

## Memo

Date	21.05.2019
To	Andrea Richardson, Senior Planner
CC	Peter Constantine, ECan
From	Duncan Gray, ECan and Richard Allibone, Waterways Consulting

## Prioritisation of native aquatic species habitat for protection under the LWRP Omnibus plan change

### Introduction

Aquatic habitat in Canterbury supports a range of native freshwater fish and the mega macroinvertebrates kēkēwai (crayfish) and kākahi (freshwater mussel). Loss of habitat, barriers to fish passage, water quality and water quantity issues present management challenges when we seek to protect this freshwater fauna while providing for human use. Resource management plans in Canterbury set rules for the use of water, standards for the quality of water in aquatic systems and regulate activities that occur within and adjacent to aquatic areas. As such the Land and Water Regional Plan (LWRP) for Canterbury is an appropriate framework through which to provide protection for the habitat of threatened species.

Allibone & Gray (2019) review the biodiversity value and distributions of indigenous freshwater fish, kēkēwai and kākahi in the Canterbury region. The report identifies the geographic distribution of species and provides information on the critical habitat requirements of these species and/or populations. This memo details a prioritisation process undertaken on the information in Allibone & Gray (2019) to establish a list of taxa and their distribution appropriate for protection under the LWRP Omnibus plan change.

### Distribution data

Allibone & Gray (2019) use distributional data for fish and macroinvertebrates derived from the New Zealand Freshwater Fish Database (NZFFD), online surveys conducted by the Canterbury Regional Council and other data provided by universities, Crown Research Institutes and consultancies. These data were entirely composed of point locations, which indicate the location that a taxon has been observed.

### Historical data

The NZFFD survey records have a broad date range with the earliest record from 1920, and the frequency of records being submitted to the NZFFD increasing over time especially since the 1980s. Currently, the majority of records submitted in Canterbury focus on threatened taxa in the Waitaki River catchment and Canterbury mudfish.

An important consideration to be made when using NZFFD records to create fish distribution maps, is applying a cut-off point for when to consider a record may no longer provide

information on what is present at a location today. Many fish species are considered threatened and population loss or reductions can be expected to be occurring. To explore the implications of excluding historic data on fish distributions, the 1<sup>st</sup> January 2000 was set as an arbitrary cut-off date with records older than this date considered historic and not used for planning maps.

For the highly threatened galaxiids, dropping the older records had very little effect on their distributions. This is because the majority, if not all, of the survey efforts for these species has occurred since 1<sup>st</sup> January 2000. Whereas, the removal of historic Canterbury mudfish records discards some sites from the species' mapped distribution. However, the fish species is now likely extinct at many of these locations. The Department of Conservation and other parties maintain a survey programme for the Canterbury mudfish, and many sites are revisited within 5-10 years of previous surveys. This means that the survey data for extant populations is current. In addition, Dunn (2019) provides occupancy area maps for several non-migratory galaxid species and, therefore, fish locations do not rely on the NZFFD records alone.

The use of a pre-2000 cut-off results in a substantial reduction in the number of records for fish species on the Canterbury Plains and coastal areas. It appears survey effort has been limited in these areas in the last 18 years. Some of the species affected, such as upland bully, common bully, black flounder and common smelt, are considered Not Threatened using the conservation status defined by Dunn et al., (2018). Therefore, the relative absence of current records of these species is presumed due to the lack of survey effort, rather than a decline in populations. For Threatened or At-Risk taxa, such as giant bully, torrentfish, bluegill bully, koaro, longfin eel, lamprey and inanga, there is a loss of records using the 2000 cut-off, but old records have been replaced with more recent survey data in nearby locations and so populations are represented in distribution maps derived from a pre-2000 cutoff.

Giant and shortjaw kokopu exist at very few locations in Canterbury and the majority of records are for one or two individuals at a survey location. The only known breeding population of giant kokopu is the landlocked population at Horseshoe Lagoon in the lower Orari catchment for which there are records post year 2000. For shortjaw kokopu, two of the three records from coastal streams north of Kaikoura are post year 2000.

Kākahi (freshwater mussel) records were derived from the NZFFD, data from consultancies and Universities and an online survey. Many of these records are pre-2000. Using a cut-off point of January 2000 removes 42% of records of kākahi in Canterbury. The vast majority of historic records come from Lake Coleridge, but this population is also represented by surveys subsequent to 2000. Many other historic mussel records were recorded from middens and do not constitute living populations. The Hinds drains area contained numerous anecdotal records of kākahi pre-1990, but this area has undergone substantial sampling recently and no kākahi have been found. In addition, streams in this area currently experience low flows and extremely elevated nitrate concentrations. Several small high-country lakes have historic records of kākahi. There has been little change in these lakes over the intervening time and so it is recommended that these specific records be retained for the purpose of distribution maps in the LWRP.

Kēkēwai (freshwater crayfish) data have been compiled in the same way as kākahi. However, only 24% of records are derived from pre-2000. These pre-2000 records include historic observations of populations in the Hinds drains area that are assumed to be extinct. In addition, a number of other widely dispersed populations are excluded by the 2000 cut-off. These populations may well have been extirpated.

A special case could be made for the retention of historic records for some species. Firstly, Stokell's smelt, common smelt and black flounder records would be significantly reduced in number if pre-2000 records were not used to produce distribution maps. The absence of river mouth fish surveys in Canterbury, except the Waitaki River, means these fish have not been reported at the majority of historic locations since the early 1990s. Therefore, for these species all records from all dates should be used to define their distribution. Redfin bully and banded kokopu also exist in restricted areas near Kaikoura, Banks Peninsula and South Canterbury. Survey work in these areas for these populations has been limited and as such all data for these populations should be used to define their distributions.

### **Taxa prioritisation list**

A spreadsheet (see Appendix 1) of threat status criteria, life history information and distributional information was analysed to help prioritise taxa for protection. The information was used to create the following flow/decision diagrams.

Figure 1 shows a breakdown of taxa into broad national and Canterbury specific threat status groups.

Group 1 includes the threatened fish classified as 'Nationally Critical', 'Nationally Endangered' and 'Nationally Vulnerable'. There are sixteen fish species across New Zealand considered to be nationally critical, endangered or vulnerable and eight of those taxa are found in Canterbury. The majority of these fish are non-migratory galaxiids entirely restricted to Canterbury.

Nationally Critical taxa are those with a very small population; a small population (natural or unnatural) with moderate ongoing decline; or any population with a very high decline. Nationally endangered taxa are those which have a (natural or unnaturally) small population with low to high ongoing decline; small (unnatural), stable population; or moderate population undergoing high rate of decline.

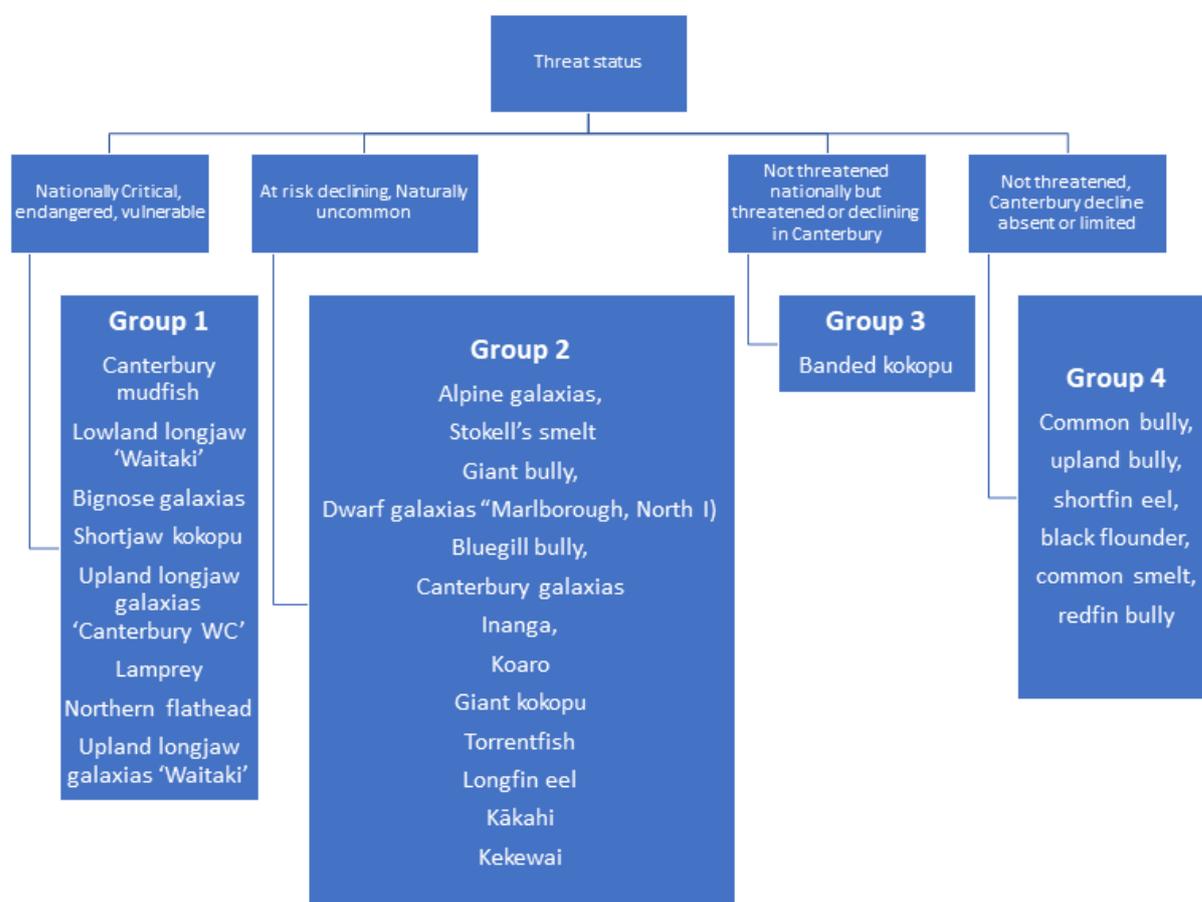
Nationally Vulnerable taxa have an unnaturally small, increasing population; unnaturally moderate stable population; or moderate population that is declining. A very small population is considered to be less than 250 mature individuals. A small population is 250 to 1,000 mature individuals, whereas a moderate population is 1000 to 5000 mature individuals (Townsend et al., 2008).

Group 2 includes taxa classified as 'At Risk, Declining' or 'Naturally Uncommon'. These are taxa that have moderate to large populations and predicted ongoing decline; a large population and low to moderate ongoing decline; or very large population and low to high ongoing decline (Townsend et al., 2008). A moderate to large population is considered to be 5,000 to 20,000 mature individuals, whereas a large to very large population is 20,000 to 100,000 mature

individuals, and a very large population is greater than 100,000. Naturally uncommon taxa are those with a distribution confined to a specific geographical area or which occur within small and widely scattered populations, where this distribution is not the result of human disturbance.

Group 3 contains taxa that are not threatened nationally but, are currently threatened or declining in Canterbury. This status is not described in Dunn et al. (2018) but, was derived from the information in Allibone & Gray (2019).

Group 4 contains taxa that are Not Threatened nationally and stable in Canterbury.



**Figure 1:** Taxa categorised by national and Canterbury specific threat status

The Nationally Endangered and Vulnerable taxa (Group 1) are further classified by their distribution in Canterbury or elsewhere in Figure 2. Four fish taxa are entirely restricted to Canterbury, and in fact to the Waitaki River catchment (Group 1a). The Canterbury mudfish has greater than 95% of its population in Canterbury and is the only taxa found within Group 1b. The northern flathead galaxias has a naturally restricted range that makes it rare in Canterbury with the majority of its population in Marlborough (Group 1c). Group 1d are fish

species assumed to be historically widely distributed in Canterbury but, are now rare both regionally and nationally.

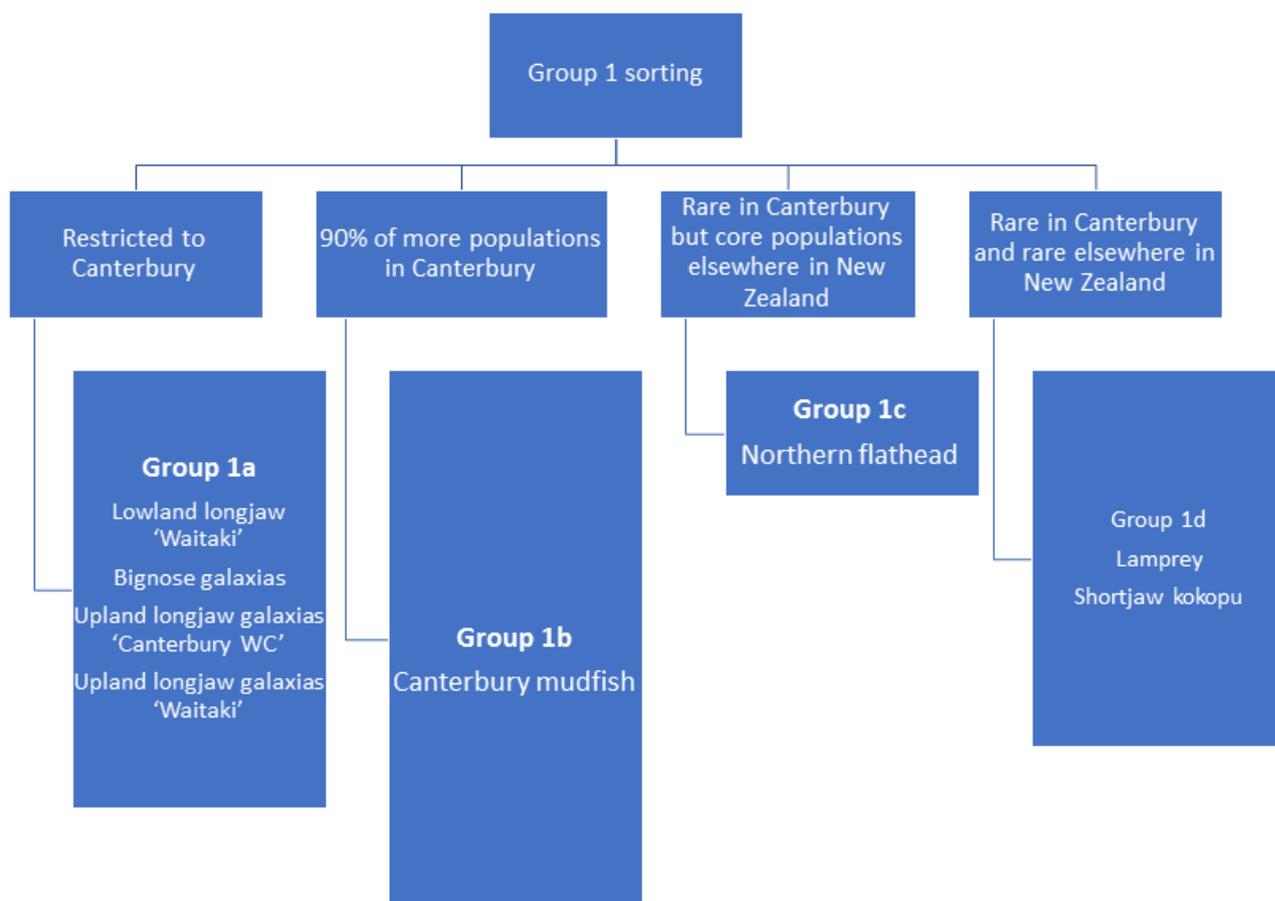


Figure 2. Nationally endangered and vulnerable taxa classified by geographical distribution.

At Risk taxa, Group 2, can be further sub-divided by threat status and geographical distribution (Figure 3). Group 2a contains a single At Risk species that is entirely restricted to Canterbury, while Group 2b contains a taxon that is only considered declining nationally, but is critically threatened in Canterbury. Group 2c are taxa primarily only present in Canterbury (>90% of populations). Group 2d is a taxon considered to be naturally rare or restricted in Canterbury, with core populations found elsewhere in New Zealand. Group 2e contains seven taxa, including the mega macroinvertebrates kēkēwai and kākahi, that are declining both nationally and in Canterbury. Finally, Group 2f contains a species that is naturally uncommon, but populations appear stable in Canterbury.

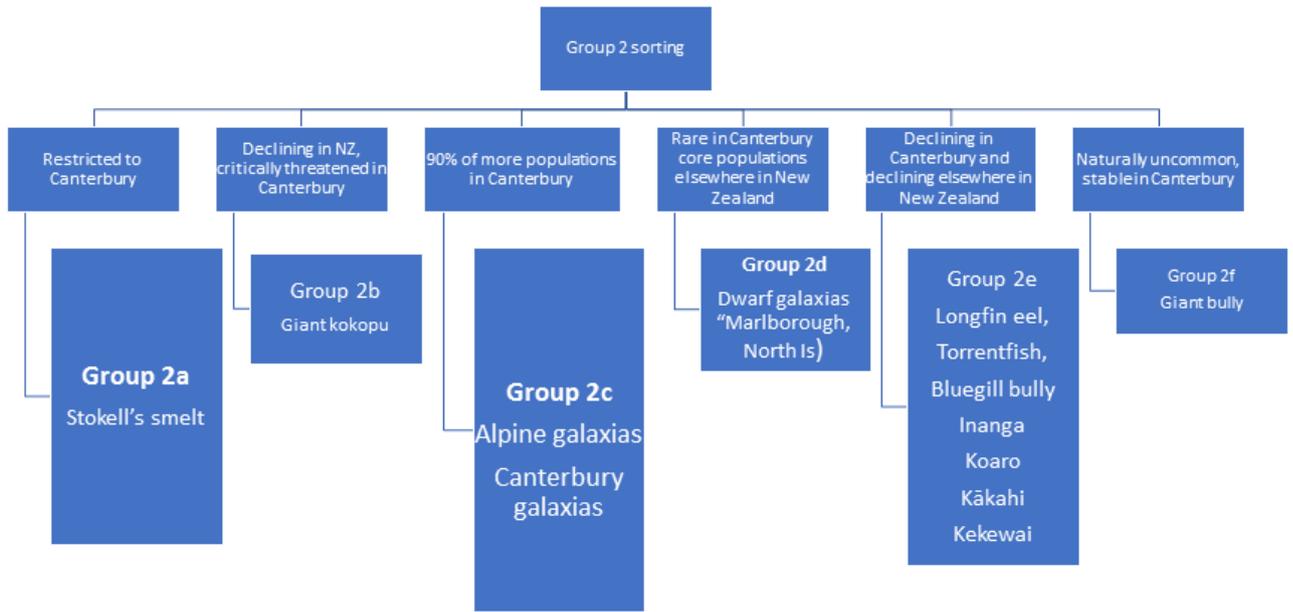


Figure 3. At Risk taxa, classified by threat status and geographical distribution.

Group 3 contained a single species, banded kokopu, which is considered to be stable and not threatened nationally but, is threatened and declining in Canterbury.

Figures 2 and 3 classify taxa based on national and regional threat status and geographical distribution. However, the broad suite of taxa threat groupings can also be classified according to jurisdictional boundaries. Specifically, whether populations occur within Protected Crown Land (PCL) or on privately owned land.

There are eight Nationally Threatened (Critical, Endangered or Vulnerable) taxa found in

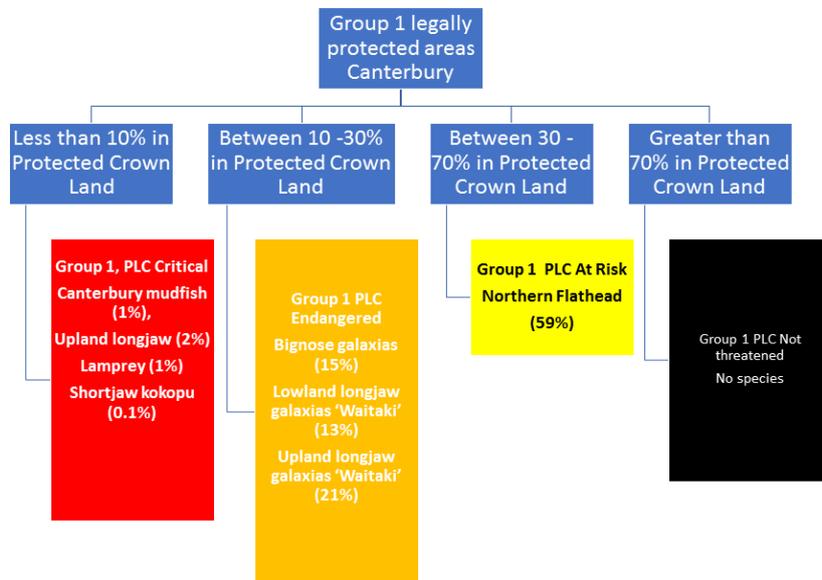


Figure 4). Four of these taxa, Canterbury mudfish, upland longjaw, lamprey and shortjaw kokopu, have less than 10% of records or habitat areas protected within PCL, and are considered "PCL critical". Protection of their habitats defaults primarily to regional land and water plans. Bignose galaxias, lowland longjaw (Waitaki) and upland longjaw (Waitaki) are considered "PCL endangered" (10-30% in PCL). Northern flathead galaxias, which in Canterbury is primarily found within the Department of Conservation administered Molesworth Station, has 59% of its habitat within PCL and is considered "PCL At Risk".

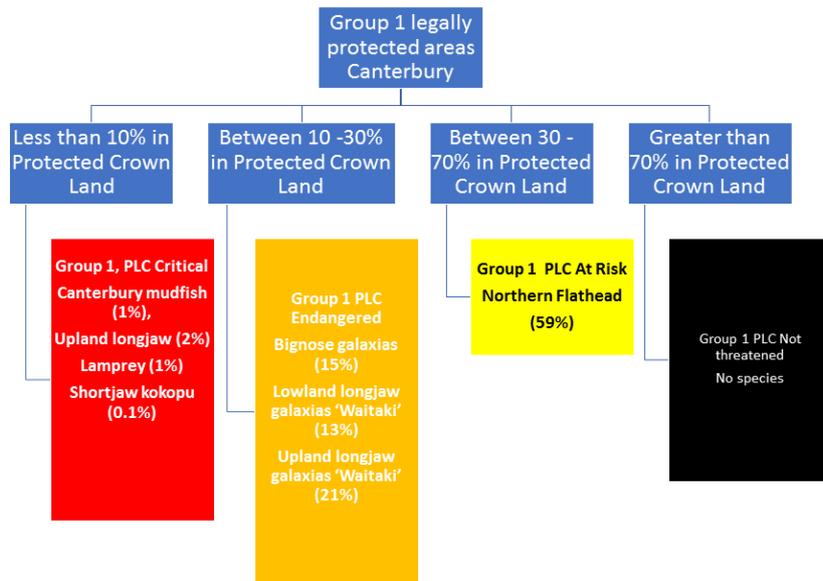


Figure 4. Nationally threatened taxa (Group 1) classified according to the proportion of population records or habitat area within Protected Crown Land.

Group 2, or At Risk taxa can similarly be classified according to jurisdictional status (Figure 5). Eight taxa considered At Risk – declining are also PCL critical having greater than 90% of populations in Canterbury occurring on private land. A further three taxa are PCL endangered being 10-30% protected within Department of Conservation estate. Finally, 61% of dwarf galaxias “northern” occur within the PCL.

Group 3 consists of a single taxon, banded kokopu, with 0.1% of its Canterbury population records within PCL and so is considered “PCL critical”.

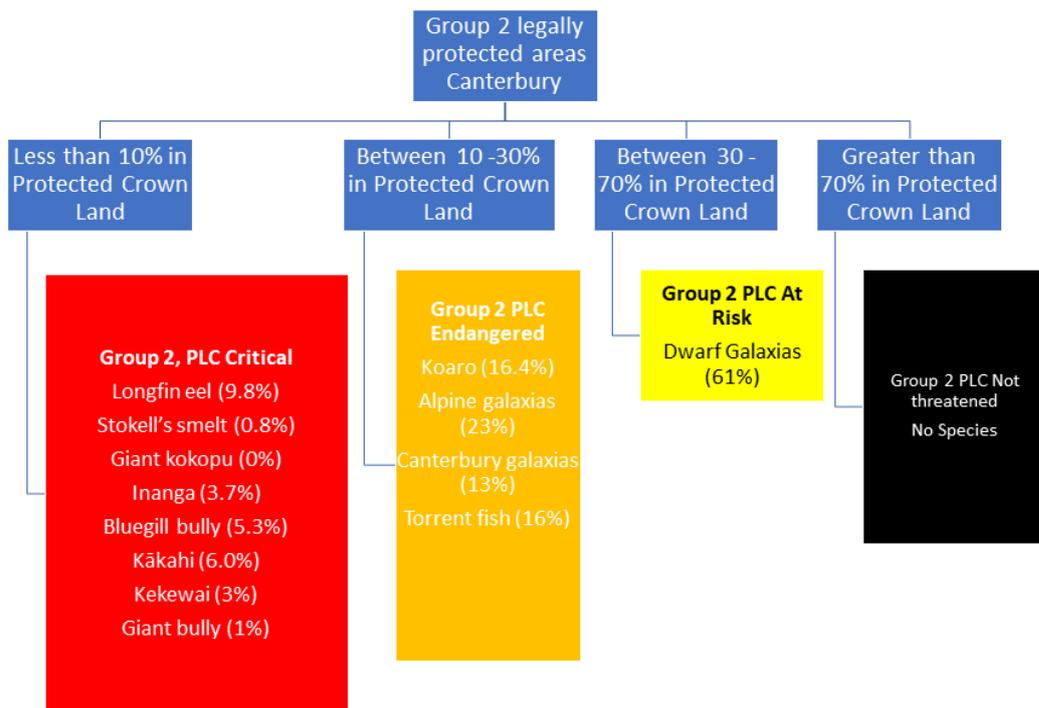


Figure 5. At Risk taxa classified according to proportion of populations or habitat area on Protected Crown Land (PCL).

The preceding classification provides a means to prioritise fish and mega macroinvertebrate taxa for protection (if prioritisation is deemed necessary). However, in addition to threat and jurisdictional status or geographical distribution, it is important to consider the natural history and habitat requirements of taxa. To effectively protect populations, it is important to understand critical habitat or lifecycle requirements. Allibone & Gray (2019) provide a review of the critical habitat requirements of fish and mega macroinvertebrate taxa found in Canterbury. This information is summarised in Figure 6. Five categories of habitat/lifecycle protection are presented, but it should be noted that this list is not exhaustive and that categories are not mutually exclusive. Several taxa appear in multiple boxes highlighting the various threats contingent upon these populations.

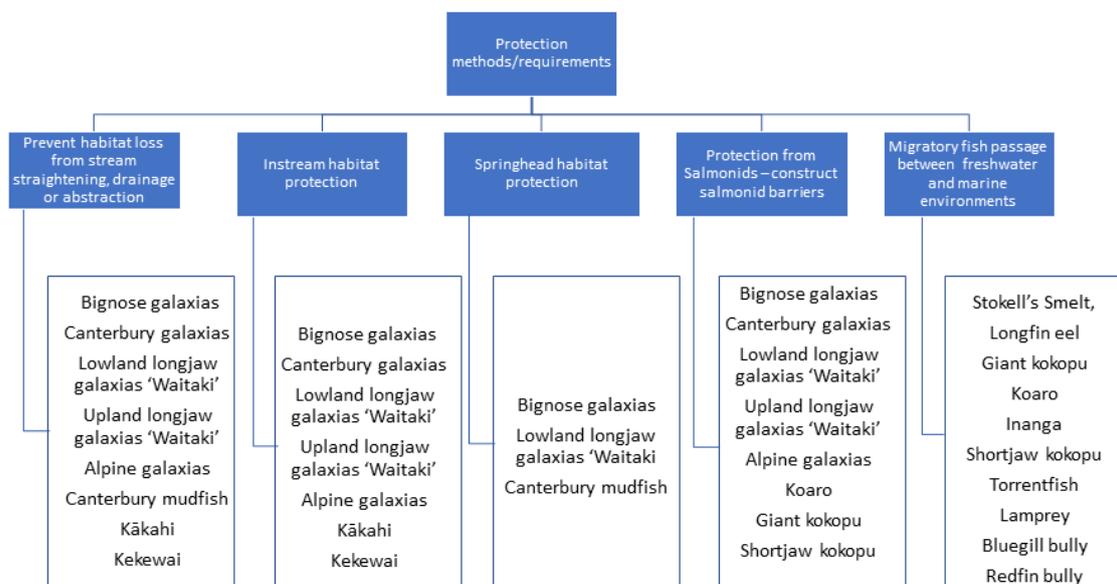


Figure 6. Critical protection methods and requirements for threatened native fish. Adapted from Allibone & Gray (2019).

## Results from categorisation

Species were prioritised for protection according to the following criteria (see Appendix 1)

- High priority = Nationally Critical, Endangered or Vulnerable OR; Very restricted or Sparse in Canterbury; AND less than 10% in PCL.
- Medium priority = At Risk OR; restricted or Unknown in Canterbury; AND less than 10% populations in PCL
- Low priority = All other fish

This process resulted in a list of eleven high priority taxa:

- Canterbury Mudfish
- Bignose galaxias
- Lowland longjaw galaxias (Waitaki)
- Upland longjaw galaxias
- Upland longjaw galaxias (Waitaki)
- Northern Flathead
- Giant kokopu
- Shortjaw kokopu
- Lamprey (spawning habitat only)
- Freshwater mussel
- Freshwater crayfish

These taxa are considered to have the highest priority for protection. However, that is not say that other species are not also threatened or in decline and would benefit for mechanisms to preserve their habitat or facilitate their lifecycles. Nine of these species' distributions have been provided by Dunn (2019). The remaining three species distributions have been mapped using an analogous method detailed in Appendix 2.

## References

Allibone, R.A. and Gray, D.P. (2019). Critical habitat for Canterbury freshwater fish, kēkēwai/kēkēwai and kākahi. Report prepared for Canterbury Regional Council by Waterways Consulting Ltd. P69.

Dunn, N.R. (2019). Mapping of non-migratory freshwater fish habitat fragment distributions. New Zealand Department of Conservation P22.

Dunn, N. R., Allibone, R. A., Closs, G. P., Crow, S. K., David, B. O., Goodman, M. J., Griffiths, M., Jack, D. C., Ling, N., Waters, J. M., Rolfe, J.R. (2018). Conservation status of New Zealand Freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation Wellington.

Townsend, A.J., de Lange, P.J., Duffy, C.A.J., Miskelly, C.M., Molloy, J., and Norton, D.A. (2008). New Zealand threat classification system manual. Department of Conservation, Wellington 35p.

<b>External review:</b>	Tanya Blakely, Boffa Miskell	April, 2019
<b>Approved for release:</b>	Tim Davie, Chief Scientist	May, 2019

## Appendix 1

### Indigenous freshwater taxa national and regional threat status, jurisdiction, life-cycle, habitats, distribution, threats and supportive actions

Taxa	Common name	DOC threat status	Taxa restricted to Canterbury waterbodies?	How common is population in Canterbury	Impact on distribution if historic records removed (i.e. older than 1 Jan 2000)	% of records/ area in Canterbury Protected Crown Land (PCL)	Current priority for protection of taxa and habitats in Canterbury (and threat grouping)	Description of lifecycle	Habitat and distribution	Primary issues that threaten taxa and habitat	Priority actions recommended to support protection of taxa and habitat
<b>Fish Species</b>											
<i>Anguilla dieffenbachii</i>	Longfin eel	At Risk Declining	No	Common	Loss of 42% of records, limited change in geographic range.	10%	<b>Medium (Group 2e)</b>	Migratory. Spawning at sea, larval stage at sea, juvenile stage (elver) freshwater, adult freshwater	Rivers, lakes, wetlands, including high country and lowland areas. Nationally distributed, but more common in the South Island, Stewart Island.	Loss of fish passage due to structures and flows; loss of habitat (juvenile/adult stage); commercial harvest	Remove barriers to fish passage (e.g. perched culverts). Remediate downstream turbine mortality at hydro-electric power stations. Provide downstream fish passage at irrigation storage dams. Prevent loss of habitat caused by damage/destruction of the riverbed. Rehabilitate habitat.
<i>Cheimarrichthys fosteri</i>	Torrentfish	At Risk Declining	No	Common	Loss of 62% of records, limited change in geographic range.	16%	<b>Medium (Group 2e)</b>	Migratory. Spawning freshwater, larval stage at sea, juvenile and adult freshwater	Riffle habitat, lowland to high country rivers. Nationwide patchy distribution	Loss of fish passage due to structures and flow; loss of habitat via water abstraction, riverbed damage/modifications	Remediate barriers to fish passage, particularly flow-related barriers (increased river reach drying in late summer and autumn) and perched culverts. Ensure sufficient stream flows and substrate availability to protect fast riffle habitat.

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<i>Galaxias argenteus</i>	Giant kokopu	At Risk declining	No	Very restricted	Loss of 3% of records, loss of isolated sites with single individual fish recorded.	0%	<b>High (Group 2b)</b>	Migratory. Spawning freshwater, larval stage at sea, juvenile and adult share freshwater habitat. Can complete life cycle in freshwater with larval rearing in lentic environments.	Pool, deep run habitat with good fish cover and prefers shaded rivers. Nationwide, but patchy and most abundant in native forested lowland rivers without salmonids. Also found on Stewart Island, Chatham Island, possibly other off shore islands	Loss of fish passage, loss of habitat via water abstraction, river modifications, predation by introduced fish, loss of terrestrial spawning habitat	Protection of riparian spawning habitat. Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish.
<i>Galaxias brevipinnis</i>	Koaro	At Risk Declining	No	Common	Loss of 29% of records, limited change in geographic range.	16%	<b>Medium (Group 2e)</b>	Migratory. Spawning freshwater, larval stage at sea, juvenile and adult freshwater. Can complete life cycle in freshwater with larval rearing in lentic environments	Riffle habitat in streams, also high-country lakes. Nationwide, but absent from lowland rivers in modified areas	Loss of fish passage, loss of habitat via water abstraction, river modifications, predation by introduced fish	Provision of fish passage appropriate for a climbing fish species. Protection of riffle habitat. Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish. Prevent further expansion of predatory fish.

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<i>Galaxias divergens</i> 'Marlborough, North Island	Dwarf galaxias	At Risk Declining	No	Very restricted	Loss of 25% of records, no change in geographic range	61%	<b>Medium (Group 2d)</b>	Non-migratory	Riffle habitat. Clarence River, Canterbury and much of west coast, Nelson Marlborough South Island and areas of the North Island	Loss of habitat due to abstraction of surface water, river/stream modifications, habitat damage due to land use change, predation by introduced fish	Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish.
<i>Galaxias maculatus</i>	Inanga	At Risk Declining	No	Common	Loss of 51% of records, limited change in geographic range	4%	<b>Medium (Group 2e)</b>	Migratory. Spawning in terrestrial vegetation flooded by tides in estuaries, larval stage at sea, juvenile and adult freshwater.	Coastal rivers, streams, wetlands. NZ wide, Stewart Island, Chatham Is and off shore Is.	Barriers to fish passage at river mouths, loss/degradation of spawning habitat in lowland streams	Maintain fish passage. Protection/remediation of spawning areas from physical damage and vegetation removal
<i>Galaxias vulgaris</i>	Canterbury galaxias	At Risk Declining	No	Restricted	Loss of 22% of records, limited change in geographic range	13%	<b>Medium (Group 2c)</b>	Non-migratory	Riffle habitat, lowland and high-country streams, Canterbury, also North Otago and localised areas of Buller catchment	Impact of salmonids, habitat loss via water abstraction, habitat modification	Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish. Prevent further expansion of predatory fish.

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<i>Gobiomorphus hubbsi</i>	Bluegill bully	At Risk Declining	No	Common	Loss of 65% of records, but little change in geographic distribution.	5%	<b>Medium (Group 2e)</b>	Migratory. Spawning freshwater, larval rearing at sea, juvenile rearing freshwater, adult freshwater.	Riffle habitat, lowland to mid reaches of river, more prevalent in rivers without long tidal or lagoon systems. Wide spread but patchy throughout North and South Islands.	Habitat loss via water abstraction, especially in smaller rivers and streams. Barriers to fish passage	Maintain fish passage Maintain riffle habitat
<i>Gobiomorphus huttoni</i>	Redfin bully	Not threatened	No	Restricted	Loss of 51% of records, limited change in geographic range. Post 1 Jan 2000 records restricted to Banks Peninsula and Kaikoura coastal streams, therefore use all records.	0%	<b>Medium (Group 4)</b>	Migratory. Spawning freshwater, larval rearing at sea, juvenile rearing freshwater, adult freshwater.	Run habitat in streams and rivers. South Island and North Island, Stewart Island, Chatham Island.	Barriers to fish passage. Loss of habitat via abstraction and river channel modification	Maintain fish passage

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<i>Galaxias cobitinis</i> 'Waitaki'	Lowland longjaw galaxias 'Waitaki'	Nationally Endangered	Yes	Very restricted	Loss of 2% of records, loss of historic extinct populations in Hakataramea River	13%	<b>High (Group 1a)</b>	Non-migratory	Spring fed streams, Mackenzie Basin, Hakataramea River	Loss of habitat via water abstraction. River/stream modifications, damage due to land use change, predation by introduced fish	Protect habitat from hydrological modification. Landowner education. Prevent physical habitat modification. Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish.
<i>Neochanna burrowsius</i>	Canterbury mudfish	Nationally Critical	No	Very restricted	Loss of 14% of records, limited change in geographic range, some losses reflect actual population losses	1%	<b>High (Group 1b)</b>	Non-migratory	Wetland, small streams, water races, lowland Canterbury. A single population outside of Canterbury.	Loss of habitat via localised water abstraction, loss of habitat via drainage and infilling, impacts of predatory fish.	Protect habitat from hydrological modification. Landowner education. Prevent physical habitat modification. Protect spawning and aestivation habitat. Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish including koaro and eel.
<i>Galaxias macronasus</i>	Bignose galaxias	Nationally Vulnerable	Yes	Very restricted	No change in records, all post-date 1 Jan 2000	15%	<b>High (Group 1a)</b>	Non-migratory	Spring fed streams, Mackenzie Basin, Hakataramea River	Loss of habitat via localised water abstraction, loss of habitat via drainage and infilling, other physical modification of habitat, impacts of predatory fish.	Protect habitat from hydrological modification. Landowner education. Prevent physical habitat modification. Retention of fish passage barriers that prevent salmonid or other

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											predatory fish invasion. Remove predatory fish.
<i>Galaxias prognathus</i>	Upland longjaw galaxias	Nationally Vulnerable	Yes	Very restricted	Loss of 18% of records, limited change in geographic range, loss of lower altitude sites.	2%	<b>High (Group 1a)</b>	Non-migratory	Rakaia and Rangitata headwaters including tributaries. Historic record from one trib. of the Hurunui River, believed extinct at this site. Only population outside of Canterbury - Maruia River now believed extinct.	Loss of habitat via localised water abstraction, impact of salmonids. Habitat loss low due to majority of populations in low intensity farming areas or Crown land	Protect habitat from hydrological modification. Landowner education. Prevent physical habitat modification. Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish.
<i>Galaxias prognathus</i> 'Waitaki'	Upland longjaw galaxias 'Waitaki'	Nationally Vulnerable	Yes	Very restricted	Loss of 18% of records, no change in geographic range	21%	<b>High (Group 1a)</b>	Non-migratory	Spring fed streams, Mackenzie Basin, primarily upstream of natural glacial lakes.	Impact of salmonids. Habitat loss low due to majority of populations in low intensity farming areas or Crown land	Protect habitat from hydrological modification. Landowner education. Prevent physical habitat modification. Retention of fish passage barriers that prevent salmonid or other

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											predatory fish invasion. Remove predatory fish.
<i>Galaxias postvectis</i>	Shortjaw kokopu	Nationally Vulnerable	No	Very restricted	Loss of 50% of records, limited change in geographic range, still restricted to streams from Clarence River to Kaikoura.	0%	<b>High (Group 1d)</b>	Migratory. Spawning freshwater, larval stage at sea, juvenile and adult freshwater.	Pool habitat coastal streams. North and South Islands aside from east coast areas. Prefers native forest areas. Only sites in Canterbury in Kaikoura area. Historic records, no recent records.	Loss of fish passage (particularly to/from sea), loss of habitat via water abstraction, river modifications, predation by introduced fish, loss of terrestrial spawning habitat	Protect riparian vegetation, provide good stream-side shade for spawning. Maintain fish passage.
<i>Galaxias spn</i>	Northern flathead	Nationally Vulnerable	No	Restricted	Loss of 9% of records historic	59%	<b>High (Group 1c)</b>	Non-migratory	Riffle habitat, Clarence River Canterbury, Marlborough and Nelson	Impact of salmonids	Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish. Prevent further expansion of predatory fish.

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<i>Geotria australis</i>	Lamprey	Nationally Vulnerable	No	Unknown	Loss of 68% of records, significant reduction in survey data but limited change in geographic range	1%	<b>High (Group 1d)</b>	Migratory. Spawning freshwater, larval rearing freshwater, juvenile rearing/migratory on freshwater, adult at sea.	Juvenile habitat in backwaters, pools and runs, buried in sediment. Known spawning areas Banks Peninsula and Christchurch, other areas of spawning undiscovered but likely to be widespread in Canterbury, but rare. Lamprey present throughout NZ, Stewart Is, Chatham Island	Loss of fish passage, disease, physical and hydrological impacts on spawning areas	Maintain fish passage. Protect known spawning areas. Landowner education
<i>Galaxias paucispondylus</i>	Alpine galaxias	At Risk Naturally Uncommon	No	Restricted	Loss of 12% of records, limited change in geographic range	23%	<b>Medium (Group 2c)</b>	Non-migratory	Canterbury high country streams and rivers, glacier, snow and rain fed. Limited occurrence in Marlborough	Impacts of salmonids	Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish. Prevent further expansion of predatory fish.

Taxa	Common name	DOC threat status	Taxa restricted to Canterbury waterbodies?	How common is population in Canterbury	Impact on distribution if historic records removed (i.e. older than 1 Jan 2000)	% of records/ area in Canterbury Protected Crown Land (PCL)	Current priority for protection of taxa and habitats in Canterbury (and threat grouping)	Description of lifecycle	Habitat and distribution	Primary issues that threaten taxa and habitat	Priority actions recommended to support protection of taxa and habitat
<i>Stokellia anisodon</i>	Stokell's smelt	At Risk- Naturally Uncommon	Yes	Restricted	Loss of 96% of records, post 1 Jan 2000 limits species to the Waitaki River, therefore use all records.	1%	<b>Medium (Group 2a)</b>	Migratory. Spawning freshwater, larval, juvenile rearing at sea, adult freshwater.	Coastal rivers and streams, most abundant in large braided rivers - Rangitata, Ashurton, Rakaia. Restricted to Canterbury	Fish passage at river mouths, unknown if other issues are present	Maintain natural periodicity of river mouth opening.
<i>Anguilla australis</i>	Shortfin eel	Not Threatened	No	Common	Loss of 29% of records, no change in geographic range.	8%	<b>Low (Group 4)</b>	Migratory. Spawning at sea, larval stage at sea, juvenile stage (elver) freshwater, adult freshwater	Predominately lowland rivers, lakes, wetlands, National distribution possibly increasing	Loss of fish passage, loss of habitat	Protect or remediate lowland stream and wetland habitat.
<i>Galaxias fasciatus</i>	Banded kokopu	Not threatened	No	Restricted	Loss of 43% of records, limited change in geographic range. Post 1 Jan 2000 records limits species to Banks Peninsula and Kaikoura coastline therefore use all records.	0%	<b>Medium (Group 3)</b>	Migratory. Spawning freshwater, larval stage at sea, juvenile and adult freshwater. Can complete life cycle in freshwater with larval rearing in lentic environments	Pool dweller, small streams, wetlands, South Canterbury, Kaikoura and Banks Peninsula. Wide spread around NZ and Stewart Island, Chatham Island and offshore islands, more abundant in	Loss of fish passage, loss of forested stream habitat. Hydrological alteration via water abstraction, river modifications, predation by introduced fish, loss of terrestrial spawning habitat	Protect riparian vegetation, provide good stream side shade for spawning, maintain fish passage

Taxa	Common name	DOC threat status	Taxa restricted to Canterbury waterbodies?	How common is population in Canterbury	Impact on distribution if historic records removed (i.e. older than 1 Jan 2000)	% of records/ area in Canterbury Protected Crown Land (PCL)	Current priority for protection of taxa and habitats in Canterbury (and threat grouping)	Description of lifecycle	Habitat and distribution	Primary issues that threaten taxa and habitat	Priority actions recommended to support protection of taxa and habitat
									salmonid free areas.		
<i>Gobiomorphus breviceps</i>	Upland bully	Not Threatened	No	Common	Loss of 26% of records, no change in geographic range.	31%	<b>Low (Group 4)</b>	Non-migratory	Run and pool habitat, common through Canterbury, also South Island and lower North Island, localised presence Stewart Island.	Physical and hydrological habitat alteration	No action required
<i>Gobiomorphus cotidianus</i>	Common bully	Not Threatened	No	Common	Loss of 43% of records, limited change in geographic range.	10%	<b>Low (Group 4)</b>	Migratory. Spawning freshwater, larval rearing at sea, juvenile rearing freshwater, adult freshwater.	Run, pool and lake habitat, migratory populations have coastal distribution. Lake locked populations common in high country areas. Common throughout	Fish passage at river mouths	Maintain fish passage

Taxa	Common name	DOC threat status	Taxa restricted to Canterbury waterbodies?	How common is population in Canterbury	Impact on distribution if historic records removed (i.e. older than 1 Jan 2000)	% of records/ area in Canterbury Protected Crown Land (PCL)	Current priority for protection of taxa and habitats in Canterbury (and threat grouping)	Description of lifecycle	Habitat and distribution	Primary issues that threaten taxa and habitat	Priority actions recommended to support protection of taxa and habitat
									Canterbury, also South Island and North Island, Stewart Island, Chatham Island		
<i>Gobiomorphus gobioides</i>	Giant bully	At risk Naturally uncommon	No	Unknown	Loss of 55% of records, limited change in geographic range.	1%	<b>Medium (Group 2f)</b>	Migratory. Spawning freshwater, larval rearing at sea, juvenile rearing freshwater, adult freshwater.	Tidal river reaches, lowland rivers, Canterbury wide, NZ wide	Fish passage at river mouths	Maintain fish passage at river mouths. Establish overhanging vegetation and stable undercut bankcs
<i>Retropinna retropinna</i>	Common smelt	Not Threatened	No	Common	Loss of 84% of records, loss of the majority of populations. Use all records	2%	<b>Low (Group 4)</b>	Migratory. Spawning freshwater, larval, juvenile rearing at sea, adult freshwater.	Coastal rivers, streams. NZ wide and Stewart Island, Chatham Is	Fish passage at river mouths	Maintain natural river mouth opening periodicity
<i>Rhombosolea retairia</i>	Black flounder	Not Threatened	No	Unknown	Loss of 77% of records, loss of approximately 50% of the populations. Use all records.	16%	<b>Low (Group 4)</b>	Migratory. Spawning at sea, larval rearing at sea juvenile rearing freshwater (or estuarine),	Lowland rivers and streams, pools and runs. Widespread in South and North Islands. Very limited	Fish passage at river mouths	Maintain natural river mouth opening periodicity

Taxa	Common name	DOC threat status	Taxa restricted to Canterbury waterbodies?	How common is population in Canterbury	Impact on distribution if historic records removed (i.e. older than 1 Jan 2000)	% of records/ area in Canterbury Protected Crown Land (PCL)	Current priority for protection of taxa and habitats in Canterbury (and threat grouping)	Description of lifecycle	Habitat and distribution	Primary issues that threaten taxa and habitat	Priority actions recommended to support protection of taxa and habitat
								adult freshwater	knowledge on biological requirements		
<b>Macroinvertebrates</b>											
<i>Parenephrops zealandicus</i>	Kēkēwai	At Risk Declining	No	Sparse	24% records removed, few likely extant populations excluded	3%	<b>High (Group 2e)</b>	Non-migratory	Streams, lakes wetlands and water races	Physical alteration of habitat and instream works such as drain clearing, wetland and stream drainage.	Protect habitat from hydrological modification. Landowner education. Prevent physical habitat modification and instream works that kill or remove individuals. Retention of fish passage barriers that prevent salmonid or other predatory fish invasion. Remove predatory fish. Prevent further expansion of predatory fish.
<i>Echyridella menziesi</i>	Kākahi	At Risk Declining	No	Sparse	46% removed, few likely extant populations excluded	6%	<b>High (Group 2e)</b>	Non-migratory, parasitic larval stage attaches to fish	Streams, lakes wetlands and water races	Physical alteration of habitat and instream works such as drain clearing, wetland and stream drainage. Vulnerable to absence of fish glochidia hosts.	Protect habitat from hydrological modification. Landowner education. Prevent physical habitat modification and instream works.

### Notes for Appendix 1 content

#### DOC threat status

- National status: Freshwater fish species is from Dunn et al. (2018);
- Macroinvertebrate species is from Grainger et al (2018)

#### Current population in Canterbury

- from New Zealand Freshwater Fish database (NZFFDB) and Dunn (2019)
- Common = the majority or all catchments; restricted = few catchments; very restricted = one catchment; Sparse = widespread but uncommon or remnant; unknown = not very restricted, expected to be common but little catch/survey data

#### Description of lifecycle habitat

- State if migratory / non-migratory;
- For migratory species, state which phases of the lifecycle occur within which environments (e.g. spawning – freshwater, juvenile – estuarine, adult - marine etc).

#### Habitat description and distribution of the taxa

- Describe broad habitat preferences
- State location in Canterbury if isolated to a particular catchment (e.g. Mackenzie basin)
- State geographic distribution of the species (e.g. wide distribution along a river reach; distributed in isolated locations (e.g. small hill-fed stream, alpine rivers etc).

#### % of records in Protected Crown Land (PCL) within Canterbury

- some sites will have more than one NZFFDB record at a single site i.e. the number of records do not necessarily equal number of populations or sites.

#### Summary of priority for protection

- Choose the most conservative category in order;
  - o High =Nationally Critical, Endangered or Vulnerable OR; Very restricted or Sparse in Canterbury AND less than 10% in PCL.
  - o Medium = At Risk OR; restricted or Unknown in Canterbury AND less than 10% populations in PCL
  - o Low = All other fish

#### Primary issues that threaten taxa and habitat – based on Allibone & Gray (2019)

Primary actions to support protection of taxa and habitat? (e.g. provisions for river mouth opening; education to land owners; restricted activities at certain times of year) - compiled by expert opinion.

## Appendix 2

### Mapping of priority taxa critical habitat

Dunn (2019) provides fragment extents, or areas of occupancy, for taxa within the genera *Galaxias*, *Neochanna* and *Gobiomorphus*. It was considered that these fragments provided a more accurate representation of the true extent of habitats for the taxa in the LWRP Omnibus plan change. Therefore, the habitat fragments of Dunn (2019) were used in preference to other distributional data where available.

Critical habitats not covered by Dunn (2019) were mapped by the Canterbury Regional Council as shown in Figure 1. A 1 km diameter buffer was applied to each known population and waterbodies (rivers and streams) within the buffer zone were clipped out to a separate shapefile. The resultant waterbody network was manually inspected and lines not associated with the waterbody in which a population occurred or with obviously different physical characteristics (a small stream flowing into a large stream) were removed. If a population was associated with a lake, the entire waterbody was included.



Figure 1. Part 1, 1000 m buffer is placed around the population location. Part 2, waterbodies within the buffer are selected. Part 3, waterbodies different to the locality of the population, but within the buffer, are removed.