Otago Regional Council

Document Id:

MEMORANDUM

To: **LWRP team**

From: **Sami Khan, Jason Augspurger**

Date: **14/12/2023**

Re: **Freshwater habitats of threatened species**

Name	Role	Date Completed
Pete Ravenscroft	Reviewer	7/2/2024

Purpose

This memo informs the use of the attributes included in Appendix 2A and 2B of the NPSFM as attributes suitable for monitoring the threatened species compulsory value included in the NPSFM.

Context

National Policy Statement for Freshwater Management (2020- revised 2023)

The NPSFM 2020 (revised 2023), in Appendix 1A) sets out four compulsory values which include Ecosystem health, human contact, threatened species and Mahinga kai. Under clause 3.9, the compulsory values listed in this appendix are to apply to every FMU. Regional councils must set outcomes for each value which apply to the FMU, or part of an FMU (clause 3.9.3).

Outcomes outline the outcome sought for the value in a way which can allows for assessing the effectiveness of plans (both regional and action) in providing for the value and outcome. When achieved, this outcome must fulfil the long-term vision for the FMU set out in the regional policy statement. For each value, council must identify attributes (clause 3.10). These attributes must be specific, and where practicable numeric. Council must then determine the baseline state of the selected attribute.

For the ecosystem health and human contact compulsory values, the NPSFM includes relevant attributes in Appendix 2A and 2B. Attributes are not explicitly provided for

threatened species or Mahinga Kai. Council must therefore determine appropriate attributes for these values.

Here we outline one potential approach for the threatened species value.

Threatened species as a compulsory value

As described in appendix 1A, the threated species value "refers to the extent to which an FMU or part of an FMU that supports a population of threatened species has the critical habitats and conditions necessary to support the presence, abundance, survival, and recovery of the threatened species. All the components of ecosystem health must be managed, as well as (if appropriate) specialized habitat or conditions needed for only part of the life cycle of the threatened species."

The description highlights that all components of ecosystem health must be managed. In Appendix 1A, the NPSFM outlines the biophysical components of ecosystem health as:

Water quality - the physical and chemical measures of the water, such as temperature, dissolved oxygen, pH, suspended sediment, nutrients, and toxicants.

Water quantity - the extent and variability in the level or flow of water

Habitat - the physical form, structure, and extent of the water body, its bed, banks, and margins; its riparian vegetation; and its connections to the floodplain and to groundwater

Aquatic life - the abundance and diversity of biota including microbes, invertebrates, plants, fish, and birds.

Ecological processes - the interactions among biota and their physical and chemical environment such as primary production, decomposition, nutrient cycling, and trophic connectivity.

A non-exhaustive list of attributes which can be used to measure ecosystem health is provided in appendix 2A and 2B. These attributes include physicochemical parameters such as nitrate, dissolved reactive phosphorus, suspended fine sediment, and others as well as biological indicators such as periphyton, macro-invertebrate indices and the fish index of biotic integrity. At least one (often more) attribute is provided for four of the five biophysical components. No attributes are provided for water quantity.

Threatened species in the Land and Water Plan

To provide for the threatened species value, ORC has a draft outcome of:

"the freshwater habitats of threatened species are protected and support the persistence and recovery of threatened species over time".

To achieve this outcome, ORC must be able to determine first whether the freshwater habitats of threatened species are protected and second whether they are supporting the persistence and recovery of threatened species over time.

Discussion

Monitoring of habitat

The draft environmental outcome reflects that if habitats are improved, populations of threatened species would be expected to be maintained or improved as well. This view is justifiable when habitat is a limiting factor for threatened species.

To provide for broadscale habitat outcomes suitable for threatened species, attributes from the Appendices 2A and 2B can be selected. Limits on resource use derived from these attributes (such as stock exclusion, nutrient rules, etc.) will lead to maintained or improved physicochemical habitat quality. Other LWRP interventions such as management of natural wetlands and flow alteration of rivers will protect critical habitats of wetland plants, benthic invertebrates, fish and birds.

Disconnect between physicochemical habitat and persistence/recovery

Providing maintained, or improved, physicochemical freshwater habitat across Otago does not necessarily mean threatened species will persist or recover for two distinct reasons. First, while physicochemical conditions may be suitable for threatened species, biological conditions may not. In this case, the presence of exotic or invasive species populations may limit threatened species populations as opposed to physicochemical habitat conditions. Thus, improvement in the physicochemical conditions does not alleviate the limiting factor and threats. Second, as outlined in the Appendix 1A description, species may have specialised habitat needs or conditions for an aspect of their life cycle which are not necessarily provided by broadscale physicochemical habitat improvements. These needs are likely to be highly species, and even population, specific.

A land and water plan is generally targeted at managing broad scale, physicochemical, type stressors. While aspects of land and water plan, such as fish passage, can help alleviate pressures from biological interactions, management of biotic interaction and population specific needs may better fall in an alternative planning mechanism (such as an action plan, pest management strategy, or biodiversity plan).

As there is a disconnect between physicochemical habitat conditions and species persistence and recovery, the physicochemical attributes can only assess whether broad scale habitat is likely to be improving. To assess whether species are persisting and/or recovering, additional attributes are likely to be required in the relevant planning document (Action plan, pest management strategy, biodiversity plan). While robust population estimates are the gold standard for assessing recovery and these types of assessments are generally costly, population specific, and require a long-term dataset. In many cases, population estimates may not be practical attribute to widely implement. However, several other attributes can work as a proxy and have high informative value for determining whether regional council is providing for persistence and recovery of threatened species. These attributes could include number of predator/pest free population, area or extent of predator/pest free habitat, and others. These attributes should be closely tied to the objective of their respective planning documents.

Conclusion

In order to achieve the desired environmental outcome, relevant attributes from the Appendices 2A and 2B can be selected. Limits on resource use deriving from these attributes (such as stock exclusion, nutrient application limits, etc.) would lead to improved physicochemical habitat quality across Otago. Other LWRP interventions such as management of natural wetlands and flow alteration will ensure protecting critical habitats of wetland plants, benthic invertebrates, fish, and birds.

However, the biotic components of threatened species habitats (such as presence of exotic and invasive species) or population specific requirements require other planning mechanisms (such as action plan, biodiversity, and pest management plans). When developed, the other planning mechanisms will require suitable attributes for assessing their respective outcomes.

The two sets of planning mechanisms, and their respective attributes, are required to determine whether regional council is achieving the draft objective (environmental outcomes) in the land and water regional plan.

References

Ministry for the Environment, National Policy Statement for Freshwater Management 2020 (February 2023 version).

Annexure 1: (Policy Advice – Freshwater Threatened Species)

Policy Advice – Freshwater Threatened Species

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April 2023

1. The new threatened species compulsory value

The Otago Regional Council (ORC) is developing a Land and Water Regional Plan (LWRP) which must give effect to the new threatened species compulsory value in the National Policy Statement for Freshwater Management (NPSFM; MfE 2023). No threatened species attributes were provided in the NPS-FM and the guidance provided as to how to implement the threatened species compulsory value is vague. Consideration of to how to implement the threatened species compulsory value reveals four problematic issues which require addressing:

1. The definition of freshwater-dependent species is vague: For example, as all organisms are dependent on water to some extent (e.g., most terrestrial animals are required to drink freshwater to survive), the broad definition of a freshwater-dependent species is open to a broad range of interpretations.
2. Data deficiency: In the NPSFM, threatened species are deemed to be those listed as nationally critical, endangered, or vulnerable under New Zealand's Threat Classification Framework (Townsend et al. 2008; Rolfe et al. 2021; Michel 2021). The determination of the regional status of such species requires robust information on species distributions as well as population status and trends at the regional scale. For many freshwater-dependent species, this information simply does not exist because systematic species inventories for all threatened species across the region have not been undertaken. Thus, the identification of threatened freshwater species relies on existing national scale threat classifications carried out by the Department of Conservation. These do not include important freshwater taxa such as charophytes and zooplankton of the taxonomic groups that have been assessed, many species are data deficient in terms of their prevalence across the country. Furthermore, to protect threatened freshwater-dependent species, a robust understanding of habitat requirements of these species, some of which only utilise freshwater habitats for part of their life cycle, must be understood. Information specifying environmental optima, tolerances and key species interactions simply isn't available for many freshwater-dependent species and, therefore, habitat models for many threatened species don't exist. Thus, robust information on habitat requirements and on current and potential future distributions of these species across the region do not exist.
3. Potential overlap with Department of Conservation mandate to conserve species and habitats: DoC's New Zealand Threat Classification Manual (Townsend et al. 2008; Rolfe et al. 2021; Michel 2021) and DoC's threat classifications carried out for indigenous freshwater invertebrates (Grainger et al. 2018), vascular plants (de Lange et al. 2021), freshwater fish (Dunn et al. 2017), birds (Robertson et al. 2021), etc. inform the incorporation of certain threatened species into the NPSFM. While DoC is the custodian of New Zealand's crown land, it also has an interest in threatened species located on private land. DoC works with private land owners to protect some threatened species and habitats. Therefore, collaboration with DoC on the conservation of threatened species and their critical habitats will be necessary. For

example, conflicts between DoC and the ORC over the management of threatened species should be minimised if not avoided altogether. At this stage, it is not clear how the threatened species mandates of both regional councils and DoC will best be managed.

4. Resource availability and partitioning: Regional councils must implement the NPSFM attributes for on water quality, ecosystem health and recreational use. Currently in the NPSFM there are 10 attributes requiring limit setting and 12 requiring action plans (MfE 2023), not including attributes that might be developed for threatened freshwater species. The burgeoning of freshwater attributes means that ORC will require additional resources to implement these attributes. Depending on how the threatened species compulsory value is implemented, mapping and managing the regional populations of threatened freshwater species could place a burden on ORC resources. The vague guidance and potentially broad scope of the new threatened species compulsory value could necessitate the investment of substantial ORC resources the ORC were to encroach, or greatly expand, on DoC's work on threatened species.

These issues highlight the need for careful consideration of how best to implement the threatened species compulsory value in the NPSFM. The ORC aims to notify its Land and Water Plan by December 2023, indicating the time frame available to develop an implementation pathway for threatened species management under the NPSFM is short.

The overall aim of this policy guidance is to propose an implementation plan to effectively manage Otago's threatened freshwater species and their habitats, while acknowledging the many potential challenges that this could elicit.

2. Legislative context and definitions

2.1 NPSFM (MfE 2023)

The NPSFM discusses the threatened species compulsory value in five different sections:

Section 1.4

- Threatened species is a compulsory value

- "Threatened species means any indigenous species of flora or fauna that:
  (a) relies on water bodies for at least part of its life cycle; and
  (b) meets the criteria for nationally critical, nationally endangered, or nationally vulnerable species in the New Zealand Threat Classification System Manual (see clause 1.8)."

Section 3.8

- "Identifying FMUs and special sites and features
  (3) Every regional council must identify the following (if present) within each FMU:
  c. the location and habitats of threatened species."

Appendix 1A - Compulsory Values:

- "3. Threatened species
  This refers to the extent to which an FMU or part of an FMU that supports a population of threatened species has the critical habitats and conditions necessary to support the presence, abundance, survival, and recovery of the threatened species. All the components of ecosystem health must be managed, as well as (if appropriate) specialised habitat or conditions needed for only part of the life cycle of the threatened species."

Special mention in relation to wetlands (Section 3.23):

- "Every regional council must identify and map every natural inland wetland in its region that is:

  (b) of a type that is naturally less than 0.05 hectares in extent (such as an ephemeral wetland) and known to contain threatened species."

Special mention in relation to trading up (Appendix 7):

- "9. …values lost [may not be] threatened or at risk/declining species or to species considered vulnerable or irreplaceable.".

2.2 THE NEW ZEALAND THREAT CLASSIFICATION MANUAL (TOWNSEND ET AL. 2008; ROLFE ET AL. 2021; MICHEL 2021)

Section 1.4 of the NPSFM defines threatened species as nationally critical, endgangered or vulnerable (except in relation to trading up in Appendix 7, where "at risk/declining species" and "species considered vulnerable or irreplaceable" are also mentioned). An update to the threat classification manual (Michel 2021) includes four sub-classes of threatened species: "nationally critical", "nationally endangered", "nationally vulnerable" and "nationally increasing" (Fig. 1). Thus, the NPSFM mandates the Department of Conservation's definition of threatened species, which aligns with Department of Conservation's nuerous assessments of the national threat status of native species within various taxonomic grouping (https://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system/).

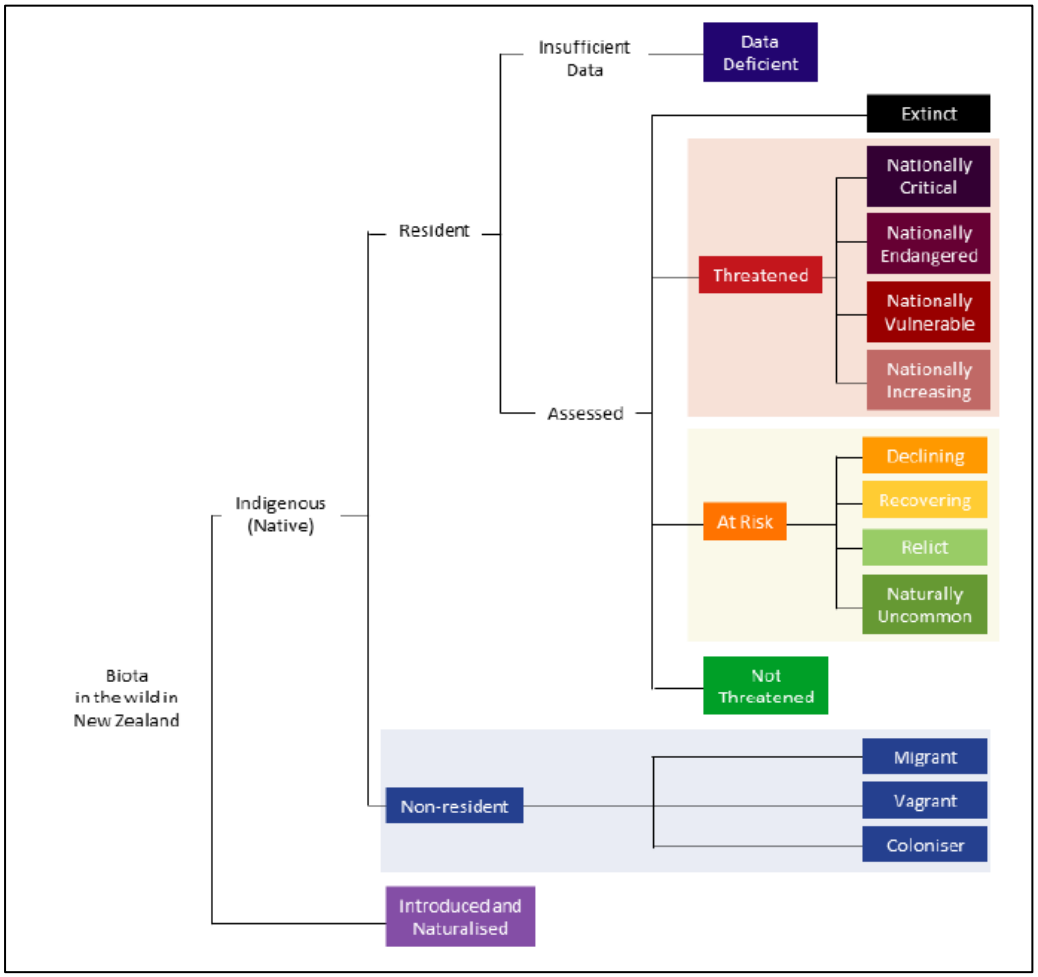

Figure 1. The updated structure of DoC's threat classification system (Michel 2021).

2.2 THREATENED SPECIES FACTSHEET: SUGGESTIONS REGARDING IMPLEMENTATION (MFE 2020)

In order to provide increased clarity concerning regional council roles with regard to the threatened species compulsory value in the NPSFM, MfE provided a threatened species factsheet as guidance. The factsheet states that:

> Regional councils are required to:
> 1. identify the location of habitats of threatened species in regional plans
> 2. set an environmental outcome for threatened species in each freshwater management unit and include the outcome as an objective in their plan. The objective must:
> − be such that the effectiveness of regional policy statements and plans can be assessed against it; and
> − when achieved, fulfil relevant long-term visions set for the region
> 3. identify attributes relevant to achieving the outcome, set targets for those attributes, and set limits on use of resources to meet those targets. Councils must then identify how the outcome and target states will be achieved. This may include rules in regional plans about discharges, water takes and disturbing the beds and banks of water bodies, methods in action plans such as habitat restoration, methods in regional pest management plans such as exclusion or eradication of pest plants and animals, or some combination of these).
> 4. map natural inland wetlands under 0.05 hectares known to contain threatened species (wetlands larger than this must be mapped regardless).

The document highlights key aspects of the NPSFM framework, including environmental outcomes, objectives, attributes, limits on resource use, and action plans. Generalised examples of how threatened species protection could be implemented are provided, such as "rules…about discharges, water takes, and disturbing the beds and banks of water bodies". Suggested actions for action plans include "habitat restoration…pest management… or a combination of these." However, no guidance on potential threatened species attributes is provided.

Further guidance on implementation is revealed in the text below, which states that the successful protection of the NPSFM compulsory value of ecosystem health (i.e., water quality, water quantity, habitat, aquatic life and ecological processes) will also provide some protection for threatened freshwater-dependent species.

> "Some of these aspects will be managed as part of the compulsory value of ecosystem health, including the components that make up ecosystem health: water quality, water quantity, habitat, aquatic life, and ecological processes. Specialised habitats, or conditions needed for part of the life cycle of the threatened species, may also need to be managed specifically for the threatened species." (MfE 2020)

In other words, achieving the targets for the 22 attributes in the NPSFM will have the additional benefit of protecting many threatened species. The document then states that, in additional to these attributes, specialised habitats or conditions required by threatened species may necessitate further protections not specifically provided by protection of the ecosystem health attributes alone.

The fact sheet suggests numerous options for the implementation of the threatened species compulsory value, including the use of specific desired planning outcomes, objectives, attributes, limits, action plans, and rules. There is also an acknowledgement that the current attributes in the NPSFM that are designed to protect ecosystem health, will also protect many threatened species (if their targets are achieved).

3. DEFINING A FRESHWATER-DEPENDENT SPECIES

Accepting DoC's threatened species assessments and criteria clarifies the NPSFM definition of a threatened species. However, a more vexing issue is the definition of what constitutes a freshwater-dependent species. In clause 1.4, the NPSFM 2020 states that:

- "Threatened species means any indigenous species of flora or fauna that:
  (a) relies on water bodies for at least part of its life cycle; and
  (b) meets the criteria for nationally critical, nationally endangered, or nationally vulnerable species in the New Zealand Threat Classification System Manual (see clause 1.8)."

> **NPSFM: "…any indigenous species… that relies on water bodies for at least part of its life cycle"**

To help identify threatened species of indigenous flora or fauna, Thorsen (2022) extracted the records of all threatened species that occur in the Otago region from a variety biodiversity database. Thorsen (2022) stated that an assessment of freshwater-dependence of the threatened species occurring on Otago should test the species in relation to three general criteria: 1) in the absence of freshwater habitat, individuals of the species would perish, 2) in the absence of freshwater habitat, individuals of the species would have a marked loss of vitality, or 3) have a marked reduction in their ability to reproduce. These criteria elaborate on the NPSFM definition of freshwater dependence and also change the focus from population level effects (the use of the term threatened **species** in the NPSFM) to effects on individuals that constitute a population of a species. This shift in focus to individuals of a species is not a trivial departure. For example, if a threatened plant species has a tolerance to waterlogged soils, some individuals of this species could be found in wetlands, but the species may grow well, or better, in drier soils. Thus, by focusing on the freshwater dependence of **individuals** instead of the national-scale **population** of a threatened species, an exaggerated interpretation of the reliance on freshwater habitats by the species could result.

> **Thorsen (2022): In the absence of freshwater habitat, individuals would either**
>
> **1. perish,**
>
> **2. have marked loss of vitality, or**
>
> **3. have marked reduction in ability to reproduce.**

On the other hand, populations are made up of individuals and populations of threatened species can't be protected unless individuals of that species are protected. Nevertheless, this shift in emphasis from protecting the national-scale population to protecting individuals could lead to inappropriate policy decisions, as described in the above example.

Having defined freshwater-dependence, Thorsen (2022) then tested the Otago threatened species extracted from the biodiversity databases for freshwater-dependence. Due to the specific types of relevant information available in the databases, six criteria for freshwater-dependence were chosen threatened species were extracted from the databases that met any of these criteria.

A) Most individuals of the species are recorded as permanently inhabiting freshwater habitats, or;

B) *Most individuals of the species use freshwater habitats for a part of their lifecycle, such as for feeding or reproductive purposes, and display adaptions or lifestyles consistent with this, or;*

C) *Some individuals of a species have been recorded temporarily or occasionally using freshwater habitats for activities important in maintaining health and wellbeing such as feeding, drinking, or bathing, or;*

D) *The species is listed as a 'freshwater' species during NZ Threat Classification Assessments, in Clarkson et al. (2021) (plants only), Storey et al. (2018) (birds only), or has been designated elsewhere as freshwater-dependent in a similar exercise to this, or;*

E) *The species is known to inhabit freshwater habitats in addition to other non-freshwater habitats.*

F) *Some individuals of the species are mapped as occurring in freshwater but their link to freshwater is not known. These species are not categorised further on their hydrosystem or other characters.*

Of these six criteria, only the first two strictly align to the definitions of freshwater dependence in the NPSFM. Criteria A and B also refer to the habitat needs "**most individuals of the species**" rather than with the habitat needs of [any] individuals of a species, which aligns more closely with the NPSFM definition (which refers to threatened species, rather than individuals).

Summary of Freshwater dependence criteria used to interrogate biodiversity databases (Thorsen 2022):

A) Most individuals permanently inhabiting freshwater habitats, or;

B) Most individuals use freshwater habitats for a part of their lifecycle or;

C) Some individuals recorded temporarily or occasionally using freshwater habitats, or;

D) The species is listed as a 'freshwater' species during NZ Threat Classification Assessments, in Clarkson et al. (2021) (plants only), Storey et al. (2018) (birds only), or has been designated elsewhere as freshwater-dependent in a similar exercise to this, or;

E) The species is known to inhabit freshwater habitats in addition to other non-freshwater habitats, or;

F) Some individuals are mapped as occurring in freshwater but their link to freshwater is not known.

It's not clear whether Thorsen (2022) intentionally placed these criteria in order of highest to lowest freshwater-dependence or not. However, criteria C, E and F indicate a weaker association with freshwater habitats than Criteria A and B and criterion D relies on other assessments of freshwater dependence (e.g., assessed by other regional councils). Therefore, species that meet either criterion A or B are freshwater-dependent according to the NPSFM guidance, but it's not clear whether species that meet criterion D must also be captured to meet the NPSFM guidance on freshwater-dependence, or not.

4. Identifying Otago's freshwater-dependent threatened species

Thorsen (2022) applied the six criteria to Otago species occurrence records, capturing 14,647 records of over 135 threatened freshwater-dependent species from the databases. Two of the species (wrybill and brown teal) are classified as "nationally increasing", but these have been included in the list because the update to the threat classification system includes this sub-class in the threatened species

class (Michel 2021). The threatened freshwater-dependent species of Otago captured by the six criteria using the Thorsen (2022) protocol are listed in Appendix 1.

> **One hundred and thirty-five species are identified as Threatened freshwater-dependent species within the Otago region (Table 4, Appendix 1. List of Threatened Freshwater-Dependent Species). 41 species are assigned as potentially freshwater dependent based solely on their being located within the mapped extent of freshwater in Otago (Criteria F). Most of the Threatened species are located in lacustrine, palustrine or riverine hydrosystems (Table 3). Forty are currently[33] categorised as Nationally Critical, 29 as Nationally Endangered, 62 as Nationally Vulnerable and two as Nationally Increasing. Nearly all Threatened species are dependent on flow quantity, and most are also dependent on flow quality (Table 3). All Threatened fish species are dependent also on fish passage, and the number of fish records in Otago strongly influences the high number of records of species dependent on freshwater passage[34]. The majority of species are threatened by weeds and aquatic pest weeds and animals (Table 3). – Thorsen (2022)**

Although many of the species captured do permanently inhabit freshwaters (e.g., galaxiids, mudfish, lamprey, caddisflies) or have strong associations with freshwater habitats (e.g., grey duck, white heron, australasian bittern, blue duck, black stilt), some captured species have weak (if any) obligatory reliance on freshwater habitats (e.g., sea lions, manuka, mistletoe, kea, southern rata). Many of the species deemed as freshwater-dependent have been classified elsewhere as terrestrial and marine species (Appendix I). Thus, the application of all six criteria captures more freshwater dependent species than is required under the NPSFM.

Applying only criterion A results in the capture of 54 species (22 are "critical", 15 are "endangered" and 17 are "vulnerable"). Adding criterion B increases the species captured to 56 (1 "critical" and 1 "endangered"). The addition of criterion D adds 13 species not captured by criteria A and B. These are species which are considered to be freshwater dependent by other regional councils or by Townsend et al. (2008), but which have not been identified in the databases as requiring freshwater habitats to complete their life cycles. These criterion D species are listed in Table 1.

Table 1. Species listed as freshwater dependent by other authorities (Criterion D) but not captured by criteria A and B, and therefore potentially not dependent on freshwater habitats for any part of their life cycle.

Latin name	English common name	Māori common name	Authority
Chalinolobus tuberculatus	long tail bat	?	Other regional council
Korthalsella salicornioides	misteltoe/dwarf mistletoe/leafless mistletoe	?	Other regional council
Lagenophora montana	New Zealand begonia	papataniwha	Other regional council
Lophomyrtus obcordata	New Zealand myrtle	rohutu	Other regional council
Neomyrtus pedunculata	myrtle	rohutu	Other regional council
Vesicaperla trilinea	stonefly	?	Townsend et al. (2008)
Kiwisaldula laelaps	shorebug	?	Townsend et al. (2008)
Coprosma cobconica	coprosma	?	Other regional council

Hydroprogne caspia	Caspian tern	taranui	Other regional council
Leptospermum coparium	manuka	mānuka	Other regional council
Libertia preregrinaus	New Zealand iris	mikoikoi	Other regional councils
Melicytus flexuosus	no common name (shrub)	?	Other regional councils
Pittosporum obcordatum	heart-leaved pittosporum	kohuhu	Other regional councils

Vesicaperla trilinea is a stonefly with an aquatic larval stage and is, therefore, freshwater-dependent according to criterion A. *Kiwisaldula laelaps* is a a member of the taxonomic group, Saldidae, also known as "shore bugs". Saldula species are described as semi-aquatic predatory invertebrates, typically found above water level in shoreline habitats of waterbodies spanning a wide range of trophic states, feeding on both aquatic and non-aquatic invertebrates (Landcare Research 2023). Thus it's highly likely that *Kiwisaldula laelaps* meets criterion B. The addition of these two species to list captured by criteria A and B brings the total freshwater-dependent species to 58. See Appendix II for the list of these species.

The other eleven taxa in Table 1 are terrestrial and, as such, I don't have the expertise to assess whether they meet criteria A or B. These taxa have been designated as freshwater dependent by other regional councils, but it is not known what criteria were used for these determinations. Therefore, the freshwater dependence of these eleven taxa (and whether they meet criteria A or B) should be assessed by plant, bird and bat experts.

5. Implementing the threatened freshwater-dependent species compulsory value

5.1 IDENTIFYING POTENTIAL ATTRIBUTES

The ORC carried out community consultation on the NPSFM, including the new threatened species compusory value. After considering community feedback, ORC developed environmental objectives for threatened species in each freshwater management unit (FMU). Two alternative wordings of the objective have been drafted:

1. *The FMU supports the presence, abundance, survival, and recovery of threatened species*
2. *The FMU supports the critical habitats and conditions for the presence, abundance, survival, and recovery of threatened species.*

These differ in that option 1 focuses on protecting the threatened species populations, while option 2 focuses on protecting the threatened species' habitats. The latter reflects the concept that if the habitats are protected then the populations of the threatened species which currently depend on these habitats should at least be maintained, if not be improved. This view is justified if populations of threatened species in Otago are mainly limited by habitat availability, which may, or may not, be the case.

Further justification for this habitat-focused approach is found in the threatened species fact sheet (MfE 2020) which states that regional councils must "set an environmental outcome for threatened species in each freshwater management unit" and

> "identify attributes relevant to achieving the outcome, set targets for those attributes, and set limits on use of resources to meet those targets. Councils must then identify how the outcome and target states will be achieved. This may include rules in regional plans about

> discharges, water takes and disturbing the beds and banks of water bodies, methods in action plans such as habitat restoration, methods in regional pest management plans such as exclusion or eradication of pest plants and animals, or some combination of these)."

It is notable that this guidance does not explicitly mandate the management of each threatened species individually. However, the guidance states that in some instances, "specialised habitats or conditions needed for part of the life cycle of the threatened species may also need to be managed specifically for the threatened species" (MfE 2020).

Thus, in this guidance, there is acknowledgement that the environmental outcomes of successfully protecting aquatic ecosystem health, water quantity, water quality, etc. will also protect freshwater-dependent threatened species. However, in some cases specialised habitats and conditions critical to the life cycles of threatened species may also need to be managed separately, although it is not clear in the guidance what the specialised habitats or conditions might refer to.

One example of how managing specialised habitats might apply is the case of Otago's threatened non-migratory galaxiids. The population strongholds of these threatened species rely on barriers preventing the migration of trout into galaxiid habitats, indicating that connectivity must be considered to protect these populations, in addition to the current attributes of ecosystem health in the NPSFM.

The ORC conducted community consultation meetings at which the community highlighted some important aspects of threatened species conservation for consideration in regional planning. These included:

- Presence/existence
- Range/area found
- Localness/endemism
- Commonness/number of populations
- Presence of secure populations (e.g., predator free)
- High diversity areas/overlap of multiple threatened species
- Connectivity (e.g., the ease of species being able to move between habitats)
- Abundance
- Range/area found
- Population integrity/similarity to natural state
- Resilience (e.g., capacity to recover)

Some of these are easier to quantify than others. As elaborated below, some of these can be developed into new attributes supporting threatened species environmental outcomes and objectives.

5.2 A PROPOSAL FOR SPECIFIC THREATENED SPECIES ATTRIBUTES

In Section 1, I discussed four difficulties in managing threatened species: 1. Finding an operatioinal definition of freshwater-dependence, 2. Data deficiencies in trying to manage populations of individual threatened species, 3. The potential overlap with DoC's manadate for native species protection, and 4. The limited resources which regional council have to undertake research and monitoring of individual threatened species. In Section 4, a further difficulty emerged in that, according to the definition of freshwater-dependence most aligned with that in the NPSFM, 58 nationally-threatened, freshwater-depenendent species have so far been identified in Otago. These issues limit the ORC's ability to undertake environment management for each population of all the known threatened species in Otago. The knowledge base of each threatened species' habitat

requirements is insufficient and, furthermore, the expertise and resources required to manage all threatened species individually may not be available.

However, the MfE (2020) acknowledges that if freshwater habitats are maintained or improved in accordance with the NPSFM, then this should result in significant protection of populations of freshwater-dependent threatened species. However, regional councils are guided to go beyond the current NPSFM ecosystem health safeguards to protect threatened species, where appropriate. Below, three proposals to add new protections for threatened freshwater-dependent species in Otago are discussed. These are presented here as new protections that could be both effective at improving protections for threatened species as well as being feasible in terms of implementation.

5.2.1 A connectivity attribute to protect threatened species

The connectivity between threatened species populations is considered a key issue for the protection and enhancement of threated species. The public consultation process undertaken by ORC identified connectivity directly as well as resilience (e.g., capacity to recover) as two key characteristics of threatened species to be managed. Thus, the community is also aware of the importance of connectivity for the protection and enhancement of threatened freshwater-dependent species in Otago.

One approach to managing connectivity is to create a new freshwater connectivity attribute which could be applied both to enhance connectivity of migratory freshwater species (e.g., lamprey/kanakana) and to ensure barriers to the migration of non-native species that threaten the populations of threatened native species (e.g., non-migratory galaxiids) remain in place. A connectivity attribute could be applied differently in different FMUs in order to obtain desired results, based on the threatened species connectivity issues that exist in the FMUs.

A connectivity attribute could include targets for opening up new habitats for migratory lamprey and targets for creating or maintaining barriers to protect non-migratory galaxiid populations.

Table ??. Potential connectivity attributes for the protection of threatened freshwater species in Otago

Attribute	Quantification
1. Barriers to salmonid migration into threatened species habitats	• Identify key barriers protecting threatened native fish from salmonid migration • Set targets for the maintenance, bolstering and construction of new barriers • Monitor the number and state/condition of these barriers
2. Maintaining access to habitat for lamprey/kanakana	• Identify actual and potential lamprey/kanakana habitats • Identify barriers to migration preventing lamprey/kanakana from accessing all potential habitats • Set targets for maintaining or improving the access to potential habitats • Monitor the number of barriers and percentage of potential habitat accessible

5.2.2 An invasive species attribute to protect threatened species

Another major factor impacting threatened species is the arrival and proliferation of invasive species. New Zealand is host to a large number of freshwater alien invaders which have devestated many populations of indigenous freshwater species (Closs et al. 2002). The community consultation undertaken by the ORC highlighted the “presence of secure populations (e.g., predator free)” as a key characteristic of threatened species to be managed.

One approach to managing invasive freshwater species is to develop and maintain a database of invasive freshwater species observations and incursions. Such a database should include information on both invasive species that already exist in Otago's freshwaters as well as freshwater invaders that could invade from outside Otago (species that already exist on the South Island but are not yet in Otago). Various invasive species attributes could be developed from such a database, allowing the management of threats of freshwater invaders.

Table ??. Potential invasive species attributes for the protection of threatened freshwater species in Otago

Attribute	Quantification
1. Extent of key invasive freshwater species incursions into Otago	• Assess invasiveness of • Set targets for the maintenance, bolstering and construction of new barriers • Monitor the number and state/condition of these barriers
2. Maintaining access to habitat for lamprey/kanakana	• Identify actual and potential lamprey/kanakana habitats • Identify barriers to migration preventing lamprey/kanakana from accessing all potential habitats • Set targets for maintaining or improving the access to potential habitats • Monitor the number of barriers and percentage of potential habitat accessible

5.2.3 Protecting existing populations and improving species distribution mapping through the consenting process

The work of Thorsen (2022) produced a list of nationally threatened freshwater-dependent species in Otago (Appendix ii). This list could be included as a schedule in Otago Regional Plans whereby the species on the list would need to be protected in the event of any developments affecting water bodies in Otago….

6. Acknowledgements

7. References

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Appendix I: List of 140 nationally-threatened, freshwater-dependent species recorded in Otago by Thorsen (2022). Freshwater-dependence was determined based on 6 criteria.

NameSimple	NameCommon	Environme	Taxono	Taxono
Alsolemia cresswelli	land snail	Terrestrial	Fauna	Invertebra
Ardea modesta	white heron, kōtuku,	Freshwater	Fauna	Birds
Asaphodes frivola	Remuremu looper moth	Terrestrial	Fauna	Invertebra
Bembidion chalmeri	Carabidae	Terrestrial	Fauna	Invertebra
Botaurus poicilоptilus	Australasian bittern, mat	Freshwater	Fauna	Birds
Brachyscome linearis		Terrestrial	Flora	Plants
Cardamine mutabilis		Terrestrial	Flora	Plants
Carmichaelia curta	Waitaki Broom, Whip Bro	Terrestrial	Flora	Plants
Ceratocephala pungens		Terrestrial	Flora	Plants
Chalinolobus tuberculatus	Long-tailed bat	Terrestrial	Fauna	Bats
Chenopodium detestans	New Zealand fish-guts pl	Terrestrial	Flora	Plants
Craspedia incana	Woollyhead	Terrestrial	Flora	Plants
Crassula peduncularis		Terrestrial	Flora	Plants
Epilobium pictum	grassland willow herb	Terrestrial	Flora	Plants
Eulimnadia marplesi	clam shrimp	Freshwater	Fauna	Invertebra
Galaxias "species D"	Clutha flathead galaxias (	Freshwater	Fauna	Fish
Galaxias "Teviot"	Teviot flathead galaxias (	Freshwater	Fauna	Fish
Galaxias cobitinis	Lowland longjaw galaxias	Freshwater	Fauna	Fish
Himantopus novaezelandiae	black stilt, kaki,	Freshwater	Fauna	Birds
Korthalsella salicornioides	Mistletoe, dwarf mistleto	Terrestrial	Flora	Plants
Lagenophora montana	papataniwha	Terrestrial	Flora	Plants
Lepidium kirkii	Kirk's scurvy grass, salt pa	Terrestrial	Flora	Plants
Leptinella conjuncta		Terrestrial	Flora	Plants
Lophomyrtus obcordata	Rohutu, New Zealand my	Terrestrial	Flora	Plants
Myosotis umbrosa		Terrestrial	Flora	Plants
Neochanna burrowsius	Canterbury mudfish	Freshwater	Fauna	Fish
Neomyrtus pedunculata	Rohutu, myrtle	Terrestrial	Flora	Plants
Nesoperla patricki	stonefly	Freshwater	Fauna	Invertebra
Oeconesus angustus	caddisfly	Freshwater	Fauna	Invertebra
Ourisia modesta	Creeping Foxglove	Terrestrial	Flora	Plants
Pimeleocoris roseus		Terrestrial	Fauna	Invertebra
Puccinellia raroflorens	Saltgrass	Terrestrial	Flora	Plants
Ramalina pollinaria		Terrestrial	Flora	Lichens
Simplicia laxa	Simplicia	Terrestrial	Flora	Plants
Sporophyla oenospora	Snout moth	Terrestrial	Fauna	Invertebra
Taraperla johnsi	stonefly	Freshwater	Fauna	Invertebra
Triglochin palustris	marsh arrow grass	Terrestrial	Flora	Plants
Vesicaperla trilinea	stonefly	Freshwater	Fauna	Invertebra
Zelandobius crawfordi	stonefly	Freshwater	Fauna	Invertebra
Zelandobius edwardsi	stonefly	Freshwater	Fauna	Invertebra
Zelandobius mariae	stonefly	Freshwater	Fauna	Invertebra
Carex cirrhosa	Curly Sedge	Terrestrial	Flora	Plants
Carex strictissima	Bastard grass, hook sedge	Terrestrial	Flora	Plants
Chaerophyllum colensoi var. d	mountain myrrh	Terrestrial	Flora	Plants
Chlidonias albostriatus	black-fronted tern, tarapi	Marine	Fauna	Birds
Crassula multicaulis		Terrestrial	Flora	Plants
Egretta sacra sacra	reef heron, matuku moan	Terrestrial	Fauna	Birds
Euchiton ensifer	Creeping Cudweed	Terrestrial	Flora	Plants
Galaxias "Nevis"	Nevis galaxias (Nevis Rive	Freshwater	Fauna	Fish
Galaxias aff. paucispondylus "N	Alpine galaxias (Manuher	Freshwater	Fauna	Fish
Galaxias anomalus	Central Otago roundhead	Freshwater	Fauna	Fish
Galaxias eldoni	Eldon's galaxias	Freshwater	Fauna	Fish
Galaxias pullus	Dusky galaxias	Freshwater	Fauna	Fish
Gratiola concinna		Terrestrial	Flora	Plants
Hypericum rubicundulum		Terrestrial	Flora	Plants
Kiwisaldula laelaps	shore bug	Freshwater	Fauna	Invertebra
Leucocarbo carunculatus	king shag, kawau,	Marine	Fauna	Birds
Maoricrambus oncobolus	Moth	Terrestrial	Fauna	Invertebra
Mazus novaezeelandiae subsp.	dwarf musk/matt leaved (	Terrestrial	Flora	Plants
Nestor notabilis	kea, kea,	Terrestrial	Fauna	Birds
Olearia hectorii	Deciduous tree daisy, Hec	Terrestrial	Flora	Plants
Oligosoma burganae	Burgan skink	Terrestrial	Fauna	Reptiles
Oligosoma grande	grand skink	Terrestrial	Fauna	Reptiles
Oligosoma otagense	Otago skink	Terrestrial	Fauna	Reptiles
Olinga fumosa	caddis	Freshwater	Fauna	Invertebra
Pseudoeconesus paludis	caddisfly	Freshwater	Fauna	Invertebra
Ranunculus acraeus		Terrestrial	Flora	Plants
Ranunculus brevis		Terrestrial	Flora	Plants
Senecio dunedinensis	Fireweed	Terrestrial	Flora	Plants
Veronica cupressoides	cypress hebe	Terrestrial	Flora	Plants
Wurmbea novae-zelandiae		Terrestrial	Flora	Plants
Althenia bilocularis		Terrestrial	Flora	Plants
Amphibromus fluitans	Water brome	Terrestrial	Flora	Plants
Anas superciliosa	grey duck, pārera,	Freshwater	Fauna	Birds
Asaphodes stinaria	Moth	Terrestrial	Fauna	Invertebra
Atriplex buchananii	Buchananâ€™s orache	Terrestrial	Flora	Plants
Carex albula	White Sedge	Terrestrial	Flora	Plants
Carex capillacea	Sedge	Terrestrial	Flora	Plants
Carex inopinata	grassy mat sedge	Terrestrial	Flora	Plants
Carex rubicunda	Sedge	Terrestrial	Flora	Plants
Carex uncifolia	Sedge	Terrestrial	Flora	Plants
Carmichaelia corrugata	common dwarf broom	Terrestrial	Flora	Plants
Carmichaelia crassicaulis subsp	slender coral broom	Terrestrial	Flora	Plants
Carmichaelia juncea		Terrestrial	Flora	Plants
Carmichaelia kirkii	climbing broom, Kirk's bro	Terrestrial	Flora	Plants
Carmichaelia nana	dwarf Broom	Terrestrial	Flora	Plants
Cephalissa siria	Moth	Terrestrial	Fauna	Invertebra
Convolvulus verecundus	Trailing bindweed, tussoc	Terrestrial	Flora	Plants
Coprosma obconica		Terrestrial	Flora	Plants
Declana toreuta		Terrestrial	Fauna	Invertebra
Edpercivalia tahatika	caddisfly	Freshwater	Fauna	Invertebra
Eryngium vesiculosum	Sea holly, coastal eryngo	Terrestrial	Flora	Plants
Eudynamys taitensis	long-tailed cuckoo, koeko	Terrestrial	Fauna	Birds
Falco novaeseelandiae novaes	eastern falcon, kārearea,	Terrestrial	Fauna	Birds
Galaxias "Pomahaka"	Pomahaka galaxias (Pom	Freshwater	Fauna	Fish
Galaxias "southern"	Southern flathead galaxia	Freshwater	Fauna	Fish
Galaxias aff. paucispondylus "S	Alpine galaxias (Southlan	Freshwater	Fauna	Fish
Galaxias depressiceps	Taieri flathead galaxias	Freshwater	Fauna	Fish
Galaxias gollumoides	Gollum galaxias	Freshwater	Fauna	Fish
Geotria australis	Lamprey	Freshwater	Fauna	Fish
Geranium retrorsum	turnip-rooted geranium	Terrestrial	Flora	Plants
Gingidiobora nebulosa	Moth	Terrestrial	Fauna	Invertebra
Hydroprogne caspia	Caspian tern, taranui,	Marine	Fauna	Birds
Hymenolaimus malacorhyncho	whio, blue duck, whio, kō	Freshwater	Fauna	Birds
Juncus pauciflorus	leafless rush	Terrestrial	Flora	Plants
Lachnagrostis tenuis	wind grass	Terrestrial	Flora	Plants
Leptospermum scoparium var.	manuka, tea tree, kahikat	Terrestrial	Flora	Plants
Libertia peregrinans	New Zealand iris, mikoikc	Terrestrial	Flora	Plants
Melicytus flexuosus		Terrestrial	Flora	Plants
Metrosideros diffusa	white rata	Terrestrial	Flora	Plants
Metrosideros umbellata	Southern rata	Terrestrial	Flora	Plants
Myosotis brevis		Terrestrial	Flora	Plants
Myosotis elderi		Terrestrial	Flora	Plants
Myosotis glauca		Terrestrial	Flora	Plants
Myosurus minimus subsp. nova	New Zealand mousetail, t	Terrestrial	Flora	Plants
Nestor meridionalis meridiona	South Island kākā, kākā, b	Terrestrial	Fauna	Birds
Olearia fimbriata		Terrestrial	Flora	Plants
Oligosoma aff. chloronoton "W	Lakes skinkwest Otago gr	Terrestrial	Fauna	Reptiles
Oligosoma aff. inconspicuum "I	North Otago skinkOteake	Terrestrial	Fauna	Reptiles
Oligosoma aff. waimatense "al	alpine rock skink	Terrestrial	Fauna	Reptiles
Oligosoma waimatense	scree skink	Terrestrial	Fauna	Reptiles
Orocrambus sophistes	Moth	Terrestrial	Fauna	Invertebra
Phocarctos hookeri	New Zealand sea lion	Marine	Fauna	Seals and
Pimelea sericeovillosa subsp. p	Cushion Pimelea	Terrestrial	Flora	Plants
Pittosporum obcordatum	Heart-leaved kohuhu	Terrestrial	Flora	Plants
Pittosporum patulum	Pitpat	Terrestrial	Flora	Plants
Podiceps cristatus australis	Australasian crested greb	Freshwater	Fauna	Birds
Porphyrio hochstetteri	South Island takahē, taka	Terrestrial	Fauna	Birds
Pseudoeconesus n. sp. T	caddisfly	Freshwater	Fauna	Invertebra
Ranunculus recens		Terrestrial	Flora	Plants
Ranunculus ternatifolius		Terrestrial	Flora	Plants
Raoulia monroi	fan-leaved mat daisy	Terrestrial	Flora	Plants
Sonchus novae-zelandiae	Dryland sow thistle	Terrestrial	Flora	Plants
Tetrachondra hamiltonii		Terrestrial	Flora	Plants
Theoxena scissaria	Moth	Terrestrial	Fauna	Invertebra
Trithuria brevistyla		Indigenous	Terrestria	Flora
Woodworthia "Raggedy"	Raggedy Range gecko	Terrestrial	Fauna	Reptiles
Xanthorhoe frigida	Looper moth	Terrestrial	Fauna	Invertebra
Anarhynchus frontalis	wrybill, ngutu-pare,	Freshwater	Fauna	Birds
Anas chlorotis	brown teal, pāteke,	Freshwater	Fauna	Birds

Appendix II: List of 58 nationally-threatened, freshwater-dependent species recorded in Otago by Thorsen (2022). Freshwater-dependence was determined based on 2 criteria.

	Latin name	Common names	Environment	Taxonomic group
1	*Ardea modesta*	white heron, kōtuku,	Freshwater	Birds
2	*Botaurus poiciloptilus*	Australasian bittern, matuku hūrepo,	Freshwater	Birds
3	*Brachyscome linearis*		Terrestrial	Plants
4	*Cardamine mutabilis*		Terrestrial	Plants
5	*Chenopodium detestans*	New Zealand fish-guts plant	Terrestrial	Plants
6	*Crassula peduncularis*		Terrestrial	Plants
7	*Eulimnadia marplesi*	clam shrimp	Freshwater	Invertebrates
8	*Galaxias "species D"*	Clutha flathead galaxias (Clutha River)	Freshwater	Fish
9	*Galaxias "Teviot"*	Teviot flathead galaxias (Teviot River)	Freshwater	Fish
10	*Galaxias cobitinis*	Lowland longjaw galaxias (Kakanui River)	Freshwater	Fish
11	*Himantopus novaezelandiae*	black stilt, kakī,	Freshwater	Birds
12	*Neochanna burrowsius*	Canterbury mudfish	Freshwater	Fish
13	*Nesoperla patricki*	stonefly	Freshwater	Invertebrates
14	*Oeconesus angustus*	caddisfly	Freshwater	Invertebrates
15	*Ourisia modesta*	Creeping Foxglove	Terrestrial	Plants
16	*Puccinellia raroflorens*	Saltgrass	Terrestrial	Plants
17	*Taraperla johnsi*	stonefly	Freshwater	Invertebrates
18	*Triglochin palustris*	marsh arrow grass	Terrestrial	Plants
19	*Zelandobius crawfordi*	stonefly	Freshwater	Invertebrates
20	*Zelandobius edwardsi*	stonefly	Freshwater	Invertebrates
21	*Zelandobius mariae*	stonefly	Freshwater	Invertebrates
22	*Carex cirrhosa*	Curly Sedge	Terrestrial	Plants
23	*Chaerophyllum colensoi var. delicatulum (CH*	mountain myrrh	Terrestrial	Plants
24	*Chlidonias albostriatus*	black-fronted tern, tarapirohe, tarapiroe	Marine	Birds
25	*Crassula multicaulis*		Terrestrial	Plants
26	*Euchiton ensifer*	Creeping Cudweed	Terrestrial	Plants
27	*Galaxias "Nevis"*	Nevis galaxias (Nevis River)	Freshwater	Fish
28	*Galaxias aff. paucispondylus "Manuherikia"*	Alpine galaxias (Manuherikia River)	Freshwater	Fish
29	*Galaxias anomalus*	Central Otago roundhead galaxias	Freshwater	Fish
30	*Galaxias eldoni*	Eldon's galaxias	Freshwater	Fish
31	*Galaxias pullus*	Dusky galaxias	Freshwater	Fish
32	*Gratiola concinna*		Terrestrial	Plants
33	*Maoricrambus oncobolus*	Moth	Terrestrial	Invertebrates
34	*Mazus novaezeelandiae subsp. impolitus f. in*	dwarf musk/matt leaved mazus	Terrestrial	Plants
35	*Olinga fumosa*	caddis	Freshwater	Invertebrates
36	*Pseudoeconesus paludis*	caddisfly	Freshwater	Invertebrates
37	*Ranunculus brevis*		Terrestrial	Plants
38	*Althenia bilocularis*		Terrestrial	Plants
39	*Amphibromus fluitans*	Water brome	Terrestrial	Plants
40	*Anas superciliosa*	grey duck, pārera,	Freshwater	Birds
41	*Carex capillacea*	Sedge	Terrestrial	Plants
42	*Carex rubicunda*	Sedge	Terrestrial	Plants
43	*Edpercivalia tahatika*	caddisfly	Freshwater	Invertebrates
44	*Galaxias "Pomahaka"*	Pomahaka galaxias (Pomahaka River)	Freshwater	Fish
45	*Galaxias "southern"*	Southern flathead galaxias (Southland, Otago)	Freshwater	Fish
46	*Galaxias aff. paucispondylus "Southland"*	Alpine galaxias (Southland)	Freshwater	Fish
47	*Galaxias depressiceps*	Taieri flathead galaxias	Freshwater	Fish
48	*Galaxias gollumoides*	Gollum galaxias	Freshwater	Fish
49	*Geotria australis*	Lamprey	Freshwater	Fish
50	*Hymenolaimus malacorhynchos*	whio, blue duck, kōwhiowhio	Freshwater	Birds
51	*Podiceps cristatus australis*	Australasian crested grebe, pūteketeke, kāmana	Freshwater	Birds
52	*Pseudoeconesus n. sp. T*	caddisfly	Freshwater	Invertebrates
53	*Ranunculus recens*		Terrestrial	Plants
54	*Trithuria brevistyla*		Indigenous	Flora
55	*Anarhynchus frontalis*	wrybill, ngutu-pare,	Freshwater	Birds
56	*Anas chlorotis*	brown teal, pāteke,	Freshwater	Birds
57	*Kiwisaldula laelaps*	shore bug	Freshwater	Invertebrates
58	*Vesicaperla trilinea*	stonefly	Freshwater	Invertebrates