81 (14%) by mid-century and 133 (24%) by late century under the RCP4.5 emissions scenario to a minimum of 224 (40%) by mid-century and 369 (66%) by late century under the RCP8.5 emissions scenario (Fig. 15). There was a notable difference in the number of Highly Vulnerable taxa between the optimistic and pessimistic assessments across all emissions scenarios and time frames. Nearly one-third of the plants were classified as being Latent Risk by mid-century under the RCP8.5 emissions scenario (149 taxa, 27%) (Fig. 16A), but all but four of these taxa had moved into the Highly Vulnerable category by late century (Fig. 16B).

Many of the 224 vascular plant taxa that were classified as Highly Vulnerable (Table 12) are associated with specific habitats such as wetlands (55 taxa), the coastal zone (50 taxa), drylands (29 taxa) and limestone habitats (19 taxa). The 84 Highly Vulnerable vascular plant taxa that were placed in the priority 1 category (Table 12) include taxa associated with all primary habitat types except shrublands.[14] A wide range of traits from all three trait dimensions were identified as drivers of vulnerability for these Threatened and At Risk – Declining plants. Significant factors in the vulnerability profiles of the vascular plants were sensitivity traits *1: Habitat specialisation* (362 taxa, 65%), *2: Dependence on a particular microhabitat or single location* (327 taxa, 58%), *6: Small population size* (394 taxa, 70%) and the corresponding trait *7: Small population with heightened sensitivity* (334 taxa, 60%) (Fig. 17). The most triggered exposure traits were *13: Extent of distributional range exposed to changes in temperature* (184 taxa, 33%) and *12: Exposure to sea level inundation and increased storm surges* (103 taxa, 18%).

Low information adequacy (i.e. high uncertainty in the knowledge) was most often reported for sensitivity traits *6: Small population* (208 taxa, 37%) and *5: Interactions with other taxa* (186 taxa, 33%). Additionally, trait *9: Low genetic diversity* was scored with low information adequacy for 185 taxa (33%) and as 'unknown' for a further 184 taxa (33%), which was a magnitude greater than the number of 'unknown' scores for any other trait (Fig. 17; see Online Supplementary Information[15] for a full list of the information adequacy scores).

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[14] We identified one primary habitat type for each of the 224 Highly Vulnerable vascular plant taxa. The habitat types were derived from the IUCN Habitat Classification Scheme (Version 3.1) but modified to reflect the drivers of plant communities in Aotearoa New Zealand. The habitat types were alpine, coastal zone, drylands, forest, islands, limestone, non-alpine rocky areas, open ground, shrublands, ultramafic and wetlands.

[15] www.doc.govt.nz/science-for-conservation-343

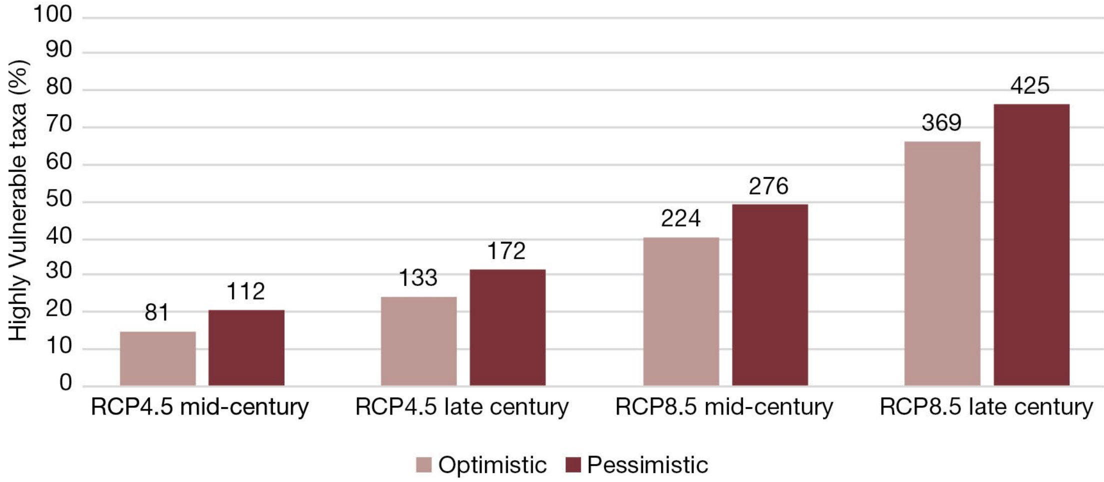

Figure 15. Percentages of the assessed vascular plant taxa in Aotearoa New Zealand that were classified as Highly Vulnerable under each emissions scenario (RCP4.5 or RCP8.5), time frame (mid- or late century) and assessment method (optimistic or pessimistic). Trait values scored as 'unknown vulnerability' were replaced with 'lower vulnerability' for the optimistic assessment and 'higher vulnerability' for the pessimistic assessment. Thus, the optimistic assessment gives an estimate of the minimum number of Highly Vulnerable taxa, while the pessimistic assessment gives an estimate of the maximum number.

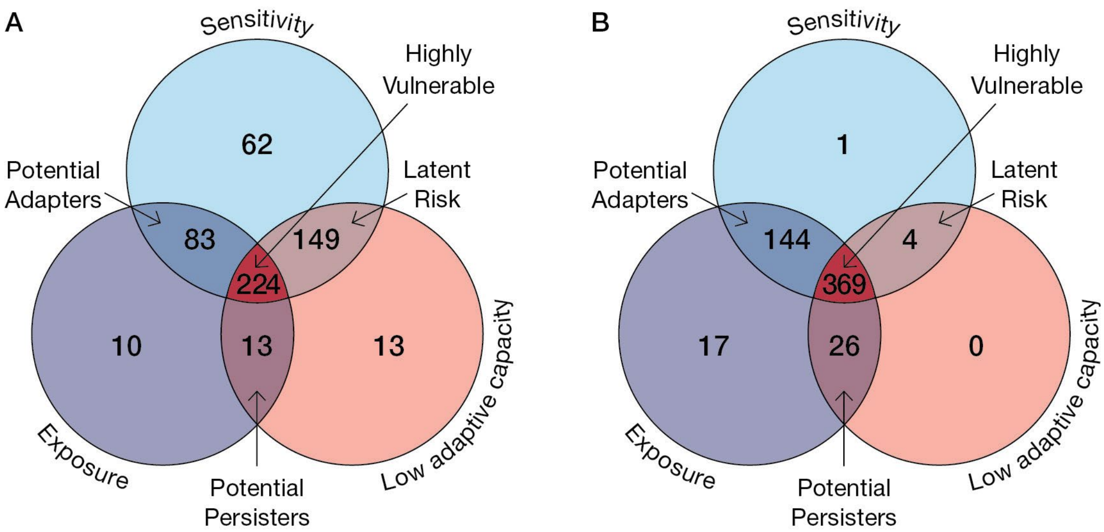

Figure 16. Number of assessed vascular plant taxa in Aotearoa New Zealand in each of the three climate change vulnerability dimensions (sensitivity, low adaptive capacity, exposure) and four climate change vulnerability categories (Highly Vulnerable, Potential Adapters, Potential Persisters and Latent Risk) by (A) mid-century and (B) late century under the RCP8.5 emissions scenario using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores). Seven taxa have not been included in (A) because they had 'lower vulnerability' scores on all three dimensions and were therefore classified as Low Vulnerability.

Table 12. Priorities and confidence scores for the 224 vascular plant taxa that were classified as Highly Vulnerable by mid-century under the RCP8.5 emissions scenario using the optimistic assessment method (traits with 'unknown vulnerability' scores were assumed to have 'lower vulnerability' scores). The higher the priority of the taxon, the more traits triggered the 'higher vulnerability' score and therefore the greater the concern. The higher the confidence score, the better the data used by experts to assess the taxon. Note that the scientific names of taxa were derived from the New Zealand Threat Classification System (NZTCS) database on 1 August 2022 and so do not account for any changes since then; the only exceptions to this are *Notothlaspi viretum* and *Ranunculus calianthus*, which were changed from *Notothlaspi* (a) (CHR 363071; Red Hills) and *Ranunculus* aff. *stylosus* (CHR 515131; Manahune), respectively, at the time of assessment. Te reo Māori / English common names have not been included in this table as so few threatened plants in Aotearoa New Zealand have common names.

SCIENTIFIC NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE MAX. = 48)	HABITAT TYPE
Sebaea ovata	1	46	Coastal
Gunnera hamiltonii	1	45	Coastal
Ranunculus (a) (AK 276181; Hope)	1	45	Wetlands
Lepidium banksii	1	44	Coastal
Lepidium kirkii	1	44	Drylands
Leptinella dispersa subsp. *rupestris*	1	44	Coastal
Trithuria inconspicua subsp. *brevistyla*	1	44	Wetlands
Cardamine dactyloides	1	43	Ultramafic
Cardamine porphyroneura	1	43	Ultramafic
Gentianella scopulorum	1	43	Coastal
Australopyrum calcis subsp. *optatum*	1	42	Limestone
Coprosma aff. *acerosa* (c) (WELT SP079167; Red Rocks)	1	42	Coastal
Craspedia (w) (CHR 395679; Burgoo)	1	40	Wetlands
Isoetes aff. *kirkii* (CHR 247118A; Lake Omapere)	1	40	Wetlands
Myosotis oreophila	1	40	Alpine
Myosotis umbrosa	1	40	Non-alpine rocky areas
Poa spania	1	40	Limestone
Ranunculus aff. *royi* (c) (CHR 513327; Waihao)	1	40	Limestone
Ranunculus pilifera	1	40	Alpine
Veronica societatis	1	40	Alpine
Craspedia (ee) (CHR 547118B; Lake Clara)	1	39	Wetlands
Helichrysum dimorphum	1	39	Limestone
Lepidium crassum	1	39	Coastal
Myosotis cheesemanii	1	39	Alpine
Senecio hauwai	1	39	Coastal
Trisetum aff. *lepidum* (AK 251835; Awahokomo)	1	39	Limestone
Chaerophyllum aff. *novae-zelandiae* (CHR 573578; Waitaki)	1	38	Limestone
Coprosma talbrockiei	1	38	Wetlands
Geranium cruentum	1	38	Wetlands
Melicytus (a) (CHR 355077; Matiri Range)	1	38	Alpine
Metrosideros bartlettii	1	38	Forest
Montia drucei	1	38	Alpine
Veronica aff. *treadwellii* (a) (CHR 394533; Bald Knob Ridge)	1	38	Alpine
Gentianella calcis subsp. *calcis*	1	37	Limestone
Gentianella calcis subsp. *manahune*	1	37	Limestone
Leptinella rotundata	1	37	Coastal
Olearia crebra	1	37	Non-alpine rocky areas
Pittosporum serpentinum	1	37	Ultramafic
Ranunculus buchananii	1	37	Alpine
Trithuria inconspicua subsp. *inconspicua*	1	37	Wetlands
Ackama nubicola	1	36	Non-alpine rocky areas

Continued on next page

Table 12 continued

SCIENTIFIC NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE MAX. = 48)	HABITAT TYPE
Myosotis colensoi	1	36	Limestone
Myosotis glauca	1	36	Open ground
Notothlaspi viretum	1	36	Alpine
Wurmbea novae-zelandiae	1	36	Wetlands
Ceratocephala pungens	1	35	Drylands
Gingidia enysii var. *enysii*	1	35	Limestone
Myosotis laeta	1	35	Ultramafic
Pseudowintera insperata	1	35	Forest
Sonchus aff. *novae-zelandiae* (CHR 84044; "glaucous")	1	35	Coastal
Cardamine alticola	1	34	Alpine
Thelymitra (a) (WELT SP79140; Ahipara)	1	34	Wetlands
Chenopodium detestans	1	32	Wetlands
Convolvulus verecundus	1	32	Drylands
Veronica adamsii	1	32	Non-alpine rocky areas
Pimelea aff. *villosa* (AK 216133; southern New Zealand)	1	31	Coastal
Pittosporum pimeleoides subsp. *majus*	1	31	Ultramafic
Hibiscus aff. *diversifolius* (AK 347684; Surville)	1	30	Ultramafic
Libertia aff. *ixioides* (c) (AK 319490; Surville Cliffs)	1	30	Ultramafic
Rhabdothamnus aff. *solandri* (a) (AK 319367; Surville Cliffs)	1	30	Ultramafic
Utricularia australis	1	30	Wetlands
Lepidium seditiosum	1	27	Coastal
Senecio esperensis	1	27	Island
Parsonsia praeruptis	1	26	Ultramafic
Senecio kermadecensis	1	23	Island
Lepidium castellanum	1	22	Coastal
Pimelea actea	2	46	Coastal
Atriplex cinerea	2	44	Coastal
Limosella (b) (CHR 515038; Manutahi)	2	44	Coastal
Veronica armstrongii	2	44	Drylands
Australopyrum calcis subsp. *calcis*	2	43	Limestone
Carex cirrhosa	2	42	Wetlands
Melicytus venosus	2	42	Coastal
Pittosporum patulum	2	42	Forest
Ranunculus recens	2	42	Wetlands
Scutellaria novae-zelandiae	2	42	Forest
Chaerophyllum colensoi var. *delicatulum* (CHR 73872; Hauhungaroa Range)	2	41	Wetlands
Pseudognaphalium ephemerum	2	41	Wetlands
Lepidium tenuicaule	2	40	Coastal
Pittosporum dallii	2	40	Forest
Carex rubicunda	2	39	Wetlands
Craspedia (l) (CHR 479212; Charleston)	2	39	Coastal
Koeleria aff. *novozelandica* (AK 252546; Awahokomo)	2	39	Limestone
Pimelea orthia subsp. *protea*	2	39	Coastal
Ranunculus callianthus	2	39	Limestone
Althenia bilocularis	2	38	Wetlands
Gratiola concinna	2	38	Wetlands
Simplicia felix	2	38	Forest

Continued on next page

Table 12 continued

SCIENTIFIC NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE MAX. = 48)	HABITAT TYPE
Coprosma waima	2	37	Non-alpine rocky areas
Craspedia (f) (CHR 514362; Hacket)	2	37	Ultramafic
Geranium rubricum	2	37	Ultramafic
Hypericum rubicundulum	2	37	Wetlands
Lepidium aegrum	2	37	Coastal
Lobelia physaloides	2	37	Forest
Myosurus minimus subsp. *novae-zelandiae*	2	37	Drylands
Pimelea mesoa subsp. *macra*	2	37	Alpine
Melicytus crassifolius	2	36	Coastal
Ranunculus brevis	2	36	Wetlands
Cardamine pachyphylla	2	35	Non-alpine rocky areas
Carex inopinata	2	35	Drylands
Dysphania pusilla	2	35	Wetlands
Lepidium oleraceum	2	35	Coastal
Leptinella aff. *pectinata* (a) (CHR 580894; Nevis)	2	35	Non-alpine rocky areas
Atriplex hollowayi	2	34	Coastal
Cardamine mutabilis	2	34	Wetlands
Pimelea sericeovillosa subsp. *pulvinaris*	2	34	Drylands
Myosotis elderi	2	33	Alpine
Gunnera densiflora	2	32	Wetlands
Goodenia heenanii	3	45	Coastal
Myosotis pygmaea	3	45	Open ground
Craspedia (c) (CHR 529115; Kaitorete)	3	44	Coastal
Craspedia (qq) (CHR 167368; Wakanui)	3	44	Coastal
Hibiscus richardsonii	3	44	Coastal
Kunzea salterae	3	44	Shrublands
Veronica lilliputiana	3	43	Wetlands
Lobelia carens	3	42	Wetlands
Craspedia (j) (CHR 516302; Lake Heron)	3	41	Drylands
Mida salicifolia	3	41	Forest
Peraxilla tetrapetala	3	41	Forest
Veronica cupressoides	3	41	Drylands
Ficinia spiralis	3	40	Coastal
Lepidium sisymbrioides	3	40	Limestone
Lepidium solandri	3	40	Drylands
Melicytus flexuosus	3	40	Shrublands
Rytidosperma telmaticum	3	40	Wetlands
Veronica salicornioides	3	40	Drylands
Calochilus herbaceus	3	39	Wetlands
Crassula peduncularis	3	39	Wetlands
Polygonum plebeium	3	39	Wetlands
Rytidosperma horrens	3	39	Wetlands
Aciphylla squarrosa var. *squarrosa*	3	38	Alpine
Coprosma intertexta	3	38	Shrublands
Corybas aff. *rivularis* (AK 251833; Kaitarakihi)	3	38	Forest
Craspedia (k) (CHR 283173; “coast”)	3	38	Coastal
Crassula multicaulis	3	38	Wetlands

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Table 12 continued

SCIENTIFIC NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE MAX. = 48)	HABITAT TYPE
Euphrasia wettsteiniana	3	38	Wetlands
Lobelia fatiscens	3	38	Wetlands
Myosotis pottsiana	3	38	Non-alpine rocky areas
Ranunculus acraeus	3	38	Alpine
Trisetum antarcticum	3	38	Coastal
Brachyglottis cockaynei	3	37	Coastal
Carmichaelia crassicaulis subsp. *racemosa*	3	37	Drylands
Craspedia (gg) (CHR 472168; Mararoa)	3	37	Wetlands
Korthalsella clavata	3	37	Shrublands
Lepidium rekohuense	3	37	Coastal
Luzula celata	3	37	Drylands
Ranunculus haastii	3	37	Alpine
Lagenophora montana	3	36	Wetlands
Leptinella filiformis	3	36	Drylands
Leucogenes tarahaoa	3	36	Alpine
Olearia fimbriata	3	36	Shrublands
Pachycladon cheesemanii	3	36	Non-alpine rocky areas
Pachycladon wallii	3	36	Non-alpine rocky areas
Pimelea villosa	3	36	Coastal
Senecio aff. *glaucophyllus* (b) (CHR 85767; Cape Campbell)	3	36	Coastal
Amphibromus fluitans	3	35	Wetlands
Cardamine coronata	3	35	Limestone
Coprosma pedicellata	3	35	Wetlands
Geranium sessiliflorum var. *arenarium*	3	35	Coastal
Lepidium panniforme	3	35	Coastal
Machaerina complanata	3	35	Wetlands
Centipeda minima subsp. *minima*	3	34	Wetlands
Epilobium pictum	3	34	Drylands
Thelymitra matthewsii	3	34	Non-alpine rocky areas
Carmichaelia uniflora	3	33	Drylands
Eleocharis neozelandica	3	33	Coastal
Lepidium oligodontum	3	33	Coastal
Spiranthes novae-zelandiae	3	33	Wetlands
Leucopogon nanum	3	32	Drylands
Myosotidium hortensia	3	32	Island
Carmichaelia corrugata	3	31	Drylands
Isolepis lenticularis	3	30	Wetlands
Coprosma aff. *macrocarpa* (AK 309497; Surville)	3	29	Ultramafic
Pomaderris paniculosa subsp. *novaezelandiae*	3	29	Ultramafic
Asplenium pauperequitum	3	27	Island
Beilschmiedia aff. *tawa* (AK 230588; Poor Knights Is.)	3	24	Forest
Craspedia (nn) (CHR 567299; “Rex”)	3	18	Wetlands
Pimelea lyallii	4	43	Coastal
Daucus glochidiatus	4	42	Drylands
Acaena microphylla var. *pauciglochidiata*	4	41	Coastal
Carex uncifolia	4	41	Wetlands
Aciphylla subflabellata	4	40	Drylands

Continued on next page

Table 12 continued

SCIENTIFIC NAME	PRIORITY (HIGHEST = 1)	CONFIDENCE SCORE MAX. = 48)	HABITAT TYPE
Anthosachne falcis	4	40	Drylands
Carmichaelia vexillata	4	40	Drylands
Coprosma wallii	4	40	Shrublands
Syzygium maire	4	40	Wetlands
Bulbinella modesta	4	39	Wetlands
Euphrasia repens	4	39	Wetlands
Dracophyllum densum	4	38	Wetlands
Rytidosperma exiguum	4	38	Drylands
Carex berggrenii	4	37	Wetlands
Korthalsella salicornioides	4	37	Forest
Metrosideros carminea	4	37	Forest
Pimelea prostrata subsp. *ventosa*	4	37	Coastal
Raoulia monroi	4	37	Drylands
Acaena buchananii	4	36	Drylands
Eryngium vesiculosum	4	36	Coastal
Raoulia beauverdii	4	36	Drylands
Acaena pallida	4	35	Coastal
Aciphylla dieffenbachii	4	35	Coastal
Lepidosperma neozelandicum	4	35	Wetlands
Leptospermum aff. *scoparium* (b) (AK 247250; “coastal silver prostrate”)	4	35	Coastal
Raoulia (a) (CHR 79537; “K”)	4	35	Non-alpine rocky areas
Brachyglottis rotundifolia var. *ambigua* (AK 251870)	4	33	Coastal
Carmichaelia nana	4	33	Drylands
Linum monogynum var. *chathamicum*	4	30	Coastal

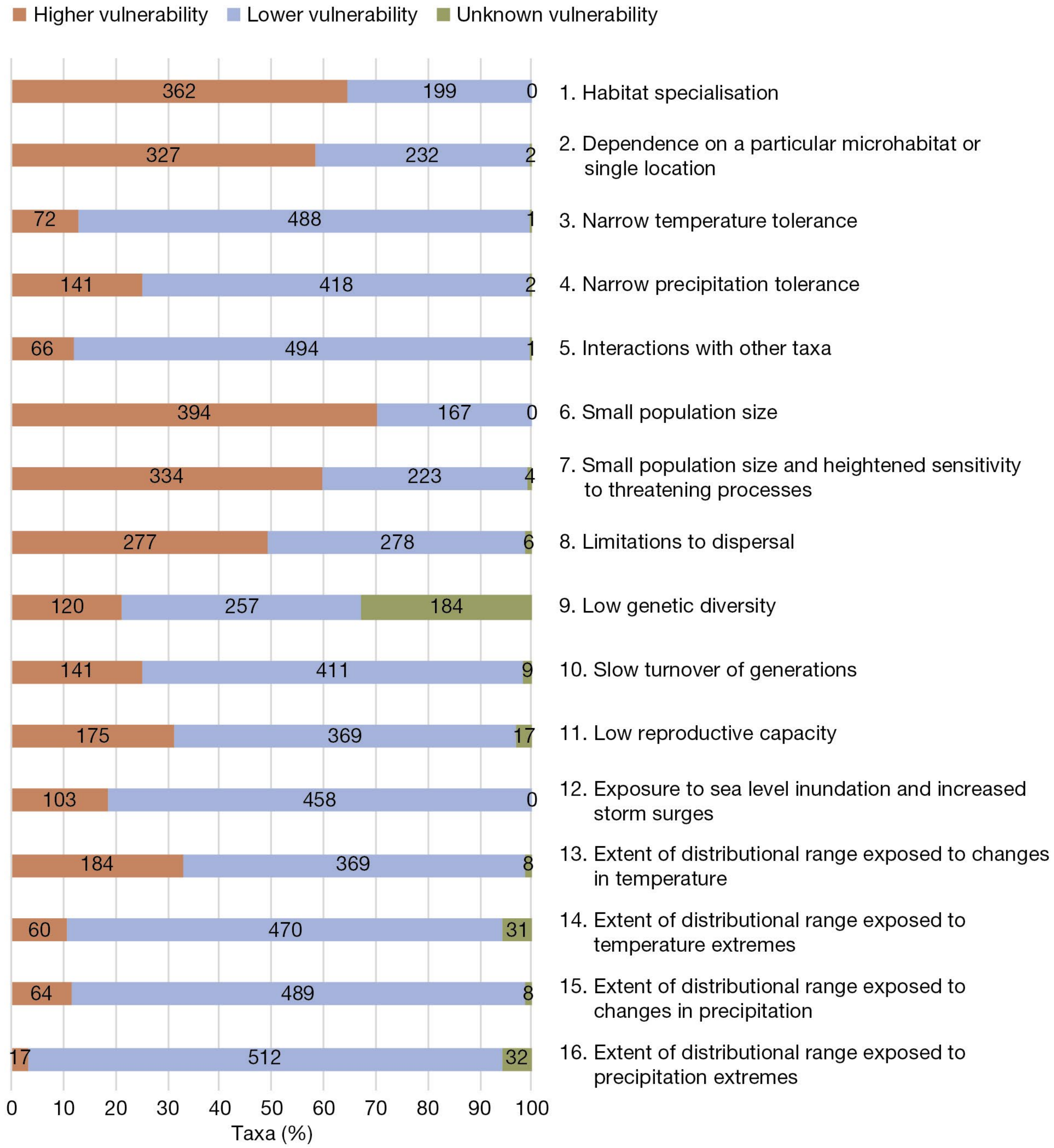


Figure 17. Number of the assessed vascular plant taxa in Aotearoa New Zealand triggering 'higher vulnerability', 'lower vulnerability' or 'unknown vulnerability' scores for each trait (sensitivity dimension traits 1–7, low adaptive capacity dimension traits 8–11 and exposure dimension traits 12–16). Results are shown for the RCP8.5 emissions scenario by mid-century.

8.3 Discussion

A high proportion (40%) of the vascular plant taxa assessed were identified as Highly Vulnerable to the impacts of climate change by mid-century under the RCP8.5 emissions scenario, even when the optimistic assessment method was used, where 'unknown vulnerability' scores were replaced with 'lower vulnerability' scores (Fig. 15). Since this assessment only included the most threatened vascular plants (i.e. those classified under the NZTCS as Threatened – Nationally Critical, Threatened – Nationally Endangered and Threatened – Nationally Vulnerable) and those with a declining population trend (At Risk – Declining), it is expected that small population size, habitat specialisation, dependence on a microhabitat and sensitivity to other threatening processes all contributed to the Highly Vulnerable assessment for many of these taxa. Relict populations and single locations are already recognised as contributing factors in species rarity profiles (de Lange et al. 2018), and limitations to dispersal also contribute to a Highly Vulnerable assessment for plants. This is in part explained by the autecology of the plants themselves and is exacerbated by the fragmentation of suitable habitats.

There is a lack of detailed information on the autecology of many vascular plant taxa in Aotearoa New Zealand. Data gaps associated with the CCVA scores were acknowledged through low information adequacy scores, 'unknown' scores, and the difference in the number of Highly Vulnerable taxa between the optimistic and pessimistic assessments (Fig. 15; Appendices 1 and 2). Published information on many of the traits was lacking for many taxa, so experts extrapolated from known examples within genera and families where possible. This meant that instead of a taxon being given an 'unknown vulnerability' score for a trait, it was recorded with inferred or estimated data and a low information adequacy score. Despite a lack of data for several plant taxa, most of the Highly Vulnerable taxa had high overall confidence scores, with only 10 out of the 224 taxa (4%) having overall confidence scores of < 30 (Table 12).

8.3.1 Vulnerable habitats for vulnerable taxa

Naturally uncommon ecosystems

Many of the vascular plant taxa that were assessed as Highly Vulnerable by mid-century under the RCP8.5 emissions scenario occur in naturally uncommon ecosystems, which are defined as ecosystems with a total extent that is less than 0.5% (i.e. < 134,000 ha) of Aotearoa New Zealand's total land area (Williams et al. 2007). These ecosystems are discrete and highly dispersed in the landscape yet ecologically very significant, as although they represent only a small fraction of the country's land area, they harbour a disproportionately large amount of its indigenous biodiversity (Williams et al. 2007). These ecosystems frequently occur within a highly modified matrix that is dominated by non-native plants, further compounding the risk for Highly Vulnerable taxa via dispersal limitation (i.e. some plants cannot move across the matrix) and direct competition. An example of a naturally uncommon ecosystem is salt pans, which are discussed in case study 8.

Coastal habitats

All coastal plants will be exposed to changes in the timing and intensity of disturbance effects. The vascular plant taxa that were identified as Highly Vulnerable in this assessment include 11 of the 17 nau / coastal cress taxa (*Lepidium* spp.), the native / prickly hibiscus (*Hibiscus diversifolius* subsp. *diversifolius*) and taonga such as the pīngao / pikao (*Ficinia spiralis*). Nearly one in five of the assessed taxa triggered the 'higher vulnerability' score for trait *12: Exposure to sea level inundation and increased storm surges* (103 taxa, 18%), highlighting the likely loss of coastal habitats where coastal squeeze or topography does not allow for the inland migration of the shoreline, as is the case throughout much of Aotearoa New Zealand (McGlone and Walker 2011).

The nutrient deposits of marine mammal haulouts and seabird colonies have historically been an important ecological driver of much of the coastal area of Aotearoa New Zealand, and the addition of marine-derived nutrients to compacted soils may have supported a wide range of plants. However, coastal modification has restricted these animal-induced areas to largely rocky shores, where only a few plant taxa remain (Wiser et al. 2013). The indirect effects of climate change (via the loss of marine animals as they themselves suffer climate change effects) on these remaining coastal plants are not fully understood, but it is likely that the loss of the marine mammals and birds will further exacerbate the other effects of climate change.

Limestone ecosystems

Of the 25 taxa associated with limestone habitats in this assessment, 19 (76%) were assessed as Highly Vulnerable to climate change. Almost all of the eastern South Island plant taxa that depend on lime-rich soils have restricted distributions, and on the east of both the North and South Islands, the loss of fragments of ecosystems and habitats will be exacerbated by projected increases in the frequency and severity of droughts (McGlone and Walker 2011). Limestone ecosystems (including erosion pavements, cliffs, scarps and tors, and screes) of Marlborough and Canterbury support populations of small, inconspicuous herbs and delicate grasses such as *Chaerophyllum basicola*, the limestone wheatgrasses *Australopyrum calcis* subsp. *calcis* and *A. calcis* subsp. *optatum*, the Awahokomo poa (*Poa spania*), the Castle Hill buttercup (*Ranunculus paucifolius*), native bittercress (*Cardamine bilobata*) and the cress *Pachycladon exile*.

Wetlands

Wetlands were identified as the most common primary habitat type supporting Highly Vulnerable taxa in this CCVA (25%). Not all of Aotearoa New Zealand's structural wetland types are described as naturally uncommon (Johnson and Gerbeaux 2004; Williams et al. 2007) – for example, swamp forests were once widespread – but those that are range from estuaries and lagoons at the coastal margin, to gumlands, raised peat-dome bogs and ephemeral wetlands in mid-elevation hill country, to tarns and snowbanks in alpine habitat above the shrub / tree line.

Key drivers of wetland ecosystems beyond hydrology include temperature, substrate type, salinity and, in some locations, wildfire. Most wetlands are acutely sensitive to the direct and indirect effects of drying and prolonged drought (Mayence et al. 2023). Wetland plant taxa that were identified as Highly Vulnerable in this CCVA include seven recently named puatea / bachelor's buttons (*Craspedia* spp.), *Wurmbea novae-zelandiae* and one of Aotearoa New Zealand's indigenous carnivorous bladderworts, *Utricularia australis*.

Alpine ecosystems

Naturally uncommon alpine ecosystems generally have skeletal or poorly developed soils and typically support low-stature, open vegetation above the treeline. Temperature-controlled treelines represent elevational limits to vascular plant growth in Aotearoa New Zealand and are typically abrupt (Wardle 2008). Since subalpine forest often has low species richness, while the alpine zone has both high species richness and high levels of endemism, the uphill movement of the treeline ecotone with warming will have potentially severe biotic consequences (McGlone and Walker 2011), as many alpine taxa appear to have low dispersal rates and can only survive in specific environmental conditions. The eventual loss of much of the current alpine areas and the severe reduction of cold-winter habitat seems inevitable – for instance, Halloy and Mark (2003) predicted a massive reduction and shrinking of alpine ‘island’ patches – and a permanently warm climate regime with only moderate fluctuations from the average will strand the cold-adapted alpine component of the biota within a small and probably shrinking climatic space (McGlone and Walker 2011).

8.3.2 Direct and indirect effects of climate change

The predicted increases in temperature and atmospheric carbon dioxide and changes in precipitation will create new biotic and abiotic stresses for many of Aotearoa New Zealand’s indigenous vascular plant taxa, which will have both direct and indirect effects. Predicting the direct responses of terrestrial biodiversity in Aotearoa New Zealand to future climate changes will be challenging (Christie 2014). Globally, climate change has led to reduced interaction strengths of mutualisms involving plants (Tylianakis et al. 2008), as well as changes in interactions across trophic levels and range shifts in Northern Hemisphere taxa (Parmesan 2006). A recent analysis of seed fall data across a range of sites in the North Island and the northern South Island of Aotearoa New Zealand found strong evidence that the fecundity of tawa (*Beilschmiedia tawa*), an important endemic forest tree, has decreased in response to rising winter and summer temperatures throughout the northern part of its range in Te Urewera (Yukich-Clendon et al. 2023) – and the loss of tawa seeds, and potentially the seeds of other important fleshy-fruited tree species, will have negative impacts on birds and other taxa that forage on them.

Indirect effects on plants include the exacerbation of existing invasive species problems, the introduction of new diseases and pathogens, and human-induced habitat loss (Christie 2014). The arrival of new weeds and the increased invasiveness of existing weeds as a result of climate change (Clements and Ditommaso 2011) are troubling, as Aotearoa New Zealand already has the greatest number of naturalised plant species of any island globally (Hulme 2020). The most important weed species to prioritise for management will be ecosystem-transforming weeds (e.g. wilding conifers), which can dominate to the extent that native species are precluded (McGlone and Walker 2011). The many interacting direct and indirect consequences of climate change, such as a higher frequency and intensity of drought conditions and new and emerging plant diseases (Anderson et al. 2004), are likely to add to or exacerbate existing pressures on plant populations (McGlone and Walker 2011). If environmental changes happen faster than projected, then we could expect most of the Latent Risk taxa to become Highly Vulnerable sooner than by late century (Fig. 16).

This assessment included 561 indigenous vascular plant taxa, making it the most comprehensive climate change assessment of plants in Aotearoa New Zealand to date, and provides baseline information that can help with the prioritisation of limited resources and the development of adaptation strategies for vulnerable taxa. However, a full assessment of the indigenous flora is still pending, with a further 2,090 indigenous taxa (excluding Data Deficient taxa) listed in the 2017 NZTCS assessment (de Lange et al. 2018). Many of these taxa occur in naturally uncommon ecosystems and other habitat types that support vulnerable plants (particularly ultramafic [see case study 9], alpine and dryland habitats), and they share traits that trigger vulnerability such as having small population sizes, being island endemics and having one known location. Ideally, all other indigenous plants except the 107 taxa classified as Data Deficient should be assessed for their climate change vulnerability to form a more complete picture for climate change related prioritisation purposes.

Case study 8: A diminutive cress is on the brink – will climate change push it over the edge?

The salt-pan cress (*Lepidium kirkii*) is an endemic brassica species that has fewer plants remaining in the wild than there are kākāpō (*Strigops habroptila*), a critically endangered parrot that receives widespread media attention. With leaves less than 1 mm wide and only 5–30 mm long, you would be forgiven for overlooking this plant, yet it is an unusual species within the Aotearoa New Zealand flora, being one of the few endemic species that is able to inhabit the inland salt pans of Central Otago (Rogers et al. 2000).

Salt-pan cress (*Lepidium kirkii*) habitat in mine tailings (top), flowers (middle) and fruit (bottom). *Photos: Jane Gosden*

Inland salt pans (also called inland saline sites) are a naturally rare (Williams et al. 2007) and critically endangered (Holdaway et al. 2012) ecosystem type in Aotearoa New Zealand that now occupy < 1% of their original distribution (Rufaut et al. 2018). The high salt (chemical) content of the soils results in a high pH (usually > 7.5) and limits the ability of other native plants to grow there (Allen 2000).

Unfortunately, inland salt pans have been invaded by a suite of salt-tolerant weedy plants, and these weeds and severe habitat loss through clearance for cultivation have been the foremost threats to the salt-pan cress and salt pan ecosystems. Other threats, before considering climate change, include edge effects from surrounding land use, genetic drift (a process whereby small populations are further affected by the random loss of genetic variation or the fixation of deleterious alleles, making the plants even more vulnerable to threats), herbivory (by both mammals and the cabbage white butterfly [*Pieris rapae*]), seed predation and potentially disease (Walker 2021).

The salt-pan cress is an example of a taxon that was classified as Highly Vulnerable to climate change because of its extreme habitat limitation, a feature shared with many of the 224 vascular plant taxa on the Highly Vulnerable list. It also provides an example of the uncertainty going forward about the indirect effects climate change will have on Aotearoa New Zealand's flora. There is growing evidence that species in the genus *Lepidium*, which includes the salt-pan cress, are affected by disease (Van Vianen et al. 2013; Smissen et al. 2022), and it is suspected that climate change will exacerbate the impacts of these emerging diseases on the native flora.

A recent survey for the salt-pan cress could only locate the plant at half of its former sites, and it was present in very low numbers at five of these sites (Walker 2021). Beyond where this plant is (or is no longer) found and some life history traits, very little is known about its ecology. Despite being one of the most threatened species in Aotearoa New Zealand, there is still a lot of basic information to gather on this species and other Highly Vulnerable plants before we can be sure of how best to protect them in the future.

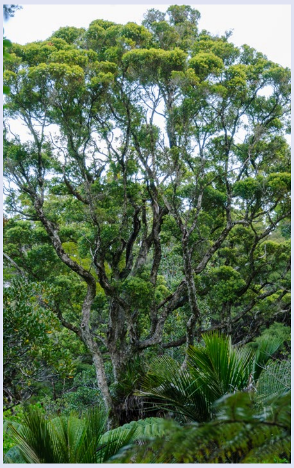
One suggestion to prolong the existence of the salt-pan cress in the wild, at least in the short term, is a form of active management whereby new saline patches are created by physically disturbing the soil surface (Rufaut et al. 2018). Given that the climate change vulnerability of this minute plant hangs on the existing rarity of both itself and its habitat, this may be the best approach we currently have to help ensure its persistence in a rapidly changing climate.

Case study 9: Northland – a hotspot for vulnerable plants

Northland has a rich assemblage of plants that are not found further south. A total of 42 vascular plant taxa that were assessed in this climate change vulnerability assessment (CCVA) are confined to Te Ika-a-Māui / the North Island of Aotearoa New Zealand, either being endemic or having a southern limit occurring there (e.g. rātā moehau [*Metrosideros bartlettii*]), and 28 of these occur naturally only north of the Auckland isthmus, on the Northland peninsula or further afield on Manawatāwhi / Three Kings Islands and Rangitāhua / Kermadec Islands. Heenan et al. (2017) showed that two areas of the Northland peninsula had particularly high endemism, largely at the species level: the northern part of the Aupōuri Peninsula and the area of land between Manukau and Herekino Harbours.

At the northernmost point of the North Island, Hikurua / de Surville Cliffs is striking for its local endemism. However, conditions on this 144-hectare outcrop of ultramafic, serpentinised olivine and peridotite are harsh: the north-facing aspect is already subject to severe seasonal, physical drought and high summer temperatures, especially on the cliffs; the soils are highly mineralised laterites (Thompson and Rodgers 1977) or bedrock that is rich in iron, aluminium, magnesium and other heavy metals; and physiological drought through exposure to salt spray is prevalent.

Te Werahi Beach, Cape Maria van Diemen and Motuopao Island from near Cape Reinga / Te Rerenga Wairua. *Photo: Andrew Townsend*



Rātā moehau (*Metrosideros bartletti*) in Whangakea (Radar) Bush at Te Paki (left) and native / prickly hibiscus (*Hibiscus diversifolius* subsp. *deversifolius*) at Te Huka Bay (right). *Photos: Andrew Townsend*

The projected hotter and drier summers in the North Island are likely to have a profound impact on many species, and all seven of the assessed vascular plant taxa that are endemic to this substrate were classified as Highly Vulnerable (Table 12), including *Pittosporum serpentinum* (Threatened – Nationally Critical), *Pittosporum pimeleoides* subsp. *majus* (Threatened – Nationally Endangered), *Parsonsia praeruptis* (Threatened – Nationally endangered), *Hibiscus* aff. *diversifolius* (AK 347684; Surville) (Threatened – Nationally Critical), *Libertia* aff. *ixioides* (c) (AK 319490; Surville Cliffs) (Threatened – Nationally Critical), *Coprosma* aff. *macrocarpa* (AK 309497; Surville) (At Risk – Declining) and *Rhabdothamnus* aff. *solandri* (a) (AK 319367; Surville Cliffs) (Threatened – Nationally Critical). There are also a further 12 At Risk taxa that are endemic to this location which have not yet been assessed for their vulnerability to climate change but are likely to have similar risk levels.

9. Discussion

There are an estimated 80,000 native taxa within Aotearoa New Zealand, all of which are being impacted by changes to the biosphere. The aim of this study was to assess 1,145 terrestrial taxa within five groups (bats, birds, herpetofauna, invertebrates and vascular plants) to identify which taxa are potentially the most vulnerable to the impacts of climate change. This information is required so that DOC can prioritise and direct climate change adaptation planning, management and research actions to the taxa that are in the most urgent need.

The CCVA data can be used to predict how each taxon's situation may change under climate change – for example, by considering which emissions scenarios and time frames triggered 'higher vulnerability' scores for the taxon. The assessment methodology particularly focused on the high-emission RPC8.5 scenario because this best reflects the current global trajectory.[16] Although the results across the five groups are not directly comparable with each other, there are some key findings that are shared across the groups or highlight important themes of relevance to Aotearoa New Zealand. This discussion aims to give a high-level overview of these shared findings and also acknowledges the limitations of the study. For a more complete interpretation of the results for a specific group of taxa, see the discussion section within the relevant section.

9.1 Common themes

According to Foden et al. (2013), taxa that are highly vulnerable to climate change generally require management intervention and / or specific research. In our study, a high proportion of the Aotearoa New Zealand terrestrial taxa assessed were identified as being vulnerable to climate change even when using the optimistic assessment method, where 'unknown vulnerability' scores were replaced with 'lower vulnerability' scores. Nearly one-third (351, 31%) of the assessed plant, bird, bat, herpetofauna and invertebrate taxa were classified as Highly Vulnerable (i.e. at greatest risk to the impacts of climate change) by mid-century, using the RCP8.5 emissions scenario (Tables 7–11), and this increased to 746 taxa (65%) by late century. The corresponding numbers using the moderate-emission RCP4.5 scenario were considerably smaller for both time frames (153 taxa [13%] by mid-century and 215 taxa [19%] by late century; Tables 7–11).

When the pessimistic assessment method was used ('unknown vulnerability' scores were replaced with 'higher vulnerability' scores), substantially more taxa were classified as Highly Vulnerable due to the large number of data gaps for invertebrates and vascular plants being assumed to signify high vulnerability (Appendix 2). Using the RCP8.5 emissions scenario, 458 (40%) and 882 (77%) of the 1,145 taxa assessed were classified as Highly Vulnerable by mid- and late century, respectively.

Using the RCP8.5 emissions scenario, only 27 taxa (14 birds, 6 herpetofauna and 7 vascular plants) were classified as Low Vulnerability by mid-century, meaning that they did not trigger 'higher vulnerability' for any traits in any of the vulnerability dimensions. This low number, and conversely the high number of Highly Vulnerable taxa, reflects the highly specialised ecology and already-threatened statuses of a high proportion of many of Aotearoa New Zealand's terrestrial plants and animals due to their small population sizes,

[16] Based on the global climate change mitigation policies and action currently in place, the world is on a trajectory to have a median warming of 2.7°C above pre-industrial levels, which is more plausible under the high-emission RCP8.5 scenario. The predicted median warming is based on the NDCs of 191 countries that were in place as at 30 July 2021. NDCs are the efforts by the countries that are Parties to the Paris Agreement to reduce their national greenhouse gas emissions. These findings are detailed in the latest NDC synthesis report (UNFCCC 2021).

limited distributional ranges and low reproductive capacities (Burns et al. 2018; Hitchmough et al. 2021; Robertson et al. 2021).

The difference between the CCVA approach and other prioritisation systems and tools such as the NZTCS and a recently published threatened species research gap analysis report (Murray et al. 2024) is that CCVA results are specifically intended to be used to influence climate change related work, acknowledging that climate change is just one of the existing threats that taxa may be facing. Out of the 351 Highly Vulnerable taxa we identified across the five CCVAs undertaken in this study, 136 were classified as Threatened – Nationally Critical under the NZTCS at the time of the assessments. Some of Aotearoa New Zealand's Threatened – Nationally Critical taxa are facing imminent extinction risk from predation or other pressures but were not assessed as Highly Vulnerable to climate change. For example, the awakopaka skink (*Oligosoma awakopaka*) is on the brink of extinction but was not included in the CCVA list of Highly Vulnerable herpetofauna (Table 9), although it was classified as Latent Risk by mid-century.

Overall, 404 (35%) of the 1,145 taxa assessed were classified as Latent Risk by mid-century. This means that they are sensitive to climate change and have low adaptive capacity but are not projected to be exposed to significant changes in climate across most of their distributional ranges by 2040. The direction of change was consistent across all groups of taxa, however, with all but a few moving to the Highly Vulnerable category by late century. The recommended action for Latent Risk taxa is to 'monitor the environment' (Foden et al. 2013). For threatened taxa, this means monitoring both population trends and examining the influence of climate change and other pressures so that it is possible to detect if environmental changes caused by climate change, such as droughts, are occurring more often or are more extreme than predicted, which would cause Latent Risk taxa to move to the Highly Vulnerable group sooner than late century.

Late century (2090) was the furthest period into the future considered in our exposure assessment, but it is important to remember that this is not a terminal point. The world's atmospheric carbon dioxide concentrations are currently tracking above 400 parts per million (ppm),[17] and the critical threshold required to limit global warming to 2°C – a tipping point emphasised by the IPCC – is 450 ppm (IPCC 2021). If the world maintains the trajectory of increasing greenhouse gas emissions, mean surface temperatures will continue to rise beyond the current modelled maximum values for 2090. Consequently, the inclusion of the RCP4.5 emissions scenario in the current CCVAs serves as a comparison only and highlights the substantial benefits global greenhouse gas mitigation could have for biodiversity.

The outputs of these CCVAs (see Online Supplementary Information[18]) can also be used to identify the greatest data and knowledge gaps that are preventing us from prioritising, and therefore managing, vulnerable taxa. There were data gaps (i.e. traits scored as 'unknown') across all groups of taxa except bats, particularly in relation to adaptive capacity traits *9: Low genetic diversity*, *10: Slow turnover of generations* and *11: Low reproductive capacity*. Furthermore, even when data were available, many traits were assigned with low information adequacy scores, reflecting knowledge gaps. Even among the birds, the group with the most significant knowledge base, 70 taxa had low information adequacy scores for trait *10: Slow turnover of generations*. This is because we know that current generation length records are not as accurate as they could be, as bird longevity records used in the generation length calculations tend to be underestimated (e.g. new longevity records for eight kiwi taxa in the New Zealand Bird Banding Scheme mean that generation lengths are 5–7 years longer than those calculated by Bird et al. [2020]). If no data existed for a particular taxon, we used inferred information (e.g. from a similar taxon) where this was available and demonstrated

[17] Global atmospheric carbon dioxide levels were 417.06 ppm in 2022 (annual average): www.co2.earth.

[18] www.doc.govt.nz/science-for-conservation-343

the lack of confidence by assigning a low information adequacy score. This approach explains the relatively low number of 'unknown' scores across bats, birds and herpetofauna and, consequently, the minimal differences between the optimistic and pessimistic assessments. By contrast, there is a more noticeable difference between the optimistic and pessimistic assessments for invertebrates and vascular plants (Figs 12 and 15), highlighting the lack of research investment across these groups in the past, which has resulted in major data and knowledge gaps today. Further examination of the reasons for scoring certain traits as 'unknown' is important as it will highlight specific knowledge gaps that should be addressed as a priority. For example, while most invertebrates were predicted to be exposed to changes in temperature by late century, almost half of them were scored 'unknown' for sensitivity to temperature, indicating that this is an important knowledge gap to be addressed by research.

9.2 Limitations of this study

Trait-based CCVAs such as were used in this study are not the same as climate change risk assessments, which explicitly consider the potential adverse consequences of climate change and the uncertainty associated with them to help decision-makers understand and manage risk (Reisinger et al. 2020). In the current assessments, we intentionally omitted the potential interactions between the assessed taxa and the impacts of climate change on other pressures they face, such as invasive pests and pathogens. For example, the impacts of introduced predators were not included in the assessment framework but, based on what is happening globally and in Aotearoa New Zealand, it is likely that negative interactions with predators will increase in a warmer climate (Christie 2014; Walker et al. 2019) as a result of factors such as predators moving to or surviving year round at higher altitudes, which may threaten alpine taxa; islands that are currently predator free becoming more vulnerable to incursions because of warmer seas; the ranges and abundances of wasps increasing, which may compound predation pressure on invertebrates and lizards; and more frequent masting of forest trees, which may increase the frequency and intensity of predator irruptions.

Ecological systems and the food webs that operate within them are complex and interconnected. Accordingly, it is impossible to predict exactly how taxa and ecosystems will respond to climate change. The traits used here to assess vulnerability are not intended as a comprehensive list of all factors associated with climate change threats but rather are *some* of the key traits that we predict correspond with different dimensions of vulnerability. We have aimed to include enough key traits for the results to be useful for prioritisation purposes, keeping in mind that the more traits that are included in the assessment, the larger the proportion of taxa that will be identified as Highly Vulnerable (Hossain et al. 2019). Traits were weighted equally in these assessments, meaning that they all had an equal impact on the overall vulnerability. A study on 17 Australian lizard species showed that there was no statistically significant difference between weighted and unweighted CCVA results (Ofori et al. 2017), but it is acknowledged that this may not be the case for all groups of taxa.

These CCVAs should not be considered an absolute assessment of the vulnerability of taxa to climate change – the results are only meaningful as a relative measure within the assessed group of taxa for which the same criteria were used. It is not valid to compare the explicit results *between* groups of taxa, as each has its own set of trait definitions and thresholds, which may not be directly comparable. In addition, the completeness of our treatment of some groups of taxa was variable, with the lowest number of taxa being assessed within the invertebrate group, largely because subject matter experts were unavailable / or knowledge was so sparse that any assessment would be mere guesswork. Furthermore, the vascular plants and terrestrial invertebrates assessed in this study are a subset of all indigenous taxa in Aotearoa New Zealand, so the results should be interpreted with caution.

There is always a level of uncertainty around climate change projections, even with the improved IPCC Sixth Assessment Report models (IPCC 2021). For example, future changes at regional levels and in the El Niño–Southern Oscillation and the Southern Annular Mode, as well as their implications for the Aotearoa New Zealand region, are still uncertain (Bodeker et al. 2022). Our exposure assessments were conducted at a coarse scale (5 km grid), which may not have captured microclimate-level variations, which likely will be important for sessile taxa with limited ranges. Projections also cannot predict the exact frequency and severity of droughts and flooding, both of which are climate change related extreme events that will potentially impact populations that have limited dispersal abilities and are confined to their current locations. Climate model selection can also affect CCVA results – for example, one study determined that ensemble means of models (like the ones we used) identified less vulnerable taxa than individual climate models (Hossain et al. 2019).

The results of these CCVAs alone are not intended for spatial conservation planning, as we did not predict the responses of taxa to climate change or model future habitat suitability for taxa. We also did not include a comprehensive analysis of geographically vulnerable 'hotspots', although we did identify some particularly vulnerable habitat types and geographical locations containing a large number of Highly Vulnerable taxa (e.g. vascular plants in Northland).

Despite the caveats and limitations of these rapid CCVA assessments, we remain confident that the results are useful as a first step towards prioritising further work on taxa that are likely to be the most vulnerable to climate change. This study covers a wide range of taxa across five groups, so it would be unwise to propose recommendations that universally apply to all taxa that were identified as Highly Vulnerable. Instead, our intention is that the information presented in this report, along with the full outputs provided in the Online Supplementary Information, will serve as a guide for informed conservation decision making and action. Finally, we hope that the insights from this report will serve as a stark reminder of the threat climate change poses to Aotearoa New Zealand's native biodiversity. The severity of this threat varies based on the projected trajectory of greenhouse gas emissions, highlighting the responsibility of Aotearoa New Zealand to contribute to global efforts in reducing emissions for a sustainable future.

10. Recommendations

To the best of our knowledge, these are the first large-scale trait-based CCVAs of terrestrial taxa in Aotearoa New Zealand (although we note that NIWA recently completed a CCVA of eight freshwater taonga taxa [Egan et al. 2020] and DOC has completed a first-pass climate change risk assessment of Aotearoa New Zealand's marine mammals [Roberts and Hendriks 2022]). By making the methods publicly available, we are hoping to enable others to update the assessments conducted here or expand future assessments to the taxa not yet assessed. Based on the lessons learned from this project, we have developed the following recommendations for future work:

1. **Create comprehensive risk assessment profiles for Highly Vulnerable taxa to understand what climate change related adaptation planning and management is needed to secure their persistence.**

   Completing CCVAs is a first step in the process of identifying taxa that require climate change related adaptation planning, management or research. The vulnerability categories and the final priority ranks should be interpreted as relative scores together with other information we have on the taxa, including what management is currently in place and where, and whether current management is sufficient (i.e. are populations declining despite management efforts?). Specific steps to be considered when developing risk assessments include:

   a. developing conceptual models to (i) describe current drivers, pressures and management actions for each vulnerable taxon and then (ii) future states once climate change vulnerabilities are added; these should identify climate-related direct and indirect consequences that may exacerbate existing pressures
   b. undertaking comprehensive literature reviews to identify what climate change related research already exists for Aotearoa New Zealand's Highly Vulnerable taxa, such as species distribution models (SDMs) to predict their future habitat suitability under a changing climate (e.g. Jarvie et al. 2021, 2022; Germano et al. 2023)
   c. gathering distributional data and mapping the distributions of the Highly Vulnerable taxa and conducting spatial analysis using the latest climate change projections from the IPCC 6th Assessment Report (IPCC 2021), downscaled to Aotearoa New Zealand; SDMs that predict potential climatically suitable areas in the future could be created for a subset of taxa that may be considered for translocations
   d. undertaking localised climate change hazard assessments for sedentary taxa with limited ranges; this would help to determine the full range and extent of their direct exposure to the projected impacts of climate change, including gradual changes in factors such as temperature and rainfall, and changes in the frequency and intensity of more extreme weather events such as fire, droughts and floods
   e. undertaking dynamic adaptive pathways planning (DAPP) for prioritised native taxa that are at risk from climate change impacts; DAPP aims to create flexible plans (pathways) that take into consideration the uncertainties associated with climate change so that approaches can be proactively adjusted in a changing context.

2. **Expand the assessments to cover more groups of taxa.**

   We assessed five groups of taxa in this study, but many other groups have been assessed under the NZTCS that would benefit from being assessed for their climate change vulnerability. For example, we were only able to include 243 of the most threatened taxa across five groups of invertebrates (spiders, beetles, butterflies and moths, wētā and grasshoppers, and land snails), yet thousands of other native invertebrates are likely to be vulnerable to climate change, including freshwater and marine taxa. DOC is currently working on expanding the CCVAs to cover more freshwater taxa and some groups of marine taxa.

3. **Expand the assessments to cover taxa that are not currently threatened.**

   We assessed mainly threatened taxa to narrow down the scope of the project, but rarity and / or a resulting conservation status are not necessarily directly correlated with climate change vulnerability (Anacker et al. 2013; Still et al. 2015). Focusing on the most threatened taxa first was a logical priority for us, but we recommend that CCVAs are next conducted for native taxa that have been assigned At Risk conservation statuses that were not included in these CCVAs (Uncommon and Recovering), followed by non-threatened taxa, as these showed high levels of latent vulnerability in the bird assessment. For example, at the time of writing, there were 693 vascular plant taxa listed as having other At Risk conservation statuses and 1,383 taxa listed as Not Threatened (de Lange et al. 2018). Undertaking these additional assessments would create a better understanding of Aotearoa New Zealand's flora and fauna and their vulnerabilities.

4. **Use the CCVA data gaps for research prioritisation.**

   There are major gaps in our knowledge of many native taxa, especially fungi, lichens, plants and many groups of invertebrates. For example, we included five spider taxa in the invertebrate CCVA, but there are 493 spider taxa listed as Data Deficient under the NZTCS (Sirvid et al. 2021), meaning that we do not have enough information to estimate their population sizes and trends and therefore assess their risk of extinction. To be able to assess the climate change vulnerability of plants, invertebrates and other lesser-known groups, we first need to fill in data gaps to understand their basic ecologies and distributions.

5. **Improve exposure assessments.**

   Experts assessed exposure by comparing the current known distributions of taxa with the mapped projected changes (https://ofcnz.niwa.co.nz/#/nationalMaps). Despite the seeming correctness of our rapid exposure assessment method (see section 3.5 Assessing exposure traits), we suggest that future CCVAs should explicitly map taxon distributions based on current best knowledge. This would facilitate spatial analysis, promoting consistency within and across assessments. Additionally, maintaining taxon distributions as readily available layers would enable efficient re-analysis when projections are improved or updated.

6. **Re-run the assessments as better data become available.**

   It may be beneficial to re-run the assessments every 5 years, or when significant new knowledge and / or data on taxa and environmental variables become available. For example, in the current assessments, we utilised the downscaled projections developed from the climate change models in the IPCC 5th Assessment Report (MfE 2018). The latest downscaled climate projections for Aotearoa New Zealand based on the IPCC's Sixth Assessment Report (IPCC 2021) were released in 2024,[19] with further updates that include SSP5-8.5 due to be released in 2025.

[19] https://environment.govt.nz/facts-and-science/climate-change/climate-change-projections/; https://niwa.co.nz/climate-and-weather/climate-change-scenarios-new-zealand

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12. References

Abarca M, Spahn R. 2021. Direct and indirect effects of altered temperature regimes and phenological mismatches on insect populations. Current Opinion in Insect Science. 47:67–74.

Ackerley D, Bell RG, Mullan AB, McMillan H. 2013. Estimation of regional departures from global-average sea-level rise around New Zealand from AOGCM simulations. Weather and Climate. 33:2–22.

Albouy C, Delattre V, Donati G, Frölicher TL, Albouy-Boyer S, Rufino M, Pellissier L, Mouillot D, Leprieur F. 2020. Global vulnerability of marine mammals to global warming. Scientific Reports. 10:548.

Allen RB. 2000. Inland *Lepidium* recovery plan 2000–2010. Wellington: Department of Conservation. Threatened Species Recovery Plan 32. www.doc.govt.nz/documents/science-and-technical/tsrp32.pdf

Alley MR, Gartrell BD. 2019. Wildlife diseases in New Zealand: recent findings and future challenges. New Zealand Veterinary Journal. 67(1):1–11.

Anacker BL, Gogol-Prokurat M, Leidholm K, Schoenig S. 2013. Climate change vulnerability assessment of rare plants in California. Madroño. 60(3):193–210.

Anderson PK, Cunningham AA, Patel NG, Morales FJ, Epstein PR, Daszak P. 2004. Emerging infectious diseases of plants: pathogen pollution, climate change and agrotechnology drivers. Trends in Ecology and Evolution. 19(10):535–544.

Ausseil AGE, Chadderton WL, Gerbeaux P, Stephens RTT, Leathwick JR. 2011. Applying systematic conservation planning principles to palustrine and inland saline wetlands of New Zealand. Freshwater Biology. 56:142–161.

Barker GM, Brook FJ, Mahlfeld K, Walker K, Roscoe DJ, Hitchmough RA, Edwards E, Rolfe JR, Michel P. 2021. Conservation status of New Zealand indigenous terrestrial Gastropoda (slugs and snails), 2020. Part 1. Athoracophoridae (leaf-veined slugs) and Succineidae (amber snails). Wellington: Department of Conservation. New Zealand Threat Classification Series 32. www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs32entire.pdf

Bhagarathi LK, Gyanpriya M. 2023. Impact of climate change on insect biology, ecology, population dynamics, and pest management: a critical review. World Journal of Advanced Research and Reviews. 19(3):541–568.

Bidart-Bouzat MG, Imeh-Nathaniel A. 2008. Global change effects on plant chemical defenses against insect herbivores. Journal of Integrative Plant Biology. 50(11):1339–1354.

Bird JP, Martin R, Akçakaya HR, Gilroy J, Burfield IJ, Garnett ST, Symes A, Taylor J, Şekercioğlu ÇH, Butchart SH. 2020. Generation lengths of the world's birds and their implications for extinction risk. Conservation Biology. 34(5):1252–1261.

Bodeker G, Tait A, Morgenstern O, Noone D, Revell L, McDonald A, Cullen N, Renwick J, Katurji M. 2022. Aotearoa New Zealand climate change projections guidance: interpreting the latest IPCC WG1 report findings. Prepared for the Ministry for the Environment, Report number CR 501. environment.govt.nz

Böhm M, Cook D, Ma H, Davidson AD, García A, Tapley B, Pearce-Kelly P, Carr J. 2016. Hot and bothered: using trait-based approaches to assess climate change vulnerability in reptiles. Biological Conservation. 204:32–41.

Briskie JV, Mackintosh M. 2004. Hatching failure increases with severity of population bottleneck in birds. Proceedings of the National Academy of Sciences. 101(2):558–561.

Bueno-Pardo J, Nobre D, Monteiro JN, Sousa PM, Costa EFS, Baptista V, Ovelheiro A, Vieira VMNCS, Chícharo L, Gaspar M, et al. 2021. Climate change vulnerability assessment of the main marine commercial fish and invertebrates of Portugal. Scientific Reports. 11:2958.

Burns RJ, Bell BD, Haigh A, Bishop P, Easton L, Wren S, Germano, J, Hitchmough RA, Rolfe JR, Makan T. 2018. Conservation status of New Zealand amphibians, 2017. Wellington: Department of Conservation. New Zealand Threat Classification Series 25. www.doc.govt.nz/Documents/science-and-technical/nztcs25entire.pdf

Carr J, Hughes AF, Foden W. 2014. A climate change vulnerability assessment of West African species. Cambridge (UK): UNEP-WCMC. Technical report 59.

Chen C, Harvey JA, Biere A, Gols R. 2019. Rain downpours affect survival and development of insect herbivores: the specter of climate change? Ecology. 100(11):e02819.

Chilvers BL, Hiscock JA. 2019. Significant decline of endangered Antipodes Island penguins: is extreme weather an additional impact? Aquatic Conservation: Marine and Freshwater Ecosystems. 29:546–553.

Chinn WGH, Chinn TJH. 2020. Tracking the snow line: responses to climate change by New Zealand alpine invertebrates. Arctic, Antarctic, and Alpine Research. 52(1):361–389.

Christie JE. 2014. Adapting to a changing climate: a proposed framework for the conservation of terrestrial native biodiversity in New Zealand. Wellington: Department of Conservation. www.doc.govt.nz/Documents/science-and-technical/sap257.pdf

Chukwuka CO. 2020. Microhabitat use by the nocturnal, cool-climate gecko *Woodworthia* "Otago/Southland" in the context of global climate change [dissertation]. Dunedin: University of Otago.

Clements DR, Ditommaso A. 2011. Climate change and weed adaptation: can evolution of invasive plants lead to greater range expansion than forecasted? Weed Research. 51(3):227–240.

Cree A. 1994. Low annual reproductive output in female reptiles from New Zealand. New Zealand Journal of Zoology. 21(4):351–372.

Czenze ZJ, Brigham RM, Hickey AJ, Parsons S. 2017. Winter climate affects torpor patterns and roost choice in New Zealand lesser short-tailed bats. Journal of Zoology. 303(3):236–243.

Death R, Bowie S, O'Donnell C. 2016. Vulnerability of freshwater ecosystems due to climate change. In: Robertson H, Bowie S, Death R, Collins D, editors. Freshwater conservation under a changing climate. Proceedings of a workshop hosted by the Department of Conservation, 10–11 December 2013, Wellington. Christchurch: Department of Conservation; p. 14–20.

de Lange PJ, Rolfe JR, Barkla JW, Courtney SP, Champion PD, Perrie LR, Beadel SM, Ford KA, Breitwieser I, Schönberger I, et al. 2018. Conservation status of New Zealand indigenous vascular plants, 2017. Wellington: Department of Conservation. New Zealand Threat Classification Series 22. www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs22entire.pdf

[DOC] Department of Conservation. 2020a. Biodiversity in Aotearoa: an overview of state, trends and pressures. Wellington: Department of Conservation. www.doc.govt.nz/globalassets/documents/conservation/biodiversity/anzbs-2020-biodiversity-report.pdf

[DOC] Department of Conservation. 2020b. Department of Conservation climate change adaptation action plan. Te Papa Atawhai he whakamahere hātepe urutau mō te huringa āhuarangi. 2020/21 – 2024/25. Wellington: Department of Conservation. www.doc.govt.nz/globalassets/documents/our-work/climate-change/climate-change-adaptation-action-plan.pdf

[DOC] Department of Conservation. 2023. Department of Conservation Climate Change Adaptation Action Plan – action tables 2022–2025. Te Mahere Hātepe Urutau mō te Huringa Āhuarangi a Te Papa Atawhai – he tūtohi mahi 2022–2025. Updated May 2023. Wellington: Department of Conservation. www.doc.govt.nz/globalassets/documents/our-work/climate-change/climate-change-adaptation-action-plan-review-update.pdf

Dunstan PK, Foster SD, King E, Risbey J, O'Kane TJ, Monselesan D, Hobday AJ, Hartog JR, Thompson PA. 2018. Global patterns of change and variation in sea surface temperature and chlorophyll a. Scientific Reports. 8(1):14624.

Egan E, Woolley J-M, Williams E. 2020. Climate change vulnerability assessment of selected taonga freshwater species technical report. Christchurch: National Institute of Water & Atmospheric Research Ltd. Client Report: 2020073CH.

Erauskin-Extramiana M, Arrizabalaga H, Hobday AJ, Cabré A, Ibaibarriaga L, Arregui I, Murua H, Chust G. 2019. Large-scale distribution of tuna species in a warming ocean. Global Change Biology. 25(6):2043–2060.

Filion A, Webster T, Poulin R, Godfrey SS. 2023. Interannual patterns of avian diseases in wild New Zealand avifauna near conservation areas. Austral Ecology. 48(7):1413–1425.

Foden WB, Butchart SHM, Stuart SN, Vié J-C, Akçakaya HR, Angulo A, DeVantier LM, Gutsche A, Turak E, Cao L, et al. 2013. Identifying the world's most climate change vulnerable species: a systematic trait-based assessment of all birds, amphibians and corals. PLOS ONE. 8(6):e65427.

Foden WB, Young BE. 2016. IUCN SSC guidelines for assessing species' vulnerability to climate change. Cambridge (UK) and Gland (Switzerland): IUCN.

Foden WB, Young BE, Akçakaya HR, Garcia RA, Hoffmann AA, Stein BA, Thomas CD, Wheatley CJ, Bickford D, Carr JA, et al. 2019. Climate change vulnerability assessment of species. Wiley Interdisciplinary Reviews: Climate Change. 10(1):e551.

Garnett S, Franklin D, editors. 2014. Climate change adaptation plan for Australian birds. Collingwood (Australia): CSIRO Publishing.

Gearhart C, Adams AM, Pinshow B, Korine C. 2020. Evaporative water loss in Kuhl's pipistrelles declines along an environmental gradient, from mesic to hyper-arid. Comparative Biochemistry and Physiology. Part A: Molecular and Integrative Physiology. 240:110587.

Gemmell NJ, Rutherford K, Prost S, Tollis M, Winter D, Macey JR, Adelson DL, Suh A, Bertozzi T, Grau JH, et al. 2020. The tuatara genome reveals ancient features of amniote evolution. Nature. 584(7821):403–409.

Germano J, Earl R, Tocher M, Pearce P, Christie J. 2023. The conservation long game: *Leiopelma* species climate envelopes in New Zealand under a changing climate. New Zealand Journal of Ecology. 47(2):3535.

Glick P, Stein BA, Edelson NA. 2011. Scanning the conservation horizon: a guide to climate change vulnerability assessment. Washington, DC: National Wildlife Federation.

Gonzalez JC, Orgeira JL, Jimenez YG, Nieto C, Romero C, Alegre A, Quiñones J. 2023. Habitat suitability under future climate scenarios in black-browed albatross (*Thalassarche melanophris*) in Southern South America and Antarctica. Polar Biology. 46(6):545–557.

Grayson KL, Mitchell NJ, Monks JM, Keall SN, Wilson JN, Nelson NJ. 2014. Sex ratio bias and extinction risk in an isolated population of tuatara (*Sphenodon punctatus*). PLOS ONE. 9(4):e94214.

Halloy SRP, Mark AF. 2003. Climate-change effects on alpine plant biodiversity: a New Zealand perspective on quantifying the threat. Arctic, Antarctic, and Alpine Research. 35:248–254.

Harper JRM, van Wilgen NJ, Turner AA, Tolley KA, Maritz B, Clusella-Trullas S, da Silva JM, Cunningham SJ, Cheney C, de Villiers AL, et al. 2022. Application of a trait-based climate change vulnerability assessment to determine management priorities at protected area scale. Conservation Science and Practice. 4(8):e12756.

Harris RJ, Barker G. 2007. Relative risk of invasive ants (Hymenoptera: Formicidae) establishing in New Zealand. New Zealand Journal of Zoology. 34:161–178.

Heenan P, Millar T, Smissen R, McGlone M, Wilton, A. 2017. Phylogenetic measures of neo- and palaeo-endemism in the indigenous vascular flora of the New Zealand archipelago. Australian Systematic Botany. 30(2):124–133.

Hitchmough RA, Barr B, Knox C, Lettink M, Monks JM, Patterson GB, Reardon JT, van Winkel D, Rolfe J, Michel P. 2021. Conservation status of New Zealand reptiles, 2021. Wellington: Department of Conservation. New Zealand Threat Classification Series 35. www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs35entire-feb2024.pdf

Hoare RJB, Dugdale JS, Edwards ED, Gibbs GW, Patrick BH, Hitchmough RA, Rolfe JR. 2017. Conservation status of New Zealand butterflies and moths (Lepidoptera), 2015. Wellington: Department of Conservation. New Zealand Threat Classification Series 20. www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs20entire.pdf

Holdaway RJ, Wiser SK, Williams PA. 2012. Status assessment of New Zealand's naturally uncommon ecosystems. Conservation Biology. 26:619–629.

Hossain MA, Kujala H, Bland LM, Burgman M, Lahoz-Monfort JJ. 2019. Assessing the impacts of uncertainty in climate-change vulnerability assessments. Diversity and Distributions. 25(8):1234–1245.

Hulme PE. 2020. Plant invasions in New Zealand: global lessons in prevention, eradication and control. Biological Invasions. 22(5):1539–1562.

[IPCC] Intergovernmental Panel on Climate Change. 2007. Climate change 2007: impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE, editors. Cambridge (UK): Cambridge University Press.

[IPCC] Intergovernmental Panel on Climate Change. 2013. Climate change 2013: the physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Stocker TF, Qin D, Plattner G-K, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V, Midgley PM, editors. Cambridge (UK): Cambridge University Press.

[IPCC] Intergovernmental Panel on Climate Change. 2014. Summary for policymakers. In: Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC, et al., editors. Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge (UK): Cambridge University Press; p.1–32.

[IPCC] Intergovernmental Panel on Climate Change. 2021. Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Masson-Delmotte V, Zhai P, Pirani A, Connors SL, Péan C, Berger S, Caud N, Chen Y, Goldfarb L, Gomis MI, et al., editors. Cambridge (UK): Cambridge University Press.

Jarvie S, Ingram T, Chapple DG, Hitchmough RA, Nielsen SV, Monks JM. 2022. Variable vulnerability to climate change in New Zealand lizards. Journal of Biogeography. 49(2):431–442.

Jarvie S, Worthy TH, Saltré F, Scofield RP, Seddon PJ, Cree A. 2021. Using holocene fossils to model the future: distribution of climate suitability for tuatara, the last rhynchocephalian. Journal of Biogeography. 48(6):1489–1502.

Johnson P, Gerbeaux P. 2004. Wetland types in New Zealand. Wellington: Department of Conservation. www.doc.govt.nz/documents/science-and-technical/WetlandsBW.pdf

Karthik S, Reddy MS, Yashaswini G. 2021. Climate change and its potential impacts on insect-plant interactions. The Nature, Causes, Effects and Mitigation of Climate Change on the Environment. 10:393–410.

Keegan L, White R, Macinnis-Ng C. 2022. Current knowledge and potential impacts of climate change on New Zealand's biological heritage. New Zealand Journal of Ecology. 46(1):1–24.

Kopp RE, Horton RM, Little CM, Mitrovica JX, Oppenheimer M, Rasmussen DJ, Strauss BH, Tebaldi C. 2014. Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites. Earth's Future. 2(8):383–406.

Kuschel G. 1975. Biogeography and ecology in New Zealand. The Hague: Junk.

Leschen RAB, Marris JWM, Emberson RM, Nunn J, Hitchmough RA, Stringer IAN. 2012: The conservation status of New Zealand Coleoptera. New Zealand Entomologist. 35(2):91–98.

Ling N, Tempero GW, Schamhart T. 2023. Using faecal DNA metabarcoding to determine the diet of the long-tailed bat, *Chalinolobus tuberculatus*. New Zealand Journal of Zoology. 1:1–8.

Lundquist CJ, Ramsay D, Bell R, Swales A, Kerr S. 2011. Predicted impacts of climate change on New Zealand's biodiversity. Pacific Conservation Biology. 17(3):179–191.

Macara G, Gibson PB. 2025. The climate and weather of Campbell Island: historic observations and projected changes. Wellington: Department of Conservation. Science for Conservation 342.

Macara G, Willsman A. 2021. NZ glacier ice volume calculated using Willsman (2017) method. Updated for Environment Aotearoa 2022. Wellington: National Institute of Water & Atmospheric Research Ltd. Client Report: 2021343WN.

Macinnis-Ng C, Mcintosh AR, Monks JM, Waipara N, White RSA, Boudjelas S, Clark CD, Clearwater MJ, Curran TJ, Dickinson KJM, et al. 2021. Climate-change impacts exacerbate conservation threats in island systems: New Zealand as a case study. Frontiers in Ecology and the Environment. 19(4):216–224.

Mahlfeld K, Brook FJ, Roscoe DJ, Hitchmough RA, Stringer IAN. 2012. The conservation status of New Zealand terrestrial Gastropoda excluding *Powelliphanta*. New Zealand Entomologist. 35(2):103–109.

Mansfield S, Ferguson CM, Gerard PJ, Hodges D, Kean JM, Phillips CB, Hardwick S, Zydenbos SM. 2021. Climate change impacts on pest ecology and risks to pasture resilience. Resilient Pastures – Grassland Research and Practice Series. 17:123–138.

Martin TG, Burgman MA, Fidler F, Kuhnert PM, Low-Choy S, McBride M, Mengersen K. 2012. Eliciting expert knowledge in conservation science. Conservation Biology. 26(1):29–38.

Mayence CE, Hawcroft A, Burlace D. 2023. Climate change vulnerability assessment (CCVA) methodology for Aotearoa New Zealand's naturally uncommon ecosystems. Christchurch: Department of Conservation (unpublished; DOC-7245163).

McGlone M, Walker S. 2011. Potential effects of climate change on New Zealand's terrestrial biodiversity and policy recommendations for mitigation, adaptation and research. Wellington: Department of Conservation. Science for Conservation 312. www.doc.govt.nz/globalassets/documents/science-and-technical/sfc312entire.pdf

McNab BK, O'Donnell C. 2018. The behavioral energetics of New Zealand's bats: Daily torpor and hibernation, a continuum. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology. 223:18–22.

Mills JA, Yarrall JW, Bradford-Grieve JM, Uddstrom MJ, Renwick JA, Merilä J. 2008. The impact of climate fluctuation on food availability and reproductive performance of the planktivorous red-billed gull *Larus novaehollandiae scopulinus*. Journal of Animal Ecology. 77(6):1129–1142.

[MfE] Ministry for the Environment. 2018. Climate change projections for New Zealand: atmosphere projections based on simulations from the IPCC Fifth Assessment, 2nd Edition. Wellington: Ministry for the Environment.

[MfE] Ministry for the Environment, Stats NZ. 2023. New Zealand's Environmental Reporting Series: Our atmosphere and climate 2023. Wellington: Ministry for the Environment.

Mitchell NJ, Allendorf FW, Keall SN, Daugherty CH, Nelson NJ. 2010. Demographic effects of temperature-dependent sex determination: will tuatara survive global warming? Global Change Biology. 16(1):60–72.

Molano-Flores B, Zaya DN, Baty J, Spyreas G. 2019. An assessment of the vulnerability of Illinois' rarest plant species to climate change. Castanea. 84(2):115–127.

Momberg M, Ryan PG, Hedding DW, Schoombie J, Goddard KA, Craig KJ, Le Roux PC. 2023. Factors determining nest-site selection of surface-nesting seabirds: a case study on the world's largest pelagic bird, the Wandering Albatross (*Diomedea exulans*). Ibis. 165(1):190–203.

Mundinger C, Fleischer T, Scheuerlein A, Kerth G. 2022. Global warming leads to larger bats with a faster life history pace in the long-lived Bechstein's bat (*Myotis bechsteinii*). Communications Biology. 5:682.

Murray TJ, Borkin KM, Brumby A, O'Donnell CFJ. 2024. Threatened species research gaps and priorities for the Department of Conservation Te Papa Atawhai. Wellington: Department of Conservation. DOC Research and Development Series 371. www.doc.govt.nz/globalassets/documents/science-and-technical/doc-research-and-development-series/drds371entire.pdf

Murray TJ, Tissue DT, Ellsworth DS, Riegler M. 2013. Interactive effects of pre-industrial, current and future [CO_2] and temperature on an insect herbivore of *Eucalyptus*. Oecologia. 171:1025–1035.

O'Donnell CFJ. 2000. Influence of season, habitat, temperature, and invertebrate availability on nocturnal activity by the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). New Zealand Journal of Zoology. 27:207–221.

O'Donnell CFJ, Borkin KM, Christie J, Davidson-Watts I, Dennis G, Pryde M, Michel P. 2023. Conservation status of bats in Aotearoa New Zealand, 2022. Wellington: Department of Conservation. New Zealand Threat Classification Series 41. www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs41entire.pdf

O'Donnell CFJ, Christie JE, Hitchmough RA, Lloyd B, Parsons S. 2010. The conservation status of New Zealand bats, 2009. New Zealand Journal of Zoology. 37:297–311.

O'Donnell CFJ, Weston KA, Monks JM. 2017. Impacts of introduced mammalian predators on New Zealand's alpine fauna. New Zealand Journal of Ecology. 41(1):1–22.

Ofori BY, Stow AJ, Baumgartner JB, Beaumont LJ. 2017. Influence of adaptive capacity on the outcome of climate change vulnerability assessment. Scientific Reports. 7:12979.

Olin AB, Dück L, Berglund PA, Karlsson E, Bohm M, Olsson O, Hentati-Sundberg J. 2024. Breeding failures and reduced nest attendance in response to heat stress in a high-latitude seabird. Marine Ecology Progress Series. 737:147–160.

Pacifici M, Foden WB, Visconti P, Watson JEM, Butchart SHM, Kovacs KM, Scheffers BR, Hole DG, Martin TG, Akçakaya HR, et al. 2015. Assessing species vulnerability to climate change. Nature Climate Change. 5(3):215–24.

Parmesan C. 2006. Ecological and evolutionary responses to recent climate change. Annual Review of Ecology, Evolution and Systematics. 37:637–669.

Parmesan C, Ryrholm N, Stefanescu C, Hill J K, Thomas CD, Descimon H, Huntley B, Kaila L, Kullberg J, Tammaru T, et al. 1999. Poleward shifts in geographical ranges of butterfly species associated with regional warming. Nature. 399(6736):579–583.

R Core Team. 2022. R: a language and environment for statistical computing. Version 4.2.3. Vienna: R Foundation for Statistical Computing.

Reisinger A, Howden M, Vera C, Garschagen M, Hurlbert M, Kreibiehl S, Mach KJ, Mintenbeck K, O'Neill B, Pathak M, et al. 2020. The concept of risk in the IPCC Sixth Assessment Report: a summary of cross-working group discussions. Geneva: Intergovernmental Panel on Climate Change.

Richardson SJ, Allen RB, Whitehead D, Carswell FE, Ruscoe WA, Platt KH. 2005. Climate and net carbon availability determine temporal patterns of seed production by *Nothofagus*. Ecology. 86(4):972–981.

Roberts JO, Hendriks HR. 2022. Potential climate change effects on New Zealand marine mammals: a review. Wellington: Department of Conservation. DOC Research and Development Series 366. www.doc.govt.nz/globalassets/documents/science-and-technical/drds366entire.pdf

Robertson HA, Baird KA, Elliot GP, Hitchmough RA, McArthur NJ, Makan TD, Miskelly CM, O'Donnell CFJ, Sagar PM, Scofield RP, et al. 2021. Conservation status of birds in Aotearoa New Zealand. Wellington: Department of Conservation. New Zealand Threat Classification Series 36. www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs36entire.pdf

Rogers G, Hewitt A, Wilson JB. 2000. Ecosystem-based conservation strategy for Central Otago's saline patches. Wellington: Department of Conservation. Science for Conservation 166. www.doc.govt.nz/documents/science-and-technical/Sfc166.pdf

Rolfe J, Hitchmough R, Michel P, Makan T, Cooper JA, de Lange PJ, Townsend CAJ, Miskelly CM, Molloy J. 2022. New Zealand Threat Classification System manual 2022. Part 1: Assessments. Wellington: Department of Conservation. www.doc.govt.nz/globalassets/documents/science-and-technical/new-zealand-threat-classification-system-manual-2022-part-1-assessments.pdf

Rolton A, Rhodes L, Hutson KS, Biessy L, Bui T, MacKenzie L, Symonds JE, Smith KF. 2022. Effects of harmful algal blooms on fish and shellfish species: a case study of New Zealand in a changing environment. Toxins. 14(5):341.

Rufaut CG, Craw D, Druzbicka J, Law S. 2018. Conservation of saline patches in Central Otago needs better recognition of physical processes to secure future habitats. New Zealand Journal of Botany. 56(1):115–126.

Shank CC, Nixon A. 2015. Climate change vulnerability of Alberta's biodiversity: a preliminary assessment. Edmonton (AB): Alberta Biodiversity Monitoring Institute.

Sirvid PJ, Vink CJ, Fitzgerald BM, Wakelin MD, Rolfe J, Michel P. 2021. Conservation status of New Zealand Araneae (spiders), 2020. Wellington: Department of Conservation. New Zealand Threat Classification Series 34. www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs34entire.pdf

Smissen R, Cooper J, Podolyan A, Walker S. 2022. Genetic variation and fungal endophytes of inland *Lepidium* species. Prepared for the Department of Conservation by Manaaki Whenua, Landcare Research. Contract report LC4110.

Still SM, Frances AL, Treher AC, Oliver L. 2015. Using two climate change vulnerability assessment methods to prioritize and manage rare plants: a case study. Natural Areas Journal. 35(1):106–121.

Tait A, Pearce P. 2019. Impacts and implications of climate change on Waituna Lagoon, Southland. Wellington: Department of Conservation. Science for Conservation 335. www.doc.govt.nz/globalassets/documents/science-and-technical/sfc335entire.pdf

Thompson RC, Rodgers KA. 1977. Laterization of the ultramafic-gabbro association at North Cape, northernmost New Zealand. Journal of the Royal Society of New Zealand. 7(3):347–377.

Toth CA, Dennis TE, Pattemore DE, Parsons S. 2015. Females as mobile resources: communal roosts promote the adoption of lek breeding in a temperate bat. Behavioural Ecology. 26(4):1156–1163.

Townsend AJ, de Lange PJ, Duffy CAJ, Miskelly CM, Molloy J, Norton D. 2008. New Zealand Threat Classification System manual. Wellington: Department of Conservation. www.doc.govt.nz/globalassets/documents/science-and-technical/sap244.pdf

Trewick S, Hegg D, Morgan-Richards M, Murray T, Watts C, Johns P, Michel P. 2022. Conservation status of Orthoptera (wētā, crickets and grasshoppers) in Aotearoa New Zealand. Wellington: Department of Conservation. New Zealand Threat Classification Series 39. www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs39entire.pdf

Trewick SA, Koot EM, Morgan-Richards M. 2023. Māwhitiwhiti Aotearoa: Phylogeny and synonymy of the silent alpine grasshopper radiation of New Zealand (Orthoptera: Acrididae). Zootaxa. 5383(2): 225–241.

Tylianakis JM, Didham RK, Bascome J, Wardle D. 2008. Global change and species interactions in terrestrial ecosystems. Ecology Letters. 11:1351–1363.

[UNFCCC] United Nations Framework Convention on Climate Change. 2021. Nationally determined contributions under the Paris Agreement. Synthesis report by the secretariat. Conference of the Parties serving as the meeting of the Parties to the Paris Agreement. Third session, Glasgow, 31 October to 12 November 2021. https://unfccc.int/sites/default/files/resource/cma2021_08_adv_1.pdf

Van Vianen JCCM, Houliston GJ, Fletcher JD, Heenan PB, Chapman HM. 2013. New threats to endangered Cook's scurvy grass (*Lepidium oleraceum*; Brassicaceae): introduced crop viruses and the extent of their spread. Australian Journal of Botany. 61(2):161–166.

van Winkle D, Baling M, Hitchmough R. 2018. Reptiles and amphibians of New Zealand: a field guide. Auckland: Auckland University Press.

Vaz-Canosa P, Laufer G, Borteiro C, Baldo D, Prigioni C, Soutullo A. 2022. Expert-based assessment of the climate change vulnerability of amphibians and reptiles of Uruguay. Environmental Conservation. 50(1):12–21.

Walker K, Brook FJ, Barker GM, Roscoe DJ, Edwards E, Hitchmough RA, Rolfe JR. 2021. Conservation status of New Zealand indigenous terrestrial Gastropoda (slugs and snails), 2020. Part 2. Achatinellidae, Bothriembryontidae (pūpūharakeke), Euconulidae, Helicarionidae, Pupinidae and Vertiginidae. Wellington: Department of Conservation. New Zealand Threat Classification Series 33. www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs33entire.pdf

Walker S. 2021. Collection of material of inland *Lepidium* species, 2020/21. Prepared for the Department of Conservation by Manaaki Whenua, Landcare Research. Contract report LC3947.

Walker S, Monks A, Innes J. 2019. Thermal squeeze will exacerbate declines in New Zealand's endemic forest birds. Biological Conservation. 237:166–174.

Wardle P. 2008. New Zealand forest to alpine transitions in global context. Arctic, Antarctic, and Alpine Research. 40:240–249.

Weston KA, O'Donnell CF, van dam-Bates P, Monks JM. 2018. Control of invasive predators improves breeding success of an endangered alpine passerine. Ibis. 160(4):892–899.

Whitehead EA, Adams N, Baird KA, Bell EA, Borelle SB, Dunphy BJ, Gaskin CP, Landers TJ, Rayner MJ, Russell JC. 2019. Threats to seabirds of northern Aotearoa New Zealand. Auckland: Northern New Zealand Seabird Charitable Trust.

Williams PA, Wiser S, Clarkson B, Stanley MC. 2007. New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. New Zealand Journal of Ecology. 31:119–128.

Williams SE, Shoo LP, Isaac JL, Hoffmann AA, Langham G. 2008. Towards an integrated framework for assessing the vulnerability of species to climate change. PLOS Biology. 6(12):e325.

Wiser SK, Buxton RP, Clarkson BR, Hoare RJB, Holdaway RJ, Richardson SJ, Smale MC, West C, Williams PA. 2013. New Zealand's naturally uncommon ecosystems. In: Dymond JR, editor. Ecosystem services in New Zealand – conditions and trends. Lincoln: Manaaki Whenua Press; p. 49–61.

Yukich-Clendon OMM, Carpenter JK, Kelly D, Timoti P, Burns BR, Boswijk G, Monks A. 2023. Global change explains reduced seeding in a widespread New Zealand tree: indigenous tūhoe knowledge informs mechanistic analysis. Frontiers in Forests and Global Change. 6:1172326.

Zhao C, Jiang J, Xie F, Li C, Zhao T. 2022. Assessment of amphibians vulnerability to climate change in China. Frontiers in Ecology and Evolution. 10:826910.

Appendix 1

Results using the optimistic assessment method

The tables in sections A1.1 to A1.5 list the vulnerability categories for each of the assessed taxa. Taxa are listed in alphabetical order within each group of taxa. Vulnerability categories are shown for all assessed emissions scenarios (RCP4.5 and RCP8.5) and time frames (mid-century and late century) using the **optimistic assessment method, where 'unknown vulnerability' scores were replaced with 'lower vulnerability' scores**. Note that the scientific names of taxa were derived from the New Zealand Threat Classification System (NZTCS) database on 1 August 2022 and so do not account for any changes since then.

The table below shows the dimension scores and recommended actions for each of the vulnerability categories, where H = higher vulnerability triggered for the dimension and L = lower vulnerability triggered for the dimension (adapted from Foden et al. 2013,[20] licensed by the authors for reuse; CC BY 4.0).

VULNERABILITY CATEGORY	SENSITIVITY	LOW ADAPTIVE CAPACITY	EXPOSURE	RECOMMENDED ACTIONS
Highly Vulnerable	H	H	H	Specific research and / or interventions generally needed
Potential Adapters	H	L	H	Monitor and plan precautionary adaptive responses
Potential Persisters	L	H	H	Monitor population trends as a precaution
Latent Risk	H	H	L	Monitor environmental variables and re-assess if predictions worsen
Sensitive Only	H	L	L	No immediate action required but monitor populations and plan to adapt management if needed
Exposed Only	L	L	H	No immediate action required but monitor populations and plan to adapt management if needed
Low Adaptive Capacity Only	L	H	L	No immediate action required but monitor populations and plan to adapt management if needed
Low Vulnerability	L	L	L	No immediate action required but monitor populations and plan to adapt management if needed

[20] Foden WB, Butchart SHM, Stuart SN, Vié J-C, Akçakaya HR, Angulo A, DeVantier LM, Gutsche A, Turak E, Cao L, et al. 2013. Identifying the world's most climate change vulnerable species: a systematic trait-based assessment of all birds, amphibians and corals. PLOS ONE. 8(6):e65427.

A1.1 Bats

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Chalinolobus tuberculatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mystacina robusta	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Mystacina tuberculata aupourica	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Mystacina tuberculata rhyacobia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mystacina tuberculata tuberculata	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable

A1.2 Birds

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Acanthisitta chloris chloris	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Acanthisitta chloris granti	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Anarhynchus frontalis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anas aucklandica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anas chlorotis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anas gracilis	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Anas nesiotis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anas rhynchotis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Anas superciliosa	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Anous minutus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anthornis melanura melanura	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Anthornis melanura obscura	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Anthornis melanura oneho	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anthus novaeseelandiae aucklandicus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anthus novaeseelandiae chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anthus novaeseelandiae novaeseelandiae	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Anthus novaeseelandiae steindachneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx australis “Haast”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx australis “northern Fiordland”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx australis “southern Fiordland”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx australis australis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx haastii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx mantelli	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Apteryx owenii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx rowi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Ardea modesta	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Aythya novaeseelandiae	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Botaurus poiciloptilus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Bowdleria punctata caudata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Bowdleria punctata punctata	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Bowdleria punctata stewartiana	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Bowdleria punctata vealeae	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Bowdleria punctata wilsoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Calidris canutus rogersi	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Callaeas wilsoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

Continued on next page

A1.2 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Catharacta antarctica lonnbergi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Charadrius bicinctus bicinctus	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Charadrius bicinctus exilis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Charadrius obscurus aquilonius	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Charadrius obscurus obscurus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chlidonias albostriatus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chrysococcyx lucidus lucidus	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Circus approximans	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Coenocorypha aucklandica aucklandica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coenocorypha aucklandica meinertzhagenae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coenocorypha aucklandica perseverance	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coenocorypha huegeli	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coenocorypha pusilla	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cyanoramphus auriceps	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Cyanoramphus forbesi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cyanoramphus hochstetteri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cyanoramphus malherbi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cyanoramphus novaezelandiae chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cyanoramphus novaezelandiae cyanurus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cyanoramphus novaezelandiae novaezelandiae	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Cyanoramphus unicolor	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Daption capense australe	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Diomedea antipodensis antipodensis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Diomedea antipodensis gibsoni	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Diomedea epomophora epomophora	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Diomedea sanfordi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Egretta novaehollandiae	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Egretta sacra sacra	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Elseyornis melanops	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Eudynamys taitensis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Eudyptes filholi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptes pachyrhynchus	Latent Risk	Latent Risk	Highly Vulnerable	Latent Risk
Eudyptes robustus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Eudyptes sclateri	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptula minor albosignata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptula minor chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Eudyptula minor iredalei	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptula minor minor	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptula novaehollandiae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Falco novaeseelandiae "southern"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Falco novaeseelandiae ferox	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Falco novaeseelandiae novaeseelandiae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Fregetta grallaria grallaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Fregetta maoriana	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Fregetta tropica	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters

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A1.2 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Fulica atra australis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Gallirallus australis australis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Gallirallus australis greyi	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Gallirallus australis hectori	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Gallirallus australis scotti	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gallirallus philippensis assimilis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Garrodia nereis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gerygone albofrontata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gerygone igata	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Gygis alba candida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Haematopus chathamensis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Haematopus finschi	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Haematopus unicolor	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hemiphaga chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Hemiphaga novaeseelandiae	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Himantopus himantopus leucocephalus	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Himantopus novaezelandiae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hirundo neoxena neoxena	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Hydroprogne caspia	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hymenolaimus malacorhynchos	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Larus bulleri	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Larus dominicanus dominicanus	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters	Potential Persisters
Larus novaehollandiae scopulinus	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Leucocarbo campbelli	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leucocarbo carunculatus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucocarbo chalconotus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Leucocarbo colensoi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucocarbo onslowi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucocarbo ranfurlyi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucocarbo stewarti	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lewinia muelleri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Limosa lapponica baueri	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Macronectes halli	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Megadyptes antipodes	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Mohoua albicilla	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Mohoua novaeseelandiae	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Mohoua ochrocephala	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Morus serrator	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Nestor meridionalis meridionalis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Nestor meridionalis septentrionalis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Nestor notabilis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ninox novaeseelandiae novaeseelandiae	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Notiomystis cincta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Onychoprion fuscatus serratus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pachyptila crassirostris crassirostris	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pachyptila crassirostris flemingi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pachyptila crassirostris pyramidalis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pachyptila desolata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pachyptila turtur	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Pachyptila vittata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pelagodroma albiclunis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pelagodroma marina maoriana	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pelecanoides urinatrix chathamensis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Pelecanoides urinatrix exsul	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Pelecanoides urinatrix urinatrix	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Pelecanoides whenuahouensis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Petroica australis australis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Petroica australis rakiura	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Petroica longipes	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Petroica macrocephala chathamensis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Petroica macrocephala dannefaerdi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Petroica macrocephala macrocephala	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Petroica macrocephala marrineri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Petroica macrocephala toitoi	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Petroica traversi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Phaethon rubricauda	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Phalacrocorax carbo novaehollandiae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Phalacrocorax melanoleucos brevirostris	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Phalacrocorax sulcirostris	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Phalacrocorax varius varius	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Philesturnus carunculatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Philesturnus rufusater	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Phoebetria palpebrata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Platalea regia	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Podiceps cristatus australis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Poliocephalus rufopectus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Porphyrio hochstetteri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Porphyrio melanotus melanotus	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Porzana pusilla affinis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Porzana tabuensis tabuensis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Procellaria aequinoctialis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Procellaria cinerea	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Procellaria parkinsoni	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Procellaria westlandica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Procelsterna cerulea albivitta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A1.2 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Prosthemadera novaeseelandiae chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Prosthemadera novaeseelandiae novaeseelandiae	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Pterodroma aff. *neglecta* “winter”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pterodroma axillaris	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pterodroma cervicalis	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Pterodroma cookii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pterodroma inexpectata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pterodroma lessonii	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Pterodroma macroptera gouldi	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pterodroma magentae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pterodroma mollis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pterodroma neglecta neglecta	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pterodroma nigripennis	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Pterodroma pycrofti	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Puffinus assimilis haurakiensis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Puffinus assimilis kermadecensis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Puffinus bulleri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Puffinus carneipes	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Puffinus elegans	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Puffinus gavia	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Puffinus griseus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Puffinus huttoni	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Puffinus pacificus pacificus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Rhipidura fuliginosa fuliginosa	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Rhipidura fuliginosa penita	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rhipidura fuliginosa placabilis	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Sterna striata aucklandorna	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Sterna striata striata	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Sterna vittata bethunei	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Sternula nereis davisae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Stictocarbo featherstoni	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Stictocarbo punctatus	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Strigops habroptilus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sula dactylatra tasmani	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tadorna variegata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Thalassarche bulleri bulleri	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Thalassarche bulleri platei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Thalassarche cauta steadi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Thalassarche chrysostoma	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Thalassarche eremita	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Thalassarche impavida	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Thalassarche salvini	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

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A1.2 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Thinornis novaeseelandiae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Todiramphus sanctus vagans	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Vanellus miles novaehollandiae	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Xenicus gilviventris	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Xenicus gilviventris rineyi	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Zosterops lateralis lateralis	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability

A1.3 Herpetofauna

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Dactylocnemis “Matapia Island”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Dactylocnemis “Mokohinau”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dactylocnemis “North Cape”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Dactylocnemis “Poor Knights”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dactylocnemis “Three Kings”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dactylocnemis pacificus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Hoplodactylus duvaucelii “northern”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Hoplodactylus duvaucelii “southern”	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Leiopelma archeyi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leiopelma hamiltoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leiopelma hochstetteri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau “Cascades”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mokopirirakau “Okarito”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau “Open Bay Islands”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau “Roys Peak”	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Mokopirirakau “southern forest”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau “southern North Island”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mokopirirakau cryptozoicus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau galaxias	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Mokopirirakau granulatus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mokopirirakau kahutarae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau nebulosus	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Naultinus elegans	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Naultinus flavirictus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Naultinus gemmeus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Naultinus grayii	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Naultinus manukanus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Naultinus punctatus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters

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A1.3 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Naultinus rudis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Naultinus stellatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Naultinus tuberculatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma "rockhopper"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma "Whirinaki"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma acrinasum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma aeneum	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma aff. *chloronoton* "eastern Otago"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *chloronoton* "Stewart Island"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *chloronoton* "West Otago"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *inconspicuum* "Big Bay"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *inconspicuum* "herbfield"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *inconspicuum* "Humboldt"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *inconspicuum* "mahogany"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *inconspicuum* "North Otago"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *inconspicuum* "pallid"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *infrapunctatum* "cobble"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *infrapunctatum* "Hokitika"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *infrapunctatum* "Southern North Island"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *longipes* "southern"	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Oligosoma aff. *polychroma* Clade 2	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *polychroma* Clade 3	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *polychroma* Clade 4	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *polychroma* Clade 5	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *smithi* "Three Kings, Te Paki, Western Northland"	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Oligosoma aff. *waimatense* "alpine rock"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *waimatense* "Marlborough"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma alani	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma albornense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma auroraense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma awakopaka	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma burganae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma chloronoton	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma elium	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma fallai	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma grande	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma hardyi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma homalonotum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma hoparatea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma inconspicuum	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters

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A1.3 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Oligosoma judgei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma kahurangi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma kokowai	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Oligosoma levidensum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma lineoocellatum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma longipes	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Oligosoma maccanni	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma macgregori	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma microlepis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma moco	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma newmani	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma nigriplantare	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma notosaurus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma oliveri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma ornatum	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma otagense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma pachysomaticum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma pikitanga	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma polychroma	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma prasinum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Oligosoma repens	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma robinsoni	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma roimata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma salmo	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma smithi	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Oligosoma stenotis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma striatum	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma suteri	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma taumakae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma tekakahu	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma toka	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma townsi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma waimatense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma whitakeri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma zelandicum	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Sphenodon punctatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Toropuku inexpectatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Toropuku stephensi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tukutuku rakiurae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Woodworthia "Central Otago"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia "Cromwell"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Woodworthia "Kaikoura"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A1.3 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Woodworthia "Marlborough mini"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia "Mount Arthur"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Woodworthia "Otago / Southland large"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia "pygmy"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia "Raggedy"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Woodworthia "Southern Alps"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Woodworthia "Southern Alps northern"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia "southern mini"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Woodworthia "south-western"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia aff. *maculata* "Muriwai"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Woodworthia cf. *brunnea*	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia chrysosiretica	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia maculata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters

A1.4 Invertebrates

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
"*Acroclita*" *discariana*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
"*Cnephasia*" *paterna*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
"*Epichorista*" *lindsayi*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
"*Hydriomena*" *clarkei*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
"*Pseudocoremia*" *cineracia*	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
"*Schiffermuelleria*" *orthophanes*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Allodiscus camelinus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Allodiscus hazelwoodi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Alsolemia cresswelli	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Amborhytida dunniae	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Amborhytida forsythi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Amborhytida sp. 1 (M.173834)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anagotus stephenensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anisoura nicobarica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Arctesthes avatar	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Arctesthes titanica	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Asaphodes frivola	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Asaphodes imperfecta	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Asaphodes obarata	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Asaphodes stinaria	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Australothis volatilis	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Austrocidaria arenosa	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters

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A1.4 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Bembidion tillyardi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Brachaspis nivalis "lowland"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Brachaspis robustus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Brullea antarctica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cephalissa siria	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Charopidae sp. 130 (NMNZ M.127912) *Phacussa* "kingae"	Latent Risk	Latent Risk	Latent Risk	Latent Risk
Charopidae sp. 46 (NMNZ M.087828) "Tom Bowling Bay sunken spire"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Chaureopa roscoei	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Clepsicosma sp. "Titirangi"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Climocella pukanui	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Costallodiscus parrishi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora brooki	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora gardneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora hirsutissima	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora hispida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora houhora	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora kerrana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora lignaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora parrishi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora taipa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora tepakiensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dasyuris partheniata	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Declana cf. *hermione* "Te Paki"	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Declana griseata	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Deinacrida carinata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida elegans	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida heteracantha	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida mahoenui	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida parva	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida pluvialis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Deinacrida rugosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida talpa	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Deinacrida tibiospina	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Delos sp. 1 (NMNZ M.029346)	Latent Risk	Latent Risk	Latent Risk	Latent Risk
Delos sp. 13 (NMNZ M.029345)	Latent Risk	Latent Risk	Latent Risk	Latent Risk
Delouagapia tasmani	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dichromodes "Cloudy Bay"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Dichromodes "Gore Bay"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Duvaliomimus (*Duvaliomimus*) *crypticus*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ericodesma aerodana	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Fectola melchior	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gadira leucophthalma	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Geodorcus alsobius	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Geodorcus capito	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Geodorcus ithaginis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Geodorcus servandus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Geodorcus sororum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gingidiobora "Eastern Otago"	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Gingidiobora nebulosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Gingidiobora subobscurata s.l.	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Gymnobathra ambigua	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Hadramphus spinipennis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hadramphus tuberculatus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Heloxycanus patricki	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Hemiandrus "furoviarius"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Hemiandrus (CMNZ 2000.121.21115) "Cromwell"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Hemideina thoracica "2n=23,24"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Holcaspis abdita	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Holcaspis bathana	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Holcaspis bidentella	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Holcaspis brevicula	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Holcaspis falcis	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Holcaspis n. sp. 1 (McKenzie, Canterbury, CMNZholc00)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Horelophus walkeri	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Izatha psychra	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Kiwaia "plains jumper"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Kiwaia jeanae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Kiwaia pumila	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Kiwaia sp. "Cloudy Bay"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Kupea electilis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Latrodectus katipo	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Liarea aupouria aupouria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Liarea sp. 1 (NMNZ M.158257) "Bream Head"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Lycaena ianthina	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Lycaena sp. "Chrystalls Beach boulder"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Lyperobius nesidiotes	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Maloides cavernicola	Latent Risk	Latent Risk	Latent Risk	Latent Risk
Maniho centralis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Maoricrambus oncobolus	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Maoritenes sp. "*Olearia*"	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Mecodema atrox	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema chiltoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema costellum costellum costellum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema howitti	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mecodema laeviceps	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mecodema manaia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema pulchellum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Mecodema quoinense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema strictum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Mecodema tenaki	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Megadromus sp. 8 "Omeo Hut" (Omeo Hut, Otago, CMNZmega08)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Meterana "Foveaux Strait"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Meterana cf. *tetrachroa*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Meterana pictula	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Migas taierii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Motuweta isolata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Neanops pritchardi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Notoreas casanova	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Notoreas edwardsi	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Notoreas perornata "Cape Campbell"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Notoreas perornata "Cape Turnagain"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Notoreas perornata "Castlepoint"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Notoreas perornata "ND/AK"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Notoreas perornata "TK/NN"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Notoreas perornata "WA/WN"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Notoreas perornata "Waiho Flats"	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Orocrambus "Mackenzie Basin"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Orocrambus fugitivellus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Orocrambus sophistes	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Orthoclydon pseudostinaria	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Orthoglymma wangapeka	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pachyrhamma delli	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Paralissotes oconnori	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Paranotoreas "Banks Peninsula"	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Paryphanta busbyi busbyi	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Paryphanta busbyi watti	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Paryphanta sp. 1 "western clade" (NMNZ M.305039)	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pasiphila sp. "*Olearia*"	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pasiphila sp. cf. *magnimaculata*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Periegops keani	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Phaulacridium otagoense	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Placostylus (*Basileostylus*) *bollonsi*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Platyptilia campsiptera	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Powelliphanta "Anatoki Range"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta "Baton"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta "Buller River"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta "Gunner River"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta "Haast"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta "Maungaharuru"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta "Mt Augustus"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta "Owen"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta "Parapara"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta "patrickensis"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A1.4 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Powelliphanta "Urewera"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta annectens	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta fiordlandica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gagei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi "Haidinger"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi "Heaphy"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi aurea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi brunnea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi compta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi fallax	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi gilliesi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi jamesoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi kahurangica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi montana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi subfusca	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri anatokiensis red form	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri bicolor	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri consobrina	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri hochstetteri brown based	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri hochstetteri yellow based	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri obscura	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria johnstoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria lignaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria lusca	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria oconnori	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria rotella	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria ruforadiata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria unicolorata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta marchanti	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Powelliphanta rossiana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta spedeni spedeni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba "Gouland Range"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba harveyi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba mouatae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba prouseorum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba richardsoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba superba	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi florida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi koputaroa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi latizona	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi otakia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi tararuaensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi traversi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Proditrix chionochloae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A1.4 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Prodontria lewisi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Protosynaema sp. "*Olearia*"	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pseudaneitea ramsayi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pseudocoremia albafasciata	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pseudocoremia sp. "Knobby Range"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Punctidae sp. 156 (NMNZ M.079798) "glabriuscula-group parrishi"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Punctidae sp. 226 (NMNZ M.154908) *Laomarex* sp. "aff. *L. regia* (Gardner, 1968)"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Punctidae sp. 36 (NMNZ M.088229) *Phrixgnathus* "wallacei"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pyrausta comastis	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pyrgotis sp. "*Olearia*"	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Pyroderces sp. "yellow"	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Rhytida oconnori	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rhytida stephenensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rhytida webbi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rhytidarex buddlei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sabulopteryx botanica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Schizoglossa gigantea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Schizoglossa worthyae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Scythris sp. "stripe"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sigaus australis "central arid"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Sigaus campestris	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sigaus childi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sigaus homerensis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Sigaus minutus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Sporophyla oenospora	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Stathmopoda albimaculata	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Stathmopoda campylocha	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Stathmopoda sp. "*Olearia*"	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Stephanorhynchus insolitus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Stigmella sp. "*Olearia*"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Stigmella sp. "*Traversia*"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Succinea archeyi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Tatosoma agrionata	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Theoxena scissaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tychanopais fougeri	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Wainuia clarki	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Wainuia edwardi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Wainuia nasuta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Waiputrechus cavernicola	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Xanthorhoe frigida	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Xylotoles costatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Zecillenus chalmeri	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Zecillenus embersoni	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Zelleria sphenota	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters

A1.5 Vascular plants

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Acaena aff. *rorida* (OTA 59561; Pool Burn)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Acaena buchananii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Acaena microphylla var. *pauciglochidiata*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Acaena pallida	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Acaena rorida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Achnatherum petriei	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Aciphylla aff. *squarrosa* (a) (AK 44773; Volcanic Plateau)	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Aciphylla dieffenbachii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Aciphylla lecomtei	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Aciphylla multisecta	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Aciphylla squarrosa var. *squarrosa*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Aciphylla subflabellata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Aciphylla takahea	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Ackama nubicola	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Agathis australis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Alectryon excelsus subsp. *grandis*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Alepis flavida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Althenia bilocularis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Amphibromus fluitans	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anisotome acutifolia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anisotome capillifolia	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Anisotome cauticola	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Anisotome patula	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anisotome pilifera	Low Vulnerability	Low Vulnerability	Exposed Only	Exposed Only
Anogramma leptophylla	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anthosachne falcis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anthosachne kingiana subsp. *multiflora*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Asplenium pauperequitum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Asplenium trichomanes subsp. *quadrivalens*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Atriplex billardierei	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Atriplex buchananii	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Atriplex cinerea	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Atriplex hollowayi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Australopyrum calcis subsp. *calcis*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Australopyrum calcis subsp. *optatum*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Austroderia turbaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Beilschmiedia aff. *tawa* (AK 230588; Poor Knights Is.)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Botrychium lunaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyglottis cockaynei	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Brachyglottis huntii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyglottis kirkii var. *kirkii*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyglottis pentacopa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyglottis perdicioides	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyglottis rotundifolia var. *ambigua* (AK 251870)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

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A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Brachyglottis sciadophila	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Brachyglottis turneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyscome aff. *humilis* (AK 231703; West Dome)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyscome linearis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyscome lucens	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyscome pinnata	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Bulbinella modesta	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Caleana minor	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Calochilus herbaceus	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cardamine alticola	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cardamine bilobata	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cardamine bisetosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Cardamine caesiella	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine coronata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine dactyloides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine dilatata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine integra	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine megalantha	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine mutabilis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine pachyphylla	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine panatohea	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Cardamine parvula	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Cardamine porphyroneura	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine sciaphila	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine serpentina	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine thalassica	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Cardamine verna	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carex albula	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Carex auceps	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carex berggrenii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex buchananii	Low Vulnerability	Low Vulnerability	Exposed Only	Exposed Only
Carex capillacea	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Carex carsei	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Carex cirrhosa	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex cremnicola	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Carex cyanea	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Carex dolomitica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carex fascicularis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Carex fretalis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Carex inopinata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex kaloides	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Carex litorosa	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Carex parvispica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carex rubicunda	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex strictissima	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carex tenuiculmis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters

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A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Carex uncifolia	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia astonii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia carmichaeliae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia corrugata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia crassicaulis subsp. *crassicaulis*	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Carmichaelia crassicaulis subsp. *racemosa*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia curta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia hollowayi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia juncea	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Carmichaelia kirkii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia monroi	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Carmichaelia muritai	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Carmichaelia nana	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia petriei	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Carmichaelia stevensonii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia torulosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia uniflora	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia vexillata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Celmisia aff. *gracilenta* (b) (CHR 469722; Mangaweka)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Celmisia aff. *similis* (AK 285874; Bald Knob Ridge)	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Celmisia holosericea	Low Vulnerability	Exposed Only	Exposed Only	Exposed Only
Centipeda minima subsp. *minima*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Centrolepis strigosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Ceratocephala pungens	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chaerophyllum aff. *novae-zelandiae* (CHR 573578; Waitaki)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Chaerophyllum basicola	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Chaerophyllum colensoi var. *delicatulum* (CHR 73872; Hauhungaroa Range)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chenopodium detestans	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chionochloa juncea	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Chionochloa ovata	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Christella aff. *dentata* (b) (AK 126902; “thermal”)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Clematis marmoraria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Clianthus maximus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Clianthus puniceus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Colobanthus brevisepalus	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Convolvulus verecundus	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Coprosma acerosa	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Coprosma aff. *acerosa* (a) (AK 158739; Central North Island)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Coprosma aff. *acerosa* (b) (CHR 285650; Cobb)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma aff. *acerosa* (c) (WELT SP079167; Red Rocks)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Coprosma aff. *macrocarpa* (AK 309497; Surville)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma brunnea	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Coprosma intertexta	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma obconica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coprosma pedicellata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma talbrockiei	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma virescens	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coprosma waima	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma wallii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Corokia aff. *cotoneaster* (b) (CHR 497632; Paritutu)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Corybas aff. *rivularis* (AK 251833; Kaitarakihi)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Corybas aff. *trilobus* (d) (WELT SP104146; "tridodd")	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Corybas carsei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Corybas dienemus	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Craspedia (a) (CHR 511522; Clutha River)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia (b) (CHR 516324; Leatham)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (c) (CHR 529115; Kaitorete)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (e) (CHR 514391; "tarn")	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (ee) (CHR 547118B; Lake Clara)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (f) (CHR 514362; Hacket)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (g) (CHR 469764; Pikikirunga)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia (gg) (CHR 472168; Mararoa)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (h) (CHR 260312; Gouland Downs)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (i) (CHR 395643; Fyfe River)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (ii) (CHR 489432; Mt Cass)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia (j) (CHR 516302; Lake Heron)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (k) (CHR 283173; "coast")	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (l) (CHR 479212; Charleston)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (nn) (CHR 567299; "Rex")	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (p) (CHR 469073; Havelock River)	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Craspedia (q) (AK 251905; Anglem)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia (qq) (CHR 167368; Wakanui)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (w) (CHR 395679; Burgoo)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (y) (CHR 516260; Cape Saunders)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia aff. *uniflora* (b) (CHR 393850; Haldon Hills)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Craspedia incana	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Craspedia uniflora var. *grandis*	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Craspedia uniflora var. *maritima*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Crassula manaia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Crassula multicaulis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Crassula peduncularis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cyclosorus interruptus	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Cyperus insularis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Dactylanthus taylorii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Daucus glochidiatus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Davallia tasmanii subsp. *cristata*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Deschampsia cespitosa	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Deyeuxia aff. *quadriseta* (AK 252511; Volcanic Plateau)	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Deyeuxia lacustris	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Deyeuxia quadriseta	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Dichelachne lautumia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dichelachne micrantha	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Dicranopteris linearis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Discaria toumatou	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Dracophyllum densum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Dracophyllum fiordense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Drymoanthus flavus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dysphania pusilla	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eleocharis neozelandica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Empodisma robustum	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Epilobium insulare	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Epilobium pictum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eryngium vesiculosum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Euchiton ensifer	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Euphorbia glauca	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Euphrasia repens	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Euphrasia wettsteiniana	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ficinia spiralis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gastrodia cooperae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gentianella aff. *calcis* subsp. *waipara* (CHR 569771; Earthquakes)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gentianella calcis subsp. *calcis*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gentianella calcis subsp. *manahune*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gentianella calcis subsp. *taiko*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Gentianella calcis subsp. *waipara*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Gentianella scopulorum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Geranium aff. *retrorsum* (b) (AK 306299; Oakley Creek)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Geranium cruentum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Geranium retrorsum	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Geranium rubricum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Geranium sessiliflorum var. *arenarium*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Geranium solanderi	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Gingidia aff. *enysii* (a) (CHR 283817; Mt Brown)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gingidia aff. *enysii* (b) (CHR 515371; Clarence)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gingidia enysii var. *enysii*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Gingidia haematitica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Goodenia heenanii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gratiola concinna	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Gunnera arenaria	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters

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A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Gunnera densiflora	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Gunnera hamiltonii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Helichrysum aff. *intermedium* (c) (*Helichrysum selago* var. *tumidum* Cheeseman; WELT SP058412)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Helichrysum dimorphum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hibiscus aff. *diversifolius* (AK 347684; Surville)	Highly Vulnerable	Latent Risk	Highly Vulnerable	Highly Vulnerable
Hibiscus diversifolius subsp. *diversifolius*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Hibiscus richardsonii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Hydrocotyle aff. *robusta* (b) (CHR 596579; Chatham Is.)	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Hymenophyllum polyanthos	Sensitive Only	Sensitive Only	Sensitive Only	Sensitive Only
Hypericum involutum	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Hypericum minutiflorum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Hypericum rubicundulum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Isoetes aff. *kirkii* (CHR 247118A; Lake Omapere)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Isoetes kirkii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Isolepis basilaris	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Isolepis lenticularis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Jovellana sinclairii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Juncus caespiticius	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Juncus holoschoenus	Sensitive Only	Potential Adapters	Sensitive Only	Potential Adapters
Juncus pauciflorus	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Koeleria aff. *novozelandica* (AK 252546; Awahokomo)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Korthalsella clavata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Korthalsella salicornioides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Kunzea amathicola	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Kunzea ericoides	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Kunzea linearis	Low Vulnerability	Exposed Only	Exposed Only	Exposed Only
Kunzea robusta	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Kunzea salterae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Kunzea serotina	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Kunzea sinclairii	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Kunzea tenuicaulis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Kunzea toelkenii	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Kunzea triregensis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Lachnagrostis ammobia	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Lachnagrostis tenuis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Lagenophora montana	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lepidium aegrum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium banksii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium castellanum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium crassum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium flexicaule	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters

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A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Lepidium juvencum	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Lepidium kirkii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lepidium limenophylax	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Lepidium naufragorum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium oblitum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Lepidium oleraceum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium oligodontum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium panniforme	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium rekohuense	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium seditiosum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium sisymbrioides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lepidium solandri	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lepidium tenuicaule	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidosperma neozelandicum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Leptinella aff. *pectinata* (a) (CHR 580894; Nevis)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leptinella conjuncta	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Leptinella dispersa subsp. *rupestris*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leptinella filiformis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Leptinella nana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leptinella pusilla	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Leptinella rotundata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leptinella serrulata	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Leptinella tenella	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Leptinella traillii subsp. *pulchella*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Leptospermum aff. *scoparium* (a) (AK 284541; Auckland)	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Leptospermum aff. *scoparium* (b) (AK 247250; “coastal silver prostrate”)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leptospermum aff. *scoparium* (c) (AK 191319; “Waikato Peat Bog”)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Leptospermum aff. *scoparium* (d) (AK 286289; East Cape)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leptospermum aff. *scoparium* (e) (AK 228147; Three Kings)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Leptospermum aff. *scoparium* (f) (AK 319498; North Cape)	Potential Adapters	Sensitive Only	Potential Adapters	Potential Adapters
Leptospermum aff. *scoparium* (g) (AK 319494; Surville Cliffs)	Potential Adapters	Sensitive Only	Potential Adapters	Potential Adapters
Leptospermum aff. *scoparium* var. *incanum* (h) (AK 309827; North Cape)	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Leptospermum scoparium var. *incanum*	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Leptospermum scoparium var. *scoparium*	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Leucogenes tarahaoa	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucopogon nanum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Libertia aff. *ixioides* (c) (AK 319490; Surville Cliffs)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Libertia cranwelliae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Libertia flaccidifolia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Libertia peregrinans	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Limosella (b) (CHR 515038; Manutahi)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

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A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Linum monogynum var. *chathamicum*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Linum monogynum var. *monogynum*	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Lobelia carens	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lobelia fatiscens	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lobelia fugax	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lobelia ionantha	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Lobelia physaloides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lophomyrtus bullata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Lophomyrtus obcordata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Luzula celata	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Luzula ulophylla	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Lycopodiella serpentina	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Machaerina complanata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Mazus arenarius	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Mazus novaezeelandiae subsp. *impolitus* f. *hirtus*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Mazus novaezeelandiae subsp. *impolitus* f. *impolitus*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Mazus novaezeelandiae subsp. *novaezeelandiae*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Melicytus (a) (CHR 355077; Matiri Range)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Melicytus aff. *alpinus* (a) (CHR 541565; Rangipo)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Melicytus aff. *crassifolius* (CHR 279358; “cliff”)	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Melicytus crassifolius	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Melicytus drucei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Melicytus flexuosus	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Melicytus improcerus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Melicytus orarius	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Melicytus venosus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Mentha cunninghamii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Metrosideros albiflora	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Metrosideros bartlettii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Metrosideros carminea	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Metrosideros colensoi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Metrosideros diffusa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Metrosideros excelsa	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Metrosideros fulgens	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Metrosideros kermadecensis	Latent Risk	Latent Risk	Latent Risk	Latent Risk
Metrosideros parkinsonii	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Metrosideros perforata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Metrosideros robusta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Metrosideros umbellata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Microlaena carsei	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Mida salicifolia	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable

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A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Montia drucei	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Montigena novae-zelandiae	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Muehlenbeckia astonii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Muehlenbeckia ephedroides	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Myoporum semotum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotidium hortensia	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis aff. *brockiei* (a) (CHR 497375; Lake Otuhie)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis aff. *glauca* (a) (WELT SP104520; "Mata-Au")	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis albosericea	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosotis amabilis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Myosotis angustata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis brevis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis chaffeyorum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis cheesemanii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosotis colensoi	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis elderi	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis glauca	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis laeta	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis lytteltonensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis matthewsii	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Myosotis mooreana	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Myosotis oreophila	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosotis pansa subsp. *pansa*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Myosotis pansa subsp. *praeceps*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Myosotis petiolata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis pottsiana	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosotis pygmaea	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis saxosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Myosotis umbrosa	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosurus minimus subsp. *novae-zelandiae*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myriophyllum robustum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myrsine argentea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myrsine coxii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myrsine umbricola	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Neomyrtus pedunculata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Notothlaspi viretum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Olearia adenocarpa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia chathamica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia crebra	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Olearia fimbriata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Olearia fragrantissima	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia gardneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia hectorii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia lineata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Olearia pachyphylla	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Olearia polita	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia telmatica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia traversiorum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Ophioglossum petiolatum	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Ourisia modesta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oxybasis ambigua	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Pachycladon cheesemanii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pachycladon exile	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pachycladon fasciarium	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Pachycladon stellatum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pachycladon wallii	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pachystegia minor var. (a) (CHR 504888; Ohau)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Parsonsia praeruptis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Paspalum orbiculare	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pellaea aff. *falcata* (b) (AK 330788; "Auckland volcanoes")	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pennantia baylisiana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Peraxilla colensoi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Peraxilla tetrapetala	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Phylloglossum drummondii	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Picris burbidgeae	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pimelea actea	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea aff. *aridula* (b) (AK 230900; Cook Strait)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea aff. *villosa* (AK 216133; southern New Zealand)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea aridula subsp. *aridula*	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pimelea aridula subsp. *oliga*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Pimelea declivis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea eremitica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea ignota	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea longifolia	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pimelea lyallii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea mesoa subsp. *macra*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pimelea mimosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pimelea orthia subsp. *orthia*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pimelea orthia subsp. *protea*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea prostrata subsp. *ventosa*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea sericeovillosa subsp. *pulvinaris*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pimelea sericeovillosa subsp. *sericeovillosa*	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pimelea tomentosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea traversii subsp. *boreus*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Pimelea villosa	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea xenica	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Pittosporum dallii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pittosporum kirkii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pittosporum obcordatum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pittosporum patulum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable

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A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Pittosporum pimeleoides subsp. *majus*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pittosporum serpentinum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pittosporum turneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pittosporum virgatum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Poa aucklandica subsp. *rakiura*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Poa billardierei	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Poa spania	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Polygonum plebeium	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pomaderris apetala subsp. *maritima*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pomaderris edgerleyi	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Pomaderris paniculosa subsp. *novaezelandiae*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pomaderris phylicifolia subsp. *phylicifolia*	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pouzolzia australis	Latent Risk	Latent Risk	Latent Risk	Latent Risk
Prasophyllum hectorii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pseudognaphalium ephemerum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pseudopanax laetus	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pseudowintera insperata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pterostylis irwinii	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pterostylis micromega	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pterostylis paludosa	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pterostylis puberula	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pterostylis tanypoda	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Pterostylis tasmanica	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pterostylis tristis	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Ptisana salicina	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Puccinellia raroflorens	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Ranunculus (a) (AK 276181; Hope)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus (b) (CHR 324466; Burgoo Stream)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus acraeus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus aff. *royi* (a) (AK 295116; Lake Rakeinui)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Ranunculus aff. *royi* (c) (CHR 513327; Waihao)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus brevis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ranunculus buchananii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus callianthus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus haastii	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ranunculus paucifolius	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ranunculus pilifera	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus recens	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ranunculus ternatifolius	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Ranunculus urvilleanus	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Ranunculus viridis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Raoulia (a) (CHR 79537; “K”)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Raoulia aff. *australis* (a) (CANU 33934; “North octaploid”)	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Raoulia aff. *hookeri* (a) (AK 239529; “coast”)	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Raoulia australis	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters	Potential Persisters

Continued on next page

A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Raoulia beauverdii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Raoulia monroi	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Raoulia parkii	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Rhabdothamnus aff. *solandri* (a) (AK 319367; Surville Cliffs)	Highly Vulnerable	Latent Risk	Highly Vulnerable	Highly Vulnerable
Rorippa divaricata	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Rytidosperma buchananii	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Rytidosperma exiguum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Rytidosperma horrens	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Rytidosperma merum	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Rytidosperma telmaticum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Rytidosperma thomsonii	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Scandia aff. *rosifolia* (AK 344466; "inland")	Low Vulnerability	Low Vulnerability	Exposed Only	Exposed Only
Scandia rosifolia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Schizacme helmsii	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Schoenus carsei	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Scutellaria novae-zelandiae	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Sebaea ovata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio aff. *glaucophyllus* (b) (CHR 85767; Cape Campbell)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio aff. *glaucophyllus* (c) (AK 286230; "South Marlborough limestone")	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Senecio biserratus	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Senecio carnosulus	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Senecio dunedinensis	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Senecio esperensis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio glaucophyllus subsp. *glaucophyllus*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Senecio hauwai	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio kermadecensis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio repangae subsp. *repangae*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Senecio scaberulus	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Simplicia buchananii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Simplicia felix	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Simplicia laxa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Solanum aviculare var. *aviculare*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Solenogyne christensenii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sonchus aff. *novae-zelandiae* (CHR 84044; "glaucous")	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Sonchus kirkii	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Sonchus novae-zelandiae	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Spiranthes novae-zelandiae	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Sticherus tener	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Sticherus urceolatus	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Syzygium maire	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Tecomanthe speciosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tetrachondra hamiltonii	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Teucrium parvifolium	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Thelymitra (a) (WELT SP79140; Ahipara)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

Continued on next page

A1.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Thelymitra matthewsii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Thelymitra sanscilia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tmesipteris horomaka	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Todea barbara	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Trichomanes caudatum	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Trichomanes humile	Latent Risk	Latent Risk	Latent Risk	Latent Risk
Triglochin palustris	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Trisetum aff. *lepidum* (AK 251835; Awahokomo)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Trisetum antarcticum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Trithuria inconspicua subsp. *brevistyla*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Trithuria inconspicua subsp. *inconspicua*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Tupeia antarctica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Urtica perconfusa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Utricularia australis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica adamsii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica aff. *albicans* (a) (AK 252966; Mt Burnett)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica aff. *bishopiana* (a) (AK 202263; Hikurangi Swamp)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Veronica aff. *treadwellii* (a) (CHR 394533; Bald Knob Ridge)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica armstrongii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica barkeri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica bishopiana	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Veronica breviracemosa	Latent Risk	Latent Risk	Latent Risk	Latent Risk
Veronica calycina	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Veronica cupressoides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica jovellanoides	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica lavaudiana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica lilliputiana	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica maccaskillii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica pareora	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica perbella	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Veronica rigidula var. *sulcata*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica salicornioides	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica saxicola	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica scopulorum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica scrupea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica societatis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica speciosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Wahlenbergia congesta	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Wurmbea novae-zelandiae	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Zostera muelleri subsp. *novazelandica*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Zoysia minima	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters

Appendix 2

Results using the pessimistic assessment method

The tables in sections A2.1 to A2.5 list the vulnerability categories for each of the assessed taxa. Taxa are listed in alphabetical order within each group of taxa. Vulnerability categories are shown for all assessed emissions scenarios (RCP4.5 and RCP8.5) and time frames (mid-century and late century) using the **pessimistic assessment method, where 'unknown vulnerability' scores were replaced with 'higher vulnerability' scores**. Note that the scientific names of taxa were derived from the New Zealand Threat Classification System (NZTCS) database on 1 August 2022 and so do not account for any changes since then.

The table below shows the dimension scores and recommended actions for each of the vulnerability categories, where H = higher vulnerability and L = lower vulnerability triggered for the dimension (adapted from Foden et al. 2013,[21] licensed by the authors for reuse; CC BY 4.0).

VULNERABILITY CATEGORY	SENSITIVITY	LOW ADAPTIVE CAPACITY	EXPOSURE	RECOMMENDED ACTIONS
Highly Vulnerable	H	H	H	Specific research and / or interventions generally needed
Potential Adapters	H	L	H	Monitor and plan precautionary adaptive responses
Potential Persisters	L	H	H	Monitor population trends as a precaution
Latent Risk	H	H	L	Monitor environmental variables and re-assess if predictions worsen
Sensitive Only	H	L	L	No immediate action required but monitor populations and plan to adapt management if needed
Exposed Only	L	L	H	No immediate action required but monitor populations and plan to adapt management if needed
Low Adaptive Capacity Only	L	H	L	No immediate action required but monitor populations and plan to adapt management if needed
Low Vulnerability	L	L	L	No immediate action required but monitor populations and plan to adapt management if needed

[21] Foden WB, Butchart SHM, Stuart SN, Vié J-C, Akçakaya HR, Angulo A, DeVantier LM, Gutsche A, Turak E, Cao L, et al. 2013. Identifying the world's most climate change vulnerable species: a systematic trait-based assessment of all birds, amphibians and corals. PLOS ONE. 8(6):e65427.

A2.1 Bats

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Chalinolobus tuberculatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mystacina robusta	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Mystacina tuberculata aupourica	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Mystacina tuberculata rhyacobia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mystacina tuberculata tuberculata	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable

A2.2 Birds

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Acanthisitta chloris chloris	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Acanthisitta chloris granti	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Anarhynchus frontalis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anas aucklandica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anas chlorotis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anas gracilis	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Anas nesiotis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anas rhynchotis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Anas superciliosa	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Anous minutus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anthornis melanura melanura	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Anthornis melanura obscura	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anthornis melanura oneho	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anthus novaeseelandiae aucklandicus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anthus novaeseelandiae chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anthus novaeseelandiae novaeseelandiae	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Anthus novaeseelandiae steindachneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx australis "Haast"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx australis "northern Fiordland"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx australis "southern Fiordland"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx australis australis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx haastii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx mantelli	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Apteryx owenii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Apteryx rowi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Ardea modesta	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Aythya novaeseelandiae	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Botaurus poiciloptilus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Bowdleria punctata caudata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Bowdleria punctata punctata	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Bowdleria punctata stewartiana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Bowdleria punctata vealeae	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Bowdleria punctata wilsoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Calidris canutus rogersi	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Callaeas wilsoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Catharacta antarctica lonnbergi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Charadrius bicinctus bicinctus	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Charadrius bicinctus exilis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Charadrius obscurus aquilonius	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Charadrius obscurus obscurus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chlidonias albostriatus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chrysococcyx lucidus lucidus	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Circus approximans	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Coenocorypha aucklandica aucklandica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coenocorypha aucklandica meinertzhagenae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coenocorypha aucklandica perseverance	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coenocorypha huegeli	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coenocorypha pusilla	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cyanoramphus auriceps	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Cyanoramphus forbesi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cyanoramphus hochstetteri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cyanoramphus malherbi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cyanoramphus novaezelandiae chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cyanoramphus novaezelandiae cyanurus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cyanoramphus novaezelandiae novaezelandiae	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Cyanoramphus unicolor	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Daption capense australe	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Diomedea antipodensis antipodensis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Diomedea antipodensis gibsoni	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Diomedea epomophora epomophora	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Diomedea sanfordi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Egretta novaehollandiae	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Egretta sacra sacra	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Elseyornis melanops	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Eudynamys taitensis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Eudyptes filholi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptes pachyrhynchus	Latent Risk	Latent Risk	Highly Vulnerable	Latent Risk
Eudyptes robustus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Eudyptes sclateri	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptula minor albosignata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptula minor chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Eudyptula minor iredalei	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptula minor minor	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eudyptula novaehollandiae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Falco novaeseelandiae "southern"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Falco novaeseelandiae ferox	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Falco novaeseelandiae novaeseelandiae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Fregetta grallaria grallaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Fregetta maoriana	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Fregetta tropica	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters

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A2.2 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Fulica atra australis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Gallirallus australis australis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Gallirallus australis greyi	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Gallirallus australis hectori	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Gallirallus australis scotti	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gallirallus philippensis assimilis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Garrodia nereis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gerygone albofrontata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gerygone igata	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Gygis alba candida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Haematopus chathamensis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Haematopus finschi	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Haematopus unicolor	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hemiphaga chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Hemiphaga novaeseelandiae	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Himantopus himantopus leucocephalus	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Himantopus novaezelandiae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hirundo neoxena neoxena	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Hydroprogne caspia	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hymenolaimus malacorhynchos	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Larus bulleri	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Larus dominicanus dominicanus	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters	Potential Persisters
Larus novaehollandiae scopulinus	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Leucocarbo campbelli	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leucocarbo carunculatus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucocarbo chalconotus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Leucocarbo colensoi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucocarbo onslowi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucocarbo ranfurlyi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucocarbo stewarti	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lewinia muelleri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Limosa lapponica baueri	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Macronectes halli	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Megadyptes antipodes	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Mohoua albicilla	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Mohoua novaeseelandiae	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Mohoua ochrocephala	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Morus serrator	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Nestor meridionalis meridionalis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Nestor meridionalis septentrionalis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Nestor notabilis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ninox novaeseelandiae novaeseelandiae	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Notiomystis cincta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Onychoprion fuscatus serratus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pachyptila crassirostris crassirostris	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pachyptila crassirostris flemingi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pachyptila crassirostris pyramidalis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pachyptila desolata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pachyptila turtur	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Pachyptila vittata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pelagodroma albiclunis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pelagodroma marina maoriana	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pelecanoides urinatrix chathamensis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Pelecanoides urinatrix exsul	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Pelecanoides urinatrix urinatrix	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Pelecanoides whenuahouensis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Petroica australis australis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Petroica australis rakiura	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Petroica longipes	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Petroica macrocephala chathamensis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Petroica macrocephala dannefaerdi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Petroica macrocephala macrocephala	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Petroica macrocephala marrineri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Petroica macrocephala toitoi	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Petroica traversi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Phaethon rubricauda	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Phalacrocorax carbo novaehollandiae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Phalacrocorax melanoleucos brevirostris	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Phalacrocorax sulcirostris	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Phalacrocorax varius varius	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Philesturnus carunculatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Philesturnus rufusater	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Phoebetria palpebrata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Platalea regia	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Podiceps cristatus australis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Poliocephalus rufopectus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Porphyrio hochstetteri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Porphyrio melanotus melanotus	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Porzana pusilla affinis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Porzana tabuensis tabuensis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Procellaria aequinoctialis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Procellaria cinerea	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Procellaria parkinsoni	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Procellaria westlandica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Procelsterna cerulea albivitta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A2.2 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Prosthemadera novaeseelandiae chathamensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Prosthemadera novaeseelandiae novaeseelandiae	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Pterodroma aff. *neglecta* "winter"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pterodroma axillaris	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pterodroma cervicalis	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Pterodroma cookii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pterodroma inexpectata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pterodroma lessonii	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Pterodroma macroptera gouldi	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Pterodroma magentae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pterodroma mollis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pterodroma neglecta neglecta	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pterodroma nigripennis	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Pterodroma pycrofti	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Puffinus assimilis haurakiensis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Puffinus assimilis kermadecensis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Puffinus bulleri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Puffinus carneipes	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Puffinus elegans	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Puffinus gavia	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Puffinus griseus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Puffinus huttoni	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Puffinus pacificus pacificus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Rhipidura fuliginosa fuliginosa	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Rhipidura fuliginosa penita	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rhipidura fuliginosa placabilis	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Sterna striata aucklandorna	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Sterna striata striata	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Sterna vittata bethunei	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Sternula nereis davisae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Stictocarbo featherstoni	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Stictocarbo punctatus	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Strigops habroptilus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sula dactylatra tasmani	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tadorna variegata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Thalassarche bulleri bulleri	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Thalassarche bulleri platei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Thalassarche cauta steadi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Thalassarche chrysostoma	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Thalassarche eremita	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Thalassarche impavida	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable

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A2.2 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Thalassarche salvini	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Thinornis novaeseelandiae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Todiramphus sanctus vagans	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Vanellus miles novaehollandiae	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability
Xenicus gilviventris	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Xenicus gilviventris rineyi	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Zosterops lateralis lateralis	Low Vulnerability	Low Vulnerability	Low Vulnerability	Low Vulnerability

A2.3 Herpetofauna

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Dactylocnemis “Matapia Island”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Dactylocnemis “Mokohinau”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dactylocnemis “North Cape”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Dactylocnemis “Poor Knights”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dactylocnemis “Three Kings”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dactylocnemis pacificus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only
Hoplodactylus duvaucelii “northern”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Hoplodactylus duvaucelii “southern”	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Leiopelma archeyi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leiopelma hamiltoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leiopelma hochstetteri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau “Cascades”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mokopirirakau “Okarito”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau “Open Bay Islands”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau “Roys Peak”	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Mokopirirakau “southern forest”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau “southern North Island”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mokopirirakau cryptozoicus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau galaxias	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Mokopirirakau granulatus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mokopirirakau kahutarae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mokopirirakau nebulosus	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Naultinus elegans	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Naultinus flavirictus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Naultinus gemmeus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Naultinus grayii	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Naultinus manukanus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Naultinus punctatus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Naultinus rudis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Naultinus stellatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Naultinus tuberculatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma “rockhopper”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma “Whirinaki”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma acrinasum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma aeneum	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma aff. *chloronoton* “eastern Otago”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *chloronoton* “Stewart Island”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *chloronoton* “West Otago”	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *inconspicuum* “Big Bay”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *inconspicuum* “herbfield”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *inconspicuum* “Humboldt”	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *inconspicuum* “mahogany”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *inconspicuum* “North Otago”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *inconspicuum* “pallid”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *infrapunctatum* “cobble”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *infrapunctatum* “Hokitika”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *infrapunctatum* “Southern North Island”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *longipes* “southern”	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Oligosoma aff. *polychroma* Clade 2	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *polychroma* Clade 3	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *polychroma* Clade 4	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *polychroma* Clade 5	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma aff. *smithi* “Three Kings, Te Paki, Western Northland”	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Oligosoma aff. *waimatense* “alpine rock”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma aff. *waimatense* “Marlborough”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma alani	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma albornense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma auroraense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma awakopaka	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma burganae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma chloronoton	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma elium	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma fallai	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma grande	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma hardyi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma homalonotum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma hoparatea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Oligosoma inconspicuum	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma judgei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma kahurangi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma kokowai	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Oligosoma levidensum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma lineoocellatum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma longipes	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Oligosoma maccanni	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma macgregori	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma microlepis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma moco	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma newmani	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma nigriplantare	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma notosaurus	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma oliveri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma ornatum	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma otagense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma pachysomaticum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma pikitanga	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma polychroma	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma prasinum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Oligosoma repens	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma robinsoni	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Oligosoma roimata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma salmo	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma smithi	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Oligosoma stenotis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma striatum	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma suteri	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma taumakae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma tekakahu	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Oligosoma toka	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Oligosoma townsi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma waimatense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma whitakeri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oligosoma zelandicum	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Sphenodon punctatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Toropuku inexpectatus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Toropuku stephensi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tukutuku rakiurae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Woodworthia "Central Otago"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia "Cromwell"	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Woodworthia “Kaikoura”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Woodworthia “Marlborough mini”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia “Mount Arthur”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Woodworthia “Otago / Southland large”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia “pygmy”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia “Raggedy”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Woodworthia “Southern Alps”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Woodworthia “Southern Alps northern”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia “southern mini”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Woodworthia “south-western”	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia aff. *maculata* “Muriwai”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Woodworthia cf. *brunnea*	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia chrysosiretica	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Woodworthia maculata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters

A2.4 Invertebrates

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
“*Acroclita*” *discariana*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
“*Cnephasia*” *paterna*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
“*Epichorista*” *lindsayi*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
“*Hydriomena*” *clarkei*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
“*Pseudocoremia*” *cineracia*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
“*Schiffermuelleria*” *orthophanes*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Allodiscus camelinus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Allodiscus hazelwoodi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Alsolemia cresswelli	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Amborhytida dunniae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Amborhytida forsythi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Amborhytida sp. 1 (M.173834)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anagotus stephenensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anisoura nicobarica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Arctesthes avatar	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Arctesthes titanica	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Asaphodes frivola	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Asaphodes imperfecta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Asaphodes obarata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Asaphodes stinaria	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Australothis volatilis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Austrocidaria arenosa	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Bembidion tillyardi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Brachaspis nivalis “lowland”	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Brachaspis robustus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Brullea antarctica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cephalissa siria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Charopidae sp. 130 (NMNZ M.127912) *Phacussa* “kingae”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Charopidae sp. 46 (NMNZ M.087828) “Tom Bowling Bay sunken spire”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Chaureopa roscoei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Clepsicosma sp. “Titirangi”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Climocella pukanui	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Costallodiscus parrishi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora brooki	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora gardneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora hirsutissima	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cytora hispida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora houhora	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora kerrana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora lignaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora parrishi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora taipa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cytora tepakiensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dasyuris partheniata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Declana cf. *hermione* “Te Paki”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Declana griseata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida carinata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida elegans	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida heteracantha	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida mahoenui	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida parva	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida pluvialis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Deinacrida rugosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Deinacrida talpa	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Deinacrida tibiospina	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Delos sp. 1 (NMNZ M.029346)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Delos sp. 13 (NMNZ M.029345)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Delouagapia tasmani	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Dichromodes “Cloudy Bay”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Dichromodes “Gore Bay”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Duvaliomimus (*Duvaliomimus*) *crypticus*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ericodesma aerodana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Fectola melchior	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gadira leucophthalma	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Geodorcus alsobius	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Geodorcus capito	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Geodorcus ithaginis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Geodorcus servandus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A2.4 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Geodorcus sororum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gingidiobora "Eastern Otago"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gingidiobora nebulosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gingidiobora subobscurata s.l.	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gymnobathra ambigua	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Hadramphus spinipennis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hadramphus tuberculatus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Heloxycanus patricki	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Hemiandrus "furoviarius"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Hemiandrus (CMNZ 2000.121.21115) "Cromwell"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Hemideina thoracica "2n=23,24"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Holcaspis abdita	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Holcaspis bathana	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Holcaspis bidentella	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Holcaspis brevicula	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Holcaspis falcis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Holcaspis n. sp. 1 (McKenzie, Canterbury, CMNZholc00)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Horelophus walkeri	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Izatha psychra	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Kiwaia "plains jumper"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Kiwaia jeanae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Kiwaia pumila	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Kiwaia sp. "Cloudy Bay"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Kupea electilis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Latrodectus katipo	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Liarea aupouria aupouria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Liarea sp. 1 (NMNZ M.158257) "Bream Head"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Lycaena ianthina	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lycaena sp. "Chrystalls Beach boulder"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lyperobius nesidiotes	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Maloides cavernicola	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Maniho centralis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Maoricrambus oncobolus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Maoritenes sp. "*Olearia*"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema atrox	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema chiltoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema costellum costellum costellum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema howitti	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mecodema laeviceps	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Mecodema manaia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema pulchellum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Mecodema quoinense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Mecodema strictum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Mecodema tenaki	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Megadromus sp. 8 “Omeo Hut” (Omeo Hut, Otago, CMNZmega08)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Meterana “Foveaux Strait”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Meterana cf. *tetrachroa*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Meterana pictula	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Migas taierii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Motuweta isolata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Neanops pritchardi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Notoreas casanova	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Notoreas edwardsi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Notoreas perornata “Cape Campbell”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Notoreas perornata “Cape Turnagain”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Notoreas perornata “Castlepoint”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Notoreas perornata “ND/AK”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Notoreas perornata “TK/NN”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Notoreas perornata “WA/WN”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Notoreas perornata “Waiho Flats”	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Orocrambus “Mackenzie Basin”	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Orocrambus fugitivellus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Orocrambus sophistes	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Orthoclydon pseudostinaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Orthoglymma wangapeka	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pachyrhamma delli	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Paralissotes oconnori	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Paranotoreas “Banks Peninsula”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Paryphanta busbyi busbyi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Paryphanta busbyi watti	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Paryphanta sp. 1 “western clade” (NMNZ M.305039)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pasiphila sp. “*Olearia*”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pasiphila sp. cf. *magnimaculata*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Periegops keani	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Phaulacridium otagoense	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Placostylus (*Basileostylus*) *bollonsi*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Platyptilia campsiptera	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Anatoki Range”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Baton”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Buller River”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Gunner River”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Haast”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Maungaharuru”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Mt Augustus”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Owen”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Parapara”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “patrickensis”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta “Urewera”	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta annectens	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta fiordlandica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A2.4 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Powelliphanta gagei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi "Haidinger"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi "Heaphy"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi aurea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi brunnea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi compta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi fallax	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi gilliesi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi jamesoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi kahurangica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi montana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta gilliesi subfusca	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri anatokiensis red form	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri bicolor	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri consobrina	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri hochstetteri brown based	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri hochstetteri yellow based	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta hochstetteri obscura	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria johnstoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria lignaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria lusca	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria oconnori	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria rotella	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria ruforadiata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta lignaria unicolorata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta marchanti	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta rossiana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta spedeni spedeni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba "Gouland Range"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba harveyi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba mouatae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba prouseorum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba richardsoni	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta superba superba	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi florida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi koputaroa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi latizona	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi otakia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi tararuaensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Powelliphanta traversi traversi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Proditrix chionochloae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Prodontria lewisi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Protosynaema sp. "*Olearia*"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pseudaneitea ramsayi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pseudocoremia albafasciata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pseudocoremia sp. "Knobby Range"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A2.4 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Punctidae sp. 156 (NMNZ M.079798) "glabriuscula-group parrishi"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Punctidae sp. 226 (NMNZ M.154908) *Laomarex* sp. "aff. *L. regia* (Gardner, 1968)"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Punctidae sp. 36 (NMNZ M.088229) *Phrixgnathus* "wallacei"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pyrausta comastis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pyrgotis sp. "*Olearia*"	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pyroderces sp. "yellow"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rhytida oconnori	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rhytida stephenensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rhytida webbi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rhytidarex buddlei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sabulopteryx botanica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Schizoglossa gigantea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Schizoglossa worthyae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Scythris sp. "stripe"	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Sigaus australis "central arid"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Sigaus campestris	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sigaus childi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sigaus homerensis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Sigaus minutus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Sporophyla oenospora	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Stathmopoda albimaculata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Stathmopoda campylocha	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Stathmopoda sp. "*Olearia*"	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Stephanorhynchus insolitus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Stigmella sp. "*Olearia*"	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Stigmella sp. "*Traversia*"	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Succinea archeyi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Tatosoma agrionata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Theoxena scissaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tychanopais fougeri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Wainuia clarki	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Wainuia edwardi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Wainuia nasuta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Waiputrechus cavernicola	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Xanthorhoe frigida	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Xylotoles costatus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Zecillenus chalmeri	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Zecillenus embersoni	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Zelleria sphenota	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

A2.5 Vascular plants

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Acaena aff. *rorida* (OTA 59561; Pool Burn)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Acaena buchananii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Acaena microphylla var. *pauciglochidiata*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Acaena pallida	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Acaena rorida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Achnatherum petriei	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Aciphylla aff. *squarrosa* (a) (AK 44773; Volcanic Plateau)	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Aciphylla dieffenbachii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Aciphylla lecomtei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Aciphylla multisecta	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Aciphylla squarrosa var. *squarrosa*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Aciphylla subflabellata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Aciphylla takahea	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Ackama nubicola	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Agathis australis	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Alectryon excelsus subsp. *grandis*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Alepis flavida	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Althenia bilocularis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Amphibromus fluitans	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anisotome acutifolia	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anisotome capillifolia	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Anisotome cauticola	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anisotome patula	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anisotome pilifera	Low Vulnerability	Low Vulnerability	Exposed Only	Exposed Only
Anogramma leptophylla	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Anthosachne falcis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Anthosachne kingiana subsp. *multiflora*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Asplenium pauperequitum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Asplenium trichomanes subsp. *quadrivalens*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Atriplex billardierei	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Atriplex buchananii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Atriplex cinerea	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Atriplex hollowayi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Australopyrum calcis subsp. *calcis*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Australopyrum calcis subsp. *optatum*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Austroderia turbaria	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Beilschmiedia aff. *tawa* (AK 230588; Poor Knights Is.)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Botrychium lunaria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyglottis cockaynei	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Brachyglottis huntii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Brachyglottis kirkii var. *kirkii*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyglottis pentacopa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyglottis perdicioides	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyglottis rotundifolia var. *ambigua* (AK 251870)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

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A2.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Brachyglottis sciadophila	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Brachyglottis turneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyscome aff. *humilis* (AK 231703; West Dome)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyscome linearis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyscome lucens	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Brachyscome pinnata	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Bulbinella modesta	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Caleana minor	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Calochilus herbaceus	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cardamine alticola	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cardamine bilobata	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cardamine bisetosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine caesiella	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine coronata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine dactyloides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine dilatata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine integra	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine megalantha	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine mutabilis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Cardamine pachyphylla	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine panatohea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine parvula	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine porphyroneura	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine sciaphila	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine serpentina	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Cardamine thalassica	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cardamine verna	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carex albula	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Carex auceps	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Carex berggrenii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex buchananii	Low Vulnerability	Low Vulnerability	Exposed Only	Exposed Only
Carex capillacea	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex carsei	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex cirrhosa	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex cremnicola	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Carex cyanea	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Carex dolomitica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carex fascicularis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Carex fretalis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Carex inopinata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex kaloides	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Carex litorosa	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Carex parvispica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carex rubicunda	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carex strictissima	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carex tenuiculmis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Carex uncifolia	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia astonii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia carmichaeliae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia corrugata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia crassicaulis subsp. *crassicaulis*	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Carmichaelia crassicaulis subsp. *racemosa*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia curta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia hollowayi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia juncea	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Carmichaelia kirkii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia monroi	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Carmichaelia muritai	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Carmichaelia nana	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia petriei	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Carmichaelia stevensonii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia torulosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Carmichaelia uniflora	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Carmichaelia vexillata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Celmisia aff. *gracilenta* (b) (CHR 469722; Mangaweka)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Celmisia aff. *similis* (AK 285874; Bald Knob Ridge)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Celmisia holosericea	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters	Potential Persisters
Centipeda minima subsp. *minima*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Centrolepis strigosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Ceratocephala pungens	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chaerophyllum aff. *novae-zelandiae* (CHR 573578; Waitaki)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Chaerophyllum basicola	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Chaerophyllum colensoi var. *delicatulum* (CHR 73872; Hauhungaroa Range)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chenopodium detestans	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Chionochloa juncea	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Chionochloa ovata	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Christella aff. *dentata* (b) (AK 126902; "thermal")	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Clematis marmoraria	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Clianthus maximus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Clianthus puniceus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Colobanthus brevisepalus	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Convolvulus verecundus	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Coprosma acerosa	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Coprosma aff. *acerosa* (a) (AK 158739; Central North Island)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Coprosma aff. *acerosa* (b) (CHR 285650; Cobb)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable

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A2.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Coprosma aff. *acerosa* (c) (WELT SP079167; Red Rocks)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Coprosma aff. *macrocarpa* (AK 309497; Surville)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma brunnea	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Coprosma intertexta	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma obconica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coprosma pedicellata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma talbrockiei	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma virescens	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Coprosma waima	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Coprosma wallii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Corokia aff. *cotoneaster* (b) (CHR 497632; Paritutu)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Corybas aff. *rivularis* (AK 251833; Kaitarakihi)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Corybas aff. *trilobus* (d) (WELT SP104146; “tridodd”)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Corybas carsei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Corybas dienemus	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Craspedia (a) (CHR 511522; Clutha River)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia (b) (CHR 516324; Leatham)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (c) (CHR 529115; Kaitorete)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (e) (CHR 514391; “tarn”)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (ee) (CHR 547118B; Lake Clara)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (f) (CHR 514362; Hacket)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (g) (CHR 469764; Pikikirunga)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia (gg) (CHR 472168; Mararoa)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (h) (CHR 260312; Gouland Downs)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (i) (CHR 395643; Fyfe River)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (ii) (CHR 489432; Mt Cass)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia (j) (CHR 516302; Lake Heron)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (k) (CHR 283173; “coast”)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (l) (CHR 479212; Charleston)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (nn) (CHR 567299; “Rex”)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (p) (CHR 469073; Havelock River)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (q) (AK 251905; Anglem)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia (qq) (CHR 167368; Wakanui)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Craspedia (w) (CHR 395679; Burgoo)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia (y) (CHR 516260; Cape Saunders)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Craspedia aff. *uniflora* (b) (CHR 393850; Haldon Hills)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Craspedia incana	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Craspedia uniflora var. *grandis*	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Craspedia uniflora var. *maritima*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Crassula manaia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Crassula multicaulis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Crassula peduncularis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Cyclosorus interruptus	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Cyperus insularis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Dactylanthus taylorii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Daucus glochidiatus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Davallia tasmanii subsp. *cristata*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Deschampsia cespitosa	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Deyeuxia aff. *quadriseta* (AK 252511; Volcanic Plateau)	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Deyeuxia lacustris	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Deyeuxia quadriseta	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Dichelachne lautumia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dichelachne micrantha	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Dicranopteris linearis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Discaria toumatou	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Dracophyllum densum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Dracophyllum fiordense	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Drymoanthus flavus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Dysphania pusilla	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eleocharis neozelandica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Empodisma robustum	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Epilobium insulare	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Epilobium pictum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Eryngium vesiculosum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Euchiton ensifer	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Euphorbia glauca	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Euphrasia repens	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Euphrasia wettsteiniana	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ficinia spiralis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gastrodia cooperae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gentianella aff. *calcis* subsp. waipara (CHR 569771; Earthquakes)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gentianella calcis subsp. *calcis*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gentianella calcis subsp. *manahune*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Gentianella calcis subsp. *taiko*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Gentianella calcis subsp. *waipara*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Gentianella scopulorum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Geranium aff. *retrorsum* (b) (AK 306299; Oakley Creek)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Geranium cruentum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Geranium retrorsum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Geranium rubricum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Geranium sessiliflorum var. *arenarium*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Geranium solanderi	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Gingidia aff. *enysii* (a) (CHR 283817; Mt Brown)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gingidia aff. *enysii* (b) (CHR 515371; Clarence)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Gingidia enysii var. *enysii*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Gingidia haematitica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Goodenia heenanii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

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A2.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Gratiola concinna	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Gunnera arenaria	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Gunnera densiflora	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Gunnera hamiltonii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Helichrysum aff. *intermedium* (c) (*Helichrysum selago* var. *tumidum* Cheeseman; WELT SP058412)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Helichrysum dimorphum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hibiscus aff. *diversifolius* (AK 347684; Surville)	Highly Vulnerable	Latent Risk	Highly Vulnerable	Highly Vulnerable
Hibiscus diversifolius subsp. *diversifolius*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Hibiscus richardsonii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Hydrocotyle aff. *robusta* (b) (CHR 596579; Chatham Is.)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hymenophyllum polyanthos	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Hypericum involutum	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Hypericum minutiflorum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Hypericum rubicundulum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Isoetes aff. *kirkii* (CHR 247118A; Lake Omapere)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Isoetes kirkii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Isolepis basilaris	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Isolepis lenticularis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Jovellana sinclairii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Juncus caespiticius	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Juncus holoschoenus	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Juncus pauciflorus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Koeleria aff. *novozelandica* (AK 252546; Awahokomo)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Korthalsella clavata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Korthalsella salicornioides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Kunzea amathicola	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Kunzea ericoides	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Kunzea linearis	Low Vulnerability	Exposed Only	Exposed Only	Exposed Only
Kunzea robusta	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Kunzea salterae	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Kunzea serotina	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Kunzea sinclairii	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Kunzea tenuicaulis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Kunzea toelkenii	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Kunzea triregensis	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Lachnagrostis ammobia	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Lachnagrostis tenuis	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Lagenophora montana	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lepidium aegrum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium banksii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium castellanum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable

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A2.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Lepidium crassum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium flexicaule	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium juvencum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium kirkii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lepidium limenophylax	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium naufragorum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium oblitum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium oleraceum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium oligodontum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium panniforme	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium rekohuense	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium seditiosum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidium sisymbrioides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lepidium solandri	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lepidium tenuicaule	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Lepidosperma neozelandicum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Leptinella aff. *pectinata* (a) (CHR 580894; Nevis)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leptinella conjuncta	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Leptinella dispersa subsp. *rupestris*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leptinella filiformis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Leptinella nana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leptinella pusilla	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Leptinella rotundata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leptinella serrulata	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Leptinella tenella	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Leptinella traillii subsp. *pulchella*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Leptospermum aff. *scoparium* (a) (AK 284541; Auckland)	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Leptospermum aff. *scoparium* (b) (AK 247250; "coastal silver prostrate")	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leptospermum aff. *scoparium* (c) (AK 191319; "Waikato Peat Bog")	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Leptospermum aff. *scoparium* (d) (AK 286289; East Cape)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Leptospermum aff. *scoparium* (e) (AK 228147; Three Kings)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Leptospermum aff. *scoparium* (f) (AK 319498; North Cape)	Potential Adapters	Sensitive Only	Potential Adapters	Potential Adapters
Leptospermum aff. *scoparium* (g) (AK 319494; Surville Cliffs)	Potential Adapters	Sensitive Only	Potential Adapters	Potential Adapters
Leptospermum aff. *scoparium* var. *incanum* (h) (AK 309827; North Cape)	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Leptospermum scoparium var. *incanum*	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Leptospermum scoparium var. *scoparium*	Low Vulnerability	Low Vulnerability	Low Vulnerability	Exposed Only
Leucogenes tarahaoa	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Leucopogon nanum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Libertia aff. *ixioides* (c) (AK 319490; Surville Cliffs)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Libertia cranwelliae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Libertia flaccidifolia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Libertia peregrinans	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Limosella (b) (CHR 515038; Manutahi)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Linum monogynum var. *chathamicum*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Linum monogynum var. *monogynum*	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Lobelia carens	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lobelia fatiscens	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lobelia fugax	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lobelia ionantha	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Lobelia physaloides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Lophomyrtus bullata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Lophomyrtus obcordata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Luzula celata	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Luzula ulophylla	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Lycopodiella serpentina	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Machaerina complanata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Mazus arenarius	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters
Mazus novaezeelandiae subsp. *impolitus* f. *hirtus*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Mazus novaezeelandiae subsp. *impolitus* f. *impolitus*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Mazus novaezeelandiae subsp. *novaezeelandiae*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Melicytus (a) (CHR 355077; Matiri Range)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Melicytus aff. *alpinus* (a) (CHR 541565; Rangipo)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Melicytus aff. *crassifolius* (CHR 279358; "cliff")	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Melicytus crassifolius	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Melicytus drucei	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Melicytus flexuosus	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Melicytus improcerus	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Melicytus orarius	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Melicytus venosus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Mentha cunninghamii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Metrosideros albiflora	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Metrosideros bartlettii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Metrosideros carminea	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Metrosideros colensoi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Metrosideros diffusa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Metrosideros excelsa	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Metrosideros fulgens	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Metrosideros kermadecensis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Metrosideros parkinsonii	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Metrosideros perforata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters
Metrosideros robusta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Metrosideros umbellata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters

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A2.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Microlaena carsei	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Mida salicifolia	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Montia drucei	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Montigena novae-zelandiae	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Muehlenbeckia astonii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Muehlenbeckia ephedroides	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myoporum semotum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotidium hortensia	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis aff. *brockiei* (a) (CHR 497375; Lake Otuhie)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis aff. *glauca* (a) (WELT SP104520; "Mata-Au")	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis albosericea	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosotis amabilis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis angustata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis brevis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis chaffeyorum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis cheesemanii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosotis colensoi	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis elderi	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis glauca	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis laeta	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis lytteltonensis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis matthewsii	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Myosotis mooreana	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Myosotis oreophila	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosotis pansa subsp. *pansa*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Myosotis pansa subsp. *praeceps*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Myosotis petiolata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myosotis pottsiana	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosotis pygmaea	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myosotis saxosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Myosotis umbrosa	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Myosurus minimus subsp. *novae-zelandiae*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myriophyllum robustum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myrsine argentea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Myrsine coxii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Myrsine umbricola	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Neomyrtus pedunculata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Notothlaspi viretum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Olearia adenocarpa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia chathamica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Olearia crebra	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Olearia fimbriata	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Olearia fragrantissima	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia gardneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia hectorii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Olearia lineata	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Olearia pachyphylla	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia polita	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Olearia telmatica	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Olearia traversiorum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ophioglossum petiolatum	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Ourisia modesta	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Oxybasis ambigua	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Pachycladon cheesemanii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pachycladon exile	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pachycladon fasciarium	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Pachycladon stellatum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pachycladon wallii	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pachystegia minor var. (a) (CHR 504888; Ohau)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Parsonsia praeruptis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Paspalum orbiculare	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pellaea aff. *falcata* (b) (AK 330788; "Auckland volcanoes")	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pennantia baylisiana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Peraxilla colensoi	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Peraxilla tetrapetala	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Phylloglossum drummondii	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Picris burbidgeae	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea actea	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea aff. *aridula* (b) (AK 230900; Cook Strait)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea aff. *villosa* (AK 216133; southern New Zealand)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea aridula subsp. *aridula*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pimelea aridula subsp. *oliga*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Pimelea declivis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea eremitica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea ignota	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea longifolia	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pimelea lyallii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea mesoa subsp. *macra*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pimelea mimosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pimelea orthia subsp. *orthia*	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pimelea orthia subsp. *protea*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea prostrata subsp. *ventosa*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea sericeovillosa subsp. *pulvinaris*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pimelea sericeovillosa subsp. *sericeovillosa*	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pimelea tomentosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pimelea traversii subsp. *boreus*	Latent Risk	Highly Vulnerable	Latent Risk	Highly Vulnerable
Pimelea villosa	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pimelea xenica	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Pittosporum dallii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pittosporum kirkii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A2.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Pittosporum obcordatum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pittosporum patulum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pittosporum pimeleoides subsp. *majus*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pittosporum serpentinum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pittosporum turneri	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pittosporum virgatum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Poa aucklandica subsp. *rakiura*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Poa billardierei	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Poa spania	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Polygonum plebeium	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pomaderris apetala subsp. *maritima*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pomaderris edgerleyi	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pomaderris paniculosa subsp. *novaezelandiae*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Pomaderris phylicifolia subsp. *phylicifolia*	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pouzolzia australis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Prasophyllum hectorii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Pseudognaphalium ephemerum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pseudopanax laetus	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pseudowintera insperata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Pterostylis irwinii	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pterostylis micromega	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pterostylis paludosa	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Pterostylis puberula	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pterostylis tanypoda	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Pterostylis tasmanica	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Pterostylis tristis	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Ptisana salicina	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Puccinellia raroflorens	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Ranunculus (a) (AK 276181; Hope)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus (b) (CHR 324466; Burgoo Stream)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus acraeus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus aff. *royi* (a) (AK 295116; Lake Rakeinui)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ranunculus aff. *royi* (c) (CHR 513327; Waihao)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus brevis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ranunculus buchananii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus callianthus	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus haastii	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ranunculus paucifolius	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ranunculus pilifera	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Ranunculus recens	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Ranunculus ternatifolius	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Ranunculus urvilleanus	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Ranunculus viridis	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Raoulia (a) (CHR 79537; "K")	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Raoulia aff. *australis* (a) (CANU 33934; "North octaploid")	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Raoulia aff. *hookeri* (a) (AK 239529; "coast")	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters

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TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Raoulia australis	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters	Potential Persisters
Raoulia beauverdii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Raoulia monroi	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Raoulia parkii	Low Adaptive Capacity Only	Low Adaptive Capacity Only	Potential Persisters	Potential Persisters
Rhabdothamnus aff. *solandri* (a) (AK 319367; Surville Cliffs)	Highly Vulnerable	Latent Risk	Highly Vulnerable	Highly Vulnerable
Rorippa divaricata	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Rytidosperma buchananii	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Rytidosperma exiguum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Rytidosperma horrens	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Rytidosperma merum	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Rytidosperma telmaticum	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Rytidosperma thomsonii	Sensitive Only	Potential Adapters	Potential Adapters	Potential Adapters
Scandia aff. *rosifolia* (AK 344466; "inland")	Low Vulnerability	Low Vulnerability	Exposed Only	Exposed Only
Scandia rosifolia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Schizacme helmsii	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Schoenus carsei	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Scutellaria novae-zelandiae	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Sebaea ovata	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio aff. *glaucophyllus* (b) (CHR 85767; Cape Campbell)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio aff. *glaucophyllus* (c) (AK 286230; "South Marlborough limestone")	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Senecio biserratus	Exposed Only	Exposed Only	Exposed Only	Exposed Only
Senecio carnosulus	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio dunedinensis	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio esperensis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio glaucophyllus subsp. *glaucophyllus*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Senecio hauwai	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio kermadecensis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Senecio repangae subsp. *repangae*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Senecio scaberulus	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Simplicia buchananii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Simplicia felix	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Simplicia laxa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Solanum aviculare var. *aviculare*	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Solenogyne christensenii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sonchus aff. *novae-zelandiae* (CHR 84044; "glaucous")	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Sonchus kirkii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Sonchus novae-zelandiae	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Spiranthes novae-zelandiae	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Sticherus tener	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Sticherus urceolatus	Sensitive Only	Sensitive Only	Potential Adapters	Potential Adapters
Syzygium maire	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Tecomanthe speciosa	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tetrachondra hamiltonii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable

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A2.5 continued

TAXON SCIENTIFIC NAME	RCP4.5 MID-CENTURY	RCP4.5 LATE CENTURY	RCP8.5 MID-CENTURY	RCP8.5 LATE CENTURY
Teucrium parvifolium	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Thelymitra (a) (WELT SP79140; Ahipara)	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Thelymitra matthewsii	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Thelymitra sanscilia	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Tmesipteris horomaka	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Todea barbara	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Trichomanes caudatum	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Trichomanes humile	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Triglochin palustris	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Trisetum aff. *lepidum* (AK 251835; Awahokomo)	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Trisetum antarcticum	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Trithuria inconspicua subsp. *brevistyla*	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Trithuria inconspicua subsp. *inconspicua*	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Tupeia antarctica	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Urtica perconfusa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Utricularia australis	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica adamsii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica aff. *albicans* (a) (AK 252966; Mt Burnett)	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica aff. *bishopiana* (a) (AK 202263; Hikurangi Swamp)	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Veronica aff. *treadwellii* (a) (CHR 394533; Bald Knob Ridge)	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica armstrongii	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica barkeri	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica bishopiana	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Veronica breviracemosa	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica calycina	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica cupressoides	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Veronica jovellanoides	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica lavaudiana	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica lilliputiana	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica maccaskillii	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica pareora	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica perbella	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Veronica rigidula var. *sulcata*	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica salicornioides	Latent Risk	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica saxicola	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica scopulorum	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica scrupea	Latent Risk	Latent Risk	Latent Risk	Highly Vulnerable
Veronica societatis	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable	Highly Vulnerable
Veronica speciosa	Sensitive Only	Sensitive Only	Sensitive Only	Potential Adapters
Wahlenbergia congesta	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Wurmbea novae-zelandiae	Latent Risk	Latent Risk	Highly Vulnerable	Highly Vulnerable
Zostera muelleri subsp. *novazelandica*	Potential Adapters	Potential Adapters	Potential Adapters	Potential Adapters
Zoysia minima	Potential Persisters	Potential Persisters	Potential Persisters	Potential Persisters

Appendix 3

Specific contributions of the subject matter experts

CCVA	NAME	AFFILIATION	WORKSHOPS	TAXON ASSESSMENTS	REVIEW OF ASSESSMENTS	CASE STUDY CONTRIBUTION	TAXON CHAPTER CONTRIBUTION
Bats	Jenny Christie	DOC		✓	✓		✓
	Gillian Dennis	Independent researcher			✓		✓
	Colin O'Donnell	DOC	✓	✓			✓
Birds	Michelle Bradshaw	DOC	✓		✓		
	Rhys Burns	DOC	✓	✓	✓		✓
	Johannes Fischer	DOC	✓	✓	✓	✓	✓
	Terry Greene	DOC	✓	✓	✓		
	Troy Makan	DOC	✓	✓	✓	✓	✓
	Colin O'Donnell	DOC	✓	✓	✓	✓	✓
	Graeme Taylor	DOC	✓	✓	✓	✓	✓
	Emma Williams	DOC	✓	✓	✓	✓	✓
Herpetofauna	Lynn Adams	DOC	✓			✓	
	Ben Barr	Independent researcher	✓	✓	✓		
	Alison Cree	University of Otago			✓		
	Jennifer Germano	DOC	✓	✓		✓	
	Scott Jarvie	Otago Regional Council		✓			
	Carey Knox	Independent researcher	✓	✓	✓	✓	✓
	Rosalie Richards	DOC	✓		✓	✓	✓
	Dylan van Winkel	Independent researcher	✓	✓	✓		✓
Invertebrates	Mark Anderson	Independent researcher	✓	✓	✓		✓
	Barbara Barratt	AgResearch		✓	✓		
	Fred Brook	Independent researcher	✓	✓		✓	
	Warren Chinn	DOC	✓	✓	✓	✓	
	Chris Green	DOC	✓	✓	✓		
	Eric Edwards	DOC	✓	✓	✓		✓
	Robert Hoare	Manaaki Whenua – Landcare Research		✓		✓	✓
	Tara Murray	DOC	✓	✓	✓	✓	✓
	Cor Vink	Lincoln University	✓	✓			

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CCVA	NAME	AFFILIATION	WORKSHOPS	TAXON ASSESSMENTS	REVIEW OF ASSESSMENTS	CASE STUDY CONTRIBUTION	TAXON CHAPTER CONTRIBUTION
Vascular plants	John Barkla	DOC	✓	✓	✓		
	Catherine Beard	DOC	✓	✓	✓		
	Paul Cashmore	DOC		✓	✓		
	Joy Comrie	DOC	✓		✓		
	Shannel Courtney	DOC	✓	✓	✓		
	Alex Fergus	Manaaki Whenua – Landcare Research	✓	✓	✓		✓
	Jane Gosden	Independent researcher	✓	✓	✓	✓	✓
	Ingrid Gruner	DOC	✓	✓			
	Rowan Hindmarsh-Walls	DOC	✓				
	Graeme La Cock	DOC	✓	✓	✓		✓
	Jane Marshall	DOC	✓	✓	✓	✓	✓
	Pascale Michel	DOC	✓	✓			
	Brian Rance	DOC		✓			
	Andrew Townsend	DOC	✓	✓	✓	✓	✓

Abbreviations: CCVA, climate change vulnerability assessment; DOC, Department of Conservation Te Papa Atawhai.