# Conservation Status of Freshwater Fishes in Tāmaki Makaurau / Auckland

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Cover image credit: Black mudfish (*Neochanna diversus*). Photograph by Carl Tutt.
Inside image credit: Īnanga (*Galaxias maculatus*) eggs on a stream bank at Te Muri Regional Park during a spawning site survey. Photograph by Jacinda Woolly.

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# Executive summary

The regional conservation status of all known freshwater fishes in Tāmaki Makaurau / Auckland was assessed for the first time, using the New Zealand Threat Classification System (NZTCS) (Townsend et al., 2008, Michel 2021, Rolfe et al., 2021). We used the draft methodology for regional conservation status assessments developed collaboratively by the Department of Conservation, regional councils and a local authority (Department of Conservation 2014). A total of 31 freshwater fish species were identified as present in Tāmaki Makaurau / Auckland.

Three species were assessed as Regionally Data Deficient. Nine species were assessed as Threatened, four as At Risk, two as Non-resident Native, and three as Not Threatened, and ten as Introduced and Naturalised. One species was recognised as to have become extinct or may have formerly occurred in the region.

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# 1 Introduction

The Department of Conservation regularly assesses the national conservation status of many taxa using the New Zealand Threat Classification System (NZTCS) (Townsend et al., 2008, Michel 2021, Rolfe et al., 2021). National conservation status assessments of New Zealand freshwater fish species are published at regular intervals as part of the Department of Conservation New Zealand Threat Classification Series (Hitchmough 2002, Hitchmough et al., 2007, Allibone et al., 2010, Goodman et al., 2014, Dunn et al., 2018). While the national assessments are helpful for prioritising conservation management, research, monitoring and natural resource management decisions, at a national scale, there are limitations in their use for informing these at a regional scale in relation to the statutory responsibilities of local government agencies.

The regional conservation status of a species is particularly important in the context of consent processes under the Resource Management Act 1991 (RMA). Under the RMA, regional and district councils have a statutory obligation to manage threatened species' habitats. A key requirement of managing threatened species' habitats and achieving recovery of threatened species in Tāmaki Makaurau / Auckland is to have a good understanding of regional population sizes and to know if and where declines are occurring. In addition to regulatory requirements, regional conservation assessments may help inform local government decisions as land managers of areas such as regional parks. Furthermore, regional conservation status assessments will provide information to support national species assessments, as they utilise regional expert knowledge and data that may not otherwise be readily available.

Completing regional conservation status assessments for freshwater fish in Tāmaki Makaurau / Auckland is a component of Auckland Council's Biodiversity Focus Area (BFA) programme. Under this programme, several projects are being established to deliver on the council's obligations for regional biodiversity management under Te Tahua Pūtea Tau 2021-2031 Long-term Plan (Auckland Council 2021), Auckland Council's Indigenous Biodiversity Strategy (Auckland Council 2012), Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy 2020 (Department of Conservation 2020), Mahere ā-Rohe Whakahaere Kaupapa Koiora Orotā mō Tāmaki Makaurau Auckland Regional Pest Management Plan 2020-2030 (Auckland Council 2020) and the National Policy Statements for Freshwater Management and Indigenous Biodiversity (Ministry for the Environment 2023a; 2023b).

Methodologies for a consistent regional threat classification system (RTCS) were drafted in collaboration with regional councils and a local authority by the Department of Conservation (2014). While based on the national NZTCS system (Townsend et al., 2008, Michel 2021, Rolfe et al., 2021), scaling thresholds were introduced to adjust for variations in regional land area relative to national land extent (Appendix 1). National strongholds and additional regional qualifiers including natural or historic range limits were also considered (Appendix 2). Greater Wellington Regional Council was the first to publish regional conservation status assessments for several taxa groups in the Wellington region (Crisp 2020a, 2020b, 2020c, Crisp et al., 2022, Crisp et al., 2023a, 2023b). Auckland Council

has recently completed regional conservation status assessments for reptiles, amphibians, vascular plants and bats using this draft methodology (Melzer et al., 2020a, 2020b, Simpkins et al., 2022, Woolly et al., 2023). This report is the first regional conservation status assessment for freshwater fishes in Tāmaki Makaurau / Auckland.

# 2 Methods

An expert panel comprised of Auckland Council ecologists Matthew Bloxham, Ange Chaffe, Carl Tutt, Jacinda Woolly, Dr Sabine Melzer and Dr Nicholas Dunn, (Department of Conservation), assessed the status of the freshwater fish species in Tāmaki Makaurau / Auckland during virtual workshops held during July 2023.

This report covers all native and naturalised freshwater fish in the region and followed the draft Department of Conservation process for assessing regional conservation status (Department of Conservation 2014, pers. comm. Pascale Michel). Taxa that have become naturalised in New Zealand after being deliberately or accidentally introduced by human agency are classified as Introduced and Naturalised. To be considered naturalised, a taxon must have established a self-sustaining population in the wild over at least three generations and must have spread beyond the site of initial establishment.

We used fish location records from Auckland Council internal surveys and externally sourced datasets to inform decisions on distribution of each freshwater fish species. External datasets included the National Institute of Water and Atmospheric Research (NIWA) administered New Zealand Freshwater Fish Database (NZFFD; https://nzffdms.niwa.co.nz/; accessed 27/6/2023) and the Wilderlab public environmental DNA (eDNA) portal (Wilderlab; https://www.wilderlab.co.nz/explore; accessed 6/7/2023). In addition, modelled fish distribution datasets were used to support area of occupancy estimates for species (Booker and Hicks 2013, Crow et al., 2014, White et al., 2022).

A decision support tool was developed in Auckland Council's conservation information system, Ruru, including an ESRI Survey123 form to facilitate assessing each species following the process outlined in Appendix 1. The Survey123 form contains a series of predefined questions and selections. Spatial data was viewed in ESRI ArcGIS Pro version 2.6.4. Type locations of fish were determined through the checklist of the fishes of New Zealand (Roberts et al., 2023).

All freshwater fish species from the national NZTCS list (Dunn et al., 2018) not known to be present in the region were removed from consideration in the assessment. Nationally Threatened species that reproduce or are resident for more than half their life cycle in the region were assessed following the process outlined in the flowchart (Appendix 1).

Current taxonomic names, and naming authorities of assessed species were checked against Eschmeyers Catalog of Fishes on 8 August 2023 (Fricke et al., 2023). Common English names were taken from Dunn et al. (2018). Māori names were taken from the NZTCS database (https://nztcs.org.nz/nztcs-species-search), provided by Tame Te Rangi (Te Runanga o Ngati Whatua; nominated on behalf of the kaitiaki forum) for Auckland Council. Additional Māori names were added where known, for example, the hapū of Hikurangi refer to black mudfish as oka riki. The names may not represent a complete list as there are dialectal differences among iwi and hapū.

To maintain the highest protection of threatened species and for consistency between regional and national assessments, the regional status must not be a lower threat category than the most recent published national status. For example, a Nationally Endangered taxon cannot be assessed as Regionally Vulnerable or lower, but it could be assessed as Regionally Critical. Population trend criteria are applied based on current knowledge, projecting from recent past into the future (over the longer of either 10 years or three generations, up to a maximum of 100 years, for shorter and longer generation species respectively).

The process for determining the regional threat status of a species is shown in Appendix 1 and the full list of qualifiers applied in Appendix 2. If more than 20% of the national population is breeding or resident for more than half their life cycle in Tāmaki Makaurau / Auckland, the species was assigned National Stronghold status and the NZTCS criteria applied. Regional thresholds for the number of mature individuals and habitat occupancy area, were applied as drafted in Department of Conservation (2014). Regional scaling thresholds were calculated by measuring the size of each region as a percentage of total New Zealand land area and applying the resultant scale to the minimum threshold for Not Threatened in the NZTCS. Regional thresholds were designed to be used universally across a wide range of taxa and allow for using either an area or population size estimate based on the information available for a species. For Tāmaki Makaurau / Auckland, the threshold was set at 500 mature individuals present or a habitat occupancy area of 250ha. If a species was below the threshold, it was assigned a regional conservation status by applying the NZTCS criteria. If it was over the threshold and the population was ±10% stable or increasing, it was assigned the status Regionally Not Threatened.

Area of occupancy (AOO) in streams and rivers was estimated using a combination of species distribution modelling by White et al. (2022) and Crow et al. (2014) and expert knowledge of fish in Tāmaki Makaurau / Auckland. These species distribution models (SDMs) aim to provide national estimates of probability of capture or occurrence for freshwater fishes using NZFFD records and the New Zealand digital river network (REC2; https://data-niwa.opendata.arcgis.com/), and when combined with estimated stream and river widths (Booker and Hicks 2013) can provide estimates of area of occupancy. As a result, these data are inherently restricted to species whose main habitat is riverine as opposed to lacustrine or palustrine hydrosystems. A further constraint is that modelling is not available for all species in the region. Crow et al. (2014) used Regularized Random Forest models while predictions of fish distribution by White et al. (2022) were based on an ensemble of Generalised Additive Mixed Models (GAMMs) and Boosted Regression Trees (BRTs) to account for between-model uncertainty. We limited the spatial extent of the area of occupancy estimates to the confirmed catchments for target species.

To determine area of occupancy, we clipped the national REC2 network buffered by width at seven day Mean Annual Low Flow (7d-MALF) to Tāmaki Makaurau / Auckland in GIS. Then we determined thresholds for each species representing a high probability of occurrence. For the Crow et al. (2014) dataset, we used the reported Cohen's Kappa (Cohen 1960) values as cut off values to select those REC2 segments where they have a high probability of occurrence, in catchments they have been confirmed as occurring in, from which estimated area of occupancy was calculated. The Crow et al. (2014) model uses NZFFD records where electrofishing is given as the method of capture, however

for longfin eel, models were also created using records using netting and visual observation as the fishing method. For this species, we applied the above approach to calculate an average area of occupancy.

Appropriate cut off values for a high probability of occurrence were not provided by White et al. (2022) for their models. To overcome this, we derived appropriate cut off values by overlaying the spatial extent showing probability of capture as estimated by Crow et al. (2014) with the White et al. (2022) probability of occurrence estimates alongside all known records of each fish species and using expert knowledge to determine a cut off value that would account for a reasonable proportion of the variation (Table 1). Non-riverine AOO was estimated using known species records and open water, palustrine and lacustrine habitats mapped in the ecosystem current extent layer (Singers et al., 2017; Auckland Council 2023) or lakes in the Freshwater Ecosystem of New Zealand (FENZ, Department of Conservation 2010) database (Table 1).

While species distribution records and modelling were used to support decision making, these data do contain caveats that need to be considered, including differences in survey methodologies, misidentification of species, location inaccuracies and bias of observations that are often clustered around public land or where development and associated surveys have occurred. The panel critically assessed the available data and also drew on their own experience and expert knowledge to consider current and likely future threats to ultimately determine the conservation status of each species.

**Table 1. Thresholds for probability of occurrence (PO) and estimated area of riverine and non-riverine area of occupancy (AOO) used for fish in Tāmaki Makaurau / Auckland. Only species where AOO was used to assess population status or Not Threatened species meeting the regional threshold are listed.**

| Species | Cohen's Kappa (Crow et al. 2014) | AOO (ha) estimate from Crow et al. (2014) | Derived PO threshold for White et al. (2022) | AOO (ha) estimate for White et al. (2022) | Average modelled riverine area of occupancy (ha) | Non-riverine AOO (ha) |
|---|---|---|---|---|---|---|
| *Anguilla australis* (Shortfin eel, Tuna, Hau) | 0.46 | 426 | 0.1 | 518 | 472 | <2000 |
| *Anguilla dieffenbachii* (Longfin eel, Tuna) | 0.3 – 0.69 | 112 | 0.1 | 528 | 320 | <1000 |
| *Galaxias fasciatus* (Banded kōkopu, kōkopu, Kōkopu taiwhara) | 0.42 | 133 | 0.2 | 387 | 260 | <1000 |
| *Gobiomorphus cotidianus* (Common bully, Tīpokopoko) | 0.41 | 240 | 0.2 | 392 | 316 | <1000 |
| *Gobiomorphus gobioides* (Giant bully, Tīpokopoko) | 0.28 | 3 | Species not modelled | Species not modelled | 3 | <100 |
| *Gobiomorphus hubbsi* (Bluegill bully) | 0.2 | 7 | 0.4 | 2 | 4 | <10 |

For the purposes of this assessment the area of the entire Hūnua Ranges Regional Park was included as part of the Auckland 'region', in agreement with Waikato Regional Council staff (Figure 1). Although a large part of the Hūnua Ranges is within the Waikato region, most of the area is managed by Auckland Council as the Hūnua Ranges Regional Park. This extensive tract of forest provides one of the most important opportunities to conserve and protect ecologically functional ecosystems and the diversity of native species that they support on the mainland of Tāmaki Makaurau / Auckland.

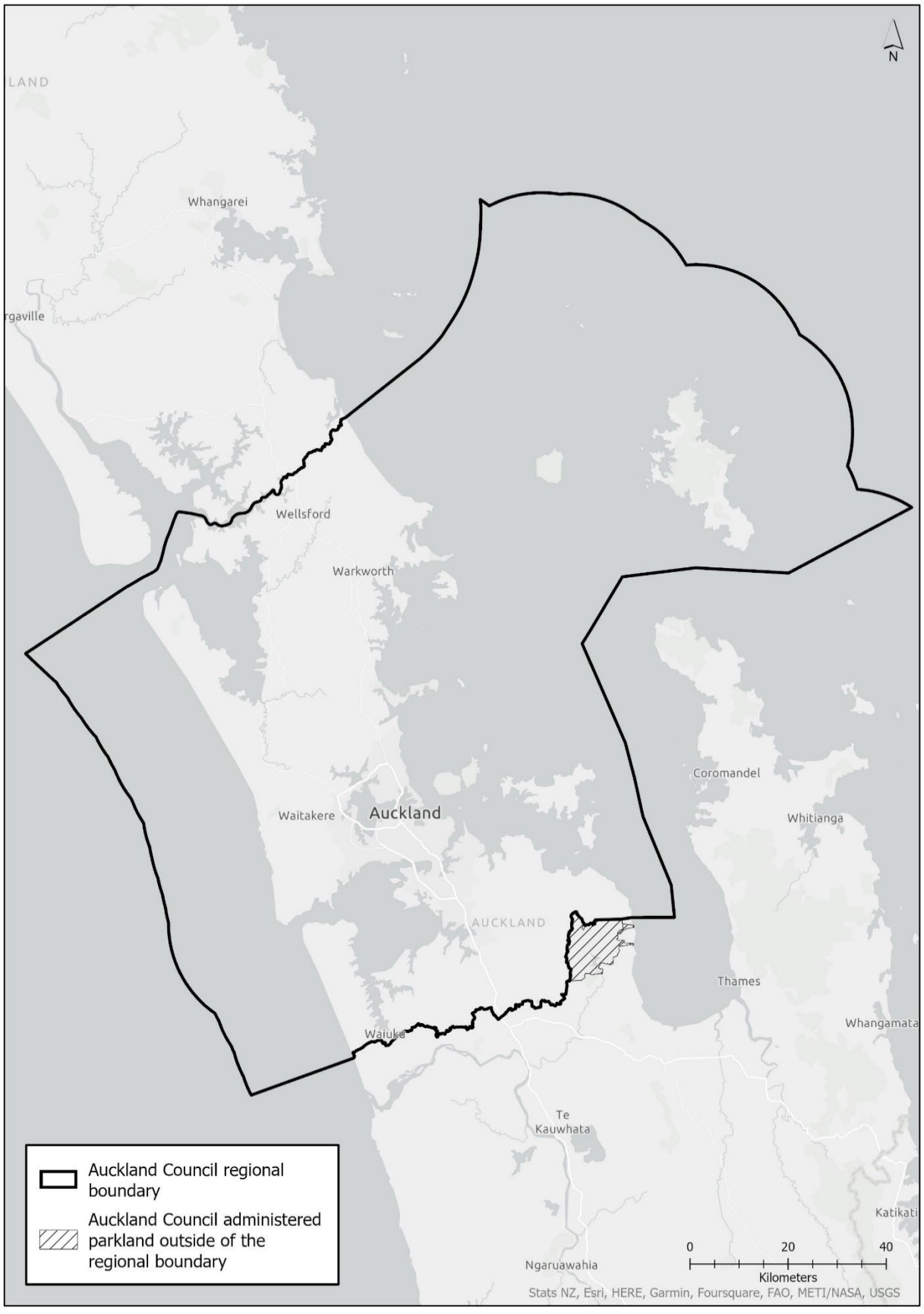


**Figure 1. Geographic extent used to assess the conservation status of species, including Auckland Council administered parkland in the Hūnua Ranges.**

# 3 Results

A total of 31 freshwater fish species were identified as present in Tāmaki Makaurau / Auckland (including introduced and naturalised species; Figure 2, Tables 2 – 7).

The region was identified as a national stronghold (>20% of the national population present) for banded kōkopu (kōkopu, kōkopu taiwhara, *Galaxias fasciatus*). No species were identified as regionally endemic to Tāmaki Makaurau / Auckland.

Of the species assessed, three were identified as Regionally Data Deficient. Of the nine Threatened species identified, four were assessed as Regionally Critical, two as Regionally Endangered, and three as Regionally Vulnerable. Of the four At Risk species identified, all were identified as Regionally Declining. A further three were assessed as Not Threatened, and two as Non-Resident Native. Ten species were assessed as Introduced and Naturalised.

**Species inclusions and exclusions**

Grayling (*Prototroctes oxyrhynchus*) was not formally assessed here as it has become extinct in New Zealand. It may have formerly occurred in the region and has therefore been included as additional information (Appendix 3). It is the only New Zealand freshwater fish species known to have gone extinct.

Although grass carp (*Ctenopharyngodon idella*) and silver carp (*Hypophthalmichthys molitrix*) are present in the region, having been introduced to some waterbodies for macrophyte and algal bloom management respectively, they were not assessed by the panel because they are not known to breed in the wild in New Zealand at this time. As there are no self-sustaining populations, they do not fit the NZTCS assessment criteria.

Another introduced species noted by the panel as occasionally observed, although not yet considered naturalised in the region was orfe (*Leuciscus idus*).

Dwarf īnanga (North Kaipara Head dune lakes; ngāore, *Galaxias gracilis*) were considered as taxonomically indistinct in the last national assessment (Dunn et al., 2018), after previously being listed as At Risk – Declining by Goodman et al. (2014). A decision was made not to include dwarf īnanga in the results of this assessment due to its unresolved taxonomy; however, the panel considered that it should it be reinstated as a species in future iterations. If dwarf īnanga were reinstated as a species, it would likely be assessed as Regionally Critical in Tāmaki Makaurau / Auckland based on its area of occupancy (<100ha), estimated number of mature individuals (<250) and estimated population trend (decline of 30-50%). Within the region the species is only known from a self-sustaining population in Lake Rototoa where it was introduced to sustain an introduced trout population. The major threat for dwarf īnanga in this lake currently is predation from introduced perch (*Perca fluviatilis*). Auckland Council is actively managing perch at this lake.

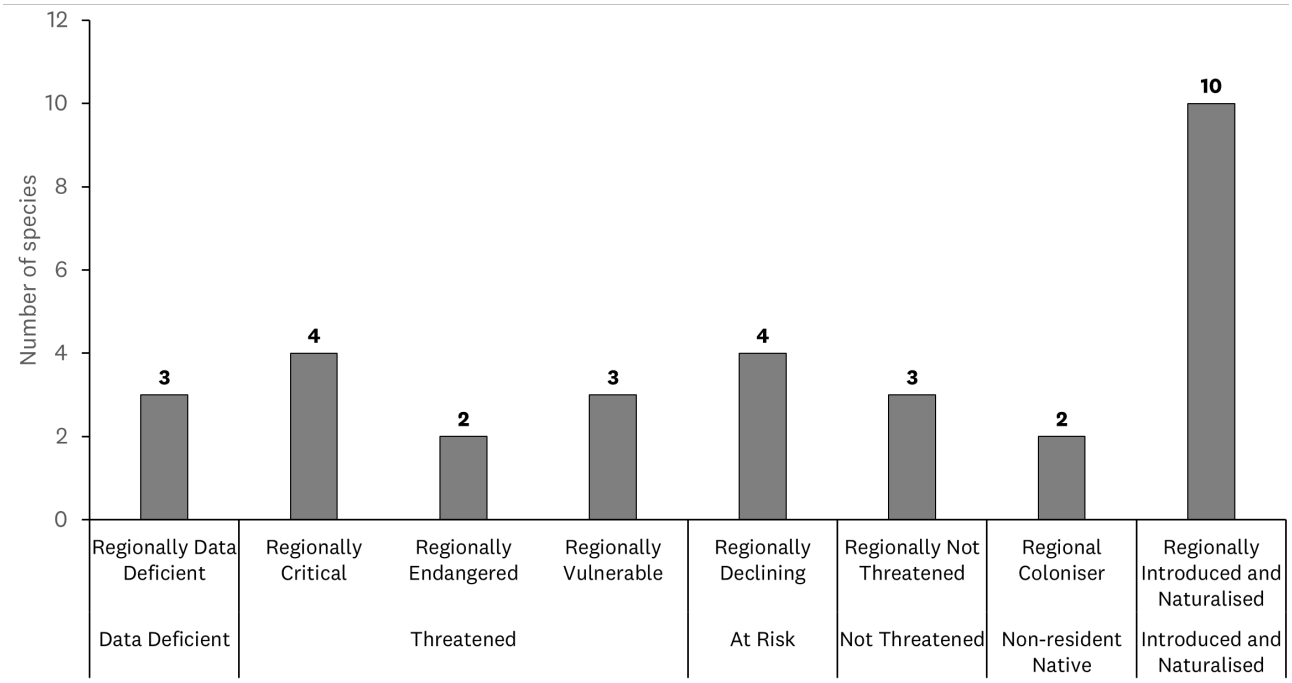


**Figure 2. Regional conservation status of freshwater fishes in Tāmaki Makaurau / Auckland.**

## 3.1 Data Deficient (3)

Taxa where information about their abundance and population trend is so lacking that an assessment is not possible (Townsend et al., 2008, Michel 2021, Rolfe et al., 2021).

**Table 2. Regionally Data Deficient fish species of Tāmaki Makaurau / Auckland.**

| Common Name | Māori Name | Name and Authority | Regional Conservation Status (2023) | National Conservation Status (2017) | Regional Criteria | National Stronghold | Regional Population Size | Regional Confidence Population Size | Regional Trend | Regional Confidence Trend | Regional Qualifiers | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Estuarine triplefin | | *Forsterygion nigripenne* (Valenciennes, 1836) | Regionally Data Deficient | Not Threatened | | | | | | | DPS, DPT | Insufficient information available on population state or trend for the panel to assess. |
| Grey mullet | Kanae | *Mugil cephalus* Linnaeus, 1758 | Regionally Data Deficient | Not Threatened | | | | | | | DPS, DPT | Unknown recreational catch pressure. Commercial catch data was insufficient for the panel to assess regional conservation status. |
| Yellow-eye mullet | Aua | *Aldrichetta forsteri* (Valenciennes, 1836) | Regionally Data Deficient | Not Threatened | | | | | | | DPS, DPT | Insufficient information available on population state or trend for the panel to assess. |

## 3.2 Threatened (9)

Taxa that meet the criteria for the categories Regionally Critical, Regionally Endangered, Regionally Vulnerable and Regionally Increasing (Townsend et al., 2008, Michel 2021, Rolfe et al., 2021).

**Table 3. Regionally Threatened freshwater fish species of Tāmaki Makaurau / Auckland.**

| Common Name | Māori Name | Name and Authority | Regional Conservation Status (2023) | National Conservation Status (2017) | Regional Criteria | National Stronghold | Regional Population Size | Regional Confidence Population Size | Regional Trend | Regional Confidence Trend | Regional Qualifiers | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black mudfish | Waikaka, Oka riki | *Neochanna diversus* Stokell, 1949 | Threatened – Regionally Critical | At Risk – Declining | A (1) | No | MATIND<250 | Medium | DEC 50-70% | Low | CI, DPS, DPT, PF, RR | Small number of known populations. Challenging to survey and monitor. Where monitoring has occurred – very small declining population. Pressures include loss of habitat, water abstraction, pest fish, declining water quality, and increased drought frequency (climate impacts). |
| Bluegill bully | | *Gobiomorphus hubbsi* (Stokell, 1959) | Threatened – Regionally Endangered | At Risk – Declining | A (3) | No | AREA<=10 | Low | DEC 10-30% | Low | CI, DPS, DPT, RR, Sp | Several records from Aotea / Great Barrier Island only. Will likely be impacted by climate change (extreme weather events). Riverine AOO est. 4ha |

| Common Name | Māori Name | Name and Authority | Regional Conservation Status (2023) | National Conservation Status (2017) | Regional Criteria | National Stronghold | Regional Population Size | Regional Confidence Population Size | Regional Trend | Regional Confidence Trend | Regional Qualifiers | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Common smelt | Pōrohe, Paraki | *Retropinna* (Richardson, 1848) | Threatened – Regionally Vulnerable | Not Threatened | C (1) | No | MATIND=1000-5000 | Low | DEC 10-30% | Low | CI, CR, DPS, DPT, PF | Less common than īnanga, but likely to benefit from same management actions. |
| Giant bully | Tīpokopoko | *Gobiomorphus gobioides* (Valenciennes, 1837) | Threatened – Regionally Vulnerable | At Risk – Naturally Uncommon | C (3) | No | AREA<=100 | Low | DEC 10-30% | Low | CI, DPR, DPS, DPT, Sp | Recognition issues with common bully. Populations are likely in decline due to pressures faced in the lower reaches habitat they occupy. Likely to be affected by sea level rise (climate impacts). |
| Giant kōkopu | Kōkopu, Tītarakura | *Galaxias argenteus* (Gmelin, 1789) | Threatened – Regionally Critical | At Risk – Declining | A (1) | No | MATIND<250 | Medium | DEC 50-70% | Low | CI, CD, CR, DPT, PD | Loss of historic mainland populations and very few individuals at remaining sites. Current conservation management efforts focus on Waiheke/ Te Motu Arai Roa populations as a regional stronghold. |
| Kōaro | Kōaro | *Galaxias brevipinnis* Günther, 1866 | Threatened – Regionally Endangered | At Risk – Declining | A (1) | No | MATIND=250-1000 | Low | DEC 10-30% | Low | CI, DPS, DPT, RR | Population estimate is conservative. Little known about their population state or trend in the region. Likely vulnerable to extreme weather events. |

| Common Name | Māori Name | Name and Authority | Regional Conservation Status (2023) | National Conservation Status (2017) | Regional Criteria | National Stronghold | Regional Population Size | Regional Confidence Population Size | Regional Trend | Regional Confidence Trend | Regional Qualifiers | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lamprey | Piharau | *Geotria australis* Gray, 1851 | Threatened – Regionally Critical | Threatened – Nationally Vulnerable | A (1) | No | MATIND<250 | Low | DEC 10-30% | Low | CI, DPS, DPT, RR, S?O | One location confirmed through physical surveys, other potential populations identified through eDNA surveys. |
| Shortjaw kōkopu | Kōkopu, Kōkopu kauae poto | *Galaxias postvectis* Clarke, 1899 | Threatened – Regionally Critical | Threatened – Nationally Vulnerable | A (1) | No | MATIND<250 | High | DEC 30-50% | Low | CI, CR, EF, RR | Small populations at a small number of sites. Vulnerable to extreme weather events. |
| Torrentfish | Mokomoko | *Cheimarrichthys fosterae* Haast, 1874 | Threatened – Regionally Vulnerable | At Risk – Declining | C (1) | No | MATIND=1000-5000 | Low | DEC 10-30% | Low | DPS, DPT, RR | Waitākere Ranges/Te Wao nui a Tiriwa contains an important population in terms of their local western distribution. Cautiously assessed as in decline, although they are occasionally found in quite degraded and modified streams with suitable riffle habitat. Conservative population estimate. |

## 3.3 At Risk (4)

Taxa that meet the criteria for Regionally Declining, Regionally Recovering, Regionally Relict or Regionally Naturally Uncommon (Townsend et al., 2008, Michel 2021, Rolfe et al., 2021).

**Table 4. Regionally At Risk freshwater fish species of Tāmaki Makaurau / Auckland.**

| Common Name | Māori Name | Name and Authority | Regional Conservation Status (2023) | National Conservation Status (2017) | Regional Criteria | National Stronghold | Regional Population Size | Regional Confidence Population Size | Regional Trend | Regional Confidence Trend | Regional Qualifiers | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cran's bully | Titikura | *Gobiomorphus basalis* (Gray, 1842) | At Risk – Regionally Declining | Not Threatened | B (1) | No | MATIND=20000-100000 | Low | DEC 10-30% | Low | DPR, DPS, DPT | Likely in decline in region due to sedimentation (impact spawning habitat) and loss of adult habitat. |
| Īnanga | Īnanga, Matamata | *Galaxias maculatus* (Jenyns, 1842) | At Risk – Regionally Declining | At Risk – Declining | A (1) | No | MATIND=5000-20000 | Low | DEC 10-30% | Low | CI, CD, DPS, DPT, SO | Decline associated with fish passage barriers and loss of spawning habitat. Conservation efforts are focusing on identifying and restoring spawning sites and remediating fish passage. |
| Longfin eel | Tuna | *Anguilla dieffenbachii* Gray, 1842 | At Risk – Regionally Declining | At Risk – Declining | A (2) | No | AREA<=1000 | Low | DEC 10-30% | Low | CI, CD, DPS, DPT | Decline associated with fish passage barriers and degradation of habitat in the region. Conservation measures include remediation of fish passage. |

| Common Name | Māori Name | Name and Authority | Regional Conservation Status (2023) | National Conservation Status (2017) | Regional Criteria | National Stronghold | Regional Population Size | Regional Confidence Population Size | Regional Trend | Regional Confidence Trend | Regional Qualifiers | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Redfin bully | Kōkopu urutira whero | *Gobiomorphus huttoni* (Ogilby, 1894) | At Risk – Regionally Declining | Not Threatened | A (1) | No | MATIND=5000-20000 | Low | DEC 10-30% | Low | CI, DPS, DPT | Likely stable in areas with good riparian cover but declining in areas where habitat is being lost due to land use change and development pressures. |

## 3.4 Not Threatened (3)

Regional resident native taxa that have large, stable populations (Townsend et al., 2008, Michel 2021, Rolfe et al., 2021).

**Table 5. Regionally Not Threatened freshwater fish species of Tāmaki Makaurau / Auckland.**

| Common Name | Māori Name | Name and Authority | Regional Conservation Status (2023) | National Conservation Status (2017) | Regional Criteria | National Stronghold | Regional Population Size | Regional Confidence Population Size | Regional Trend | Regional Confidence Trend | Regional Qualifiers | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Banded kōkopu | Kōkopu, Kōkopu taiwhara | *Galaxias fasciatus* Gray, 1842 | Regionally Not Threatened | Not Threatened | | Yes | MATIND=20000-100000 | Low | STABLE +/-10% | Low | DPT, NStr | Widely distributed across the region. Would benefit from monitoring to give higher confidence in population state and trend estimates. |
| Common bully | Tīpokopoko | *Gobiomorphus cotidianus* McDowall, 1975 | Regionally Not Threatened | Not Threatened | | No | MATIND>100000 | Medium | STABLE +/-10% | Low | DPR, DPS, DPT | Widely distributed and reasonably common. Would benefit from monitoring to give higher confidence in population state and trend estimates. |
| Shortfin eel | Tuna, Hau | *Anguilla australis* Richardson, 1841 | Regionally Not Threatened | Not Threatened | | No | MATIND>100000 | Medium | STABLE +/-10% | Medium | | Wide tolerance of environmental conditions including modified habitats. Modelled AOOs are underestimates as they don't capture all the habitats where shortfin eel are found in Auckland. |

## 3.5 Non-resident Native (2)

Taxa whose natural presence in the region is either discontinuous (Migrant), sporadic or temporary (Vagrant) or which have succeeded in recently (since 1950) establishing a resident breeding population (Coloniser), (Townsend et al., 2008, Michel 2021, Rolfe et al., 2021).

**Table 6. Regionally Non-resident Native freshwater fish species of Tāmaki Makaurau / Auckland.**

| Common Name | Māori Name | Name and Authority | Regional Conservation Status (2023) | National Conservation Status (2017) | Regional Criteria | National Stronghold | Regional Population Size | Regional Confidence Population Size | Regional Trend | Regional Confidence Trend | Regional Qualifiers | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australian longfin eel | | *Anguilla reinhardtii* Steindachner, 1867 | Regional Coloniser | Coloniser | | | | | | | | Not common yet but slowly becoming more widely distributed. |
| Dart goby | | *Parioglossus marginalis* Rennis & Hoese, 1985 | Regional Coloniser | Coloniser | | | | | | | | Not common yet. |

## 3.6 Introduced and Naturalised (10)

Taxa that have become naturalised in the region after being deliberately or accidentally introduced by human agency. To be considered naturalised, a taxon must have established a self-sustaining population in the wild over at least three generations and must have spread beyond the site of initial establishment (Townsend et al., 2008, Michel 2021, Rolfe et al., 2021).

**Table 7. Introduced and Naturalised freshwater fish species of Tāmaki Makaurau / Auckland.**

| Common Name | Name and Authority | Regional Conservation Status (2023) | National Conservation Status (2017) | Notes |
|---|---|---|---|---|
| Bridled goby | *Arenigobius bifrenatus* (Kner, 1865) | Introduced and Naturalised | Introduced and Naturalised | |
| Brown bullhead catfish | *Ameiurus nebulosus* (Lesueur, 1819) | Introduced and Naturalised | Introduced and Naturalised | Pest species in Auckland RPMP (exclude from establishing on Aotea / Great Barrier Island; site-led control at priority lakes; sustained control whole region). |
| Brown trout | *Salmo trutta* Linnaeus, 1758 | Introduced and Naturalised | Introduced and Naturalised | |
| Gambusia | *Gambusia affinis* (Baird & Girard, 1853) | Introduced and Naturalised | Introduced and Naturalised | Pest species in Auckland RPMP (exclude from establishing on Aotea / Great Barrier Island; sustained control whole region). |
| Goldfish | *Carassius auratus* (Linnaeus, 1758) | Introduced and Naturalised | Introduced and Naturalised | Pest species in Auckland RPMP (exclude from establishing on Aotea / Great Barrier Island; sustained control whole region where outside of containment). |
| Koi carp* | *Cyprinus carpio* Linnaeus, 1758 | Introduced and Naturalised | Introduced and Naturalised | Pest species in Auckland RPMP (exclude from establishing on Aotea / Great Barrier Island; site-led control at priority lakes; sustained control whole region). |
| Perch (Red fin/European) | *Perca fluviatilis* Linnaeus, 1758 | Introduced and Naturalised | Introduced and Naturalised | Pest species in Auckland RPMP (exclude from establishing on Aotea / Great Barrier Island; site-led control at priority lakes; sustained control whole region). |
| Rainbow trout | *Oncorhynchus mykiss* (Walbaum, 1792) | Introduced and Naturalised | Introduced and Naturalised | |
| Rudd | *Scardinius erythrophthalmus* (Linnaeus, 1758) | Introduced and Naturalised | Introduced and Naturalised | Pest species in Auckland RPMP (exclude from establishing on Aotea / Great Barrier Island; site-led control at priority lakes; sustained control whole region). |
| Tench | *Tinca* (Linnaeus, 1758) | Introduced and Naturalised | Introduced and Naturalised | Pest species in Auckland RPMP (exclude from establishing on Aotea / Great Barrier Island; site-led control at priority lakes; sustained control whole region). |

* Growing evidence suggests that koi carp in New Zealand are likely a different species – *Cyprinus rubrofuscus*, but have been listed here as *C. carpio* in line with Dunn et al. (2018).

# 4 Discussion

Of the 31 freshwater fishes present in Tāmaki Makaurau / Auckland, nine are considered Regionally Threatened and four as Regionally At Risk. These regional conservation assessments will help guide the prioritisation of species for targeted survey, monitoring, management, and research to ensure regional viability of indigenous species is maintained over the long-term.

Completing regional conservation status assessments for freshwater fishes in Tāmaki Makaurau / Auckland is a component of Auckland Council's Biodiversity Focus Area programme. Biodiversity Focus Areas represent the minimum set of sites requiring targeted management of critical pressures to ensure the regional viability of indigenous ecosystems, sequences and species is maintained over the long-term (>50 years). The BFA programme helps to fulfil objectives of Auckland Council's Indigenous Biodiversity Strategy (2012).

Auckland Council has been undertaking and supporting survey and management work for freshwater fishes for a number of years, with further council supported surveys underway or planned.

Of the Regionally Threatened species identified through this assessment, the panel holds particular concern for black mudfish (waikaka, oka riki, *Neochanna diversus*), giant kōkopu (kōkopu, tītarakura, *Galaxias argenteus*) and shortjaw kōkopu (kōkopu, kōkopu kauae poto*, Galaxias postvectis*). These species are vulnerable to a range of pressures including habitat modification, declines in water quality, predation, extreme weather events related to climate change and recruitment failure.

**Black mudfish (*waikaka, oka riki, Neochanna diversus*)**

There are currently four natural populations known to be remaining in the region, none of which are secure. All are subject to multiple, actual, or potential stressors, including habitat modification from land use change, potential water overallocation/abstraction and nutrient enrichment, impacts from unrestricted pest animal access, and edge effects. The historical loss of extensive wetland habitat throughout Tāmaki Makaurau / Auckland has undoubtedly contributed to the decline of black mudfish.

Auckland Council's and Auckland Zoo's black mudfish recovery efforts focus on searching for new populations and developing husbandry and breeding methods to facilitate future reintroduction/re-stocking. Auckland Zoo have successfully bred black mudfish since 2018. It is hoped that the over 200 individuals bred in 2019 will soon be released at a suitable location in partnership with mana whenua.

Current work focuses on identifying release sites that lie within the same ecological region as the Northland founder population, are free from pressures, satisfy habitat and water quality requirements and have no resident mudfish in order to safeguard the founder Otaikairangi repo (wetland) population's genome. Additional challenges include satisfying requirements for monitoring by the Department of Conservation since release sites must contain surface water that is accessible

throughout so that rearing habitat can be reliably and repeatably sampled to determine the success of the translocation.

**Giant kōkopu (*kōkopu, tītarakura, Galaxias argenteus*)**

Once relatively widespread in Tāmaki Makaurau / Auckland, only a small number of giant kōkopu populations persist on the mainland. Giant kōkopu are restricted to relatively undisturbed forested catchments and / or forested local parks and reserves where fewer pressures exist. Declining water quality and habitat loss – primarily the wholesale loss of riverine coastal wetlands likely drove the historic decline of giant kōkopu in the region.

Pressures for giant kōkopu include recruitment failure, predation, declines in water quality, habitat degradation and climate change impacts. Populations at relatively protected sites, such as in the Waitākere Ranges / Te Wao nui a Tiriwa are under pressure because there are insufficient giant kōkopu source populations to maintain recruitment and balance the diminishing impact that sink environments can impose on recruitment success, and which have the potential to register as a loss across the whole fishery (including source populations).

Distributional survey work between 2015-2019 focused on revisiting 25 historic populations and sites with suitable habitat in the region (Bartels 2015, Goldwater 2019, Nyegaard 2019). No giant kōkopu were found in any historic mainland population locations, but two new populations were discovered at Whatipū in the Waitākere Ranges / Te Wao nui a Tiriwa (two individuals observed) and near Te Matuku Bay on Waiheke Island / Te Motu Arai Roa (approximately 20 individuals). In 2014, a local resident discovered a population of around 20 fish at Awaawaroa on Waiheke Island. With the two largest populations in the region, Waiheke Island / Te Motu Arai Roa now represents a regional stronghold for giant kōkopu. While it remains possible that other populations exist, recent experience indicates it's unlikely any large mainland Auckland populations will be found in future.

There is growing concern that the more docile large bodied galaxiid species are comparatively more vulnerable to predation by pest vertebrates, but more conservation research is required to confirm any impacts on populations. As with the other galaxiid species that lay their eggs terrestrially, the eggs of giant kōkopu are highly vulnerable to predation over the 1-2-month maturation period they are out of water in riparian bankside vegetation. Protection of eggs from predators, such as rodents and hedgehogs, is essential to the long-term survival of these galaxiid species.

Sedimentation influencing water quality is of major concern, particularly from unsealed roads and car parks, as well as earthworks. Sediment is responsible for the decline and range contraction of giant kōkopu populations throughout mainland of Tāmaki Makaurau / Auckland (Matt Bloxham, pers. obs.). Populations have been lost recently in Auckland due to sediment run-off from bulk earthwork sites, including at West Hoe Heights (Ōrewa). In the neighbouring Nukumea catchment, the population is now also coming under pressure from urban development, while a population on Waiheke Island / Te Motu Arai Roa is thought to have recently disappeared due to sediment.

Major stochastic storm events of the type we can expect more of under predicted climate change scenarios (Lorrey et al. 2018) have the potential to generate considerably more sediment and compromise giant kōkopu populations. Further, extremely high summer water temperatures are

another critical water quality issue at sites with limited or no riparian vegetation or forest cover. For example, at Awaawaroa, the upstream reaches of the awa run through an open, unfenced pastoral landscape and the mainstem's modest flows are sluggish, discoloured and unshaded so readily heat up. As one of the longest water courses on the island, Awaawaroa is also subject to unrestricted domestic water takes which can exacerbate temperature impacts.

Management strategies for giant kōkopu in Tāmaki Makaurau / Auckland must include reinstating viable clusters comprising geographically linked populations, whose adult populations can be underpinned and sustained by juveniles recruiting from the same oceanic larval source and which in turn are augmented by successful source breeding populations.

Currently the focus is to stabilise populations on Waiheke Island / Te Motu Arai Roa by removing fish passage barriers, revegetation, predator control and habitat enhancement. The latter includes plans to trial seeding Awaawaroa stream with wood to provide complex habitat for this relatively large and long-lived fish. Wood provides semi-permanent daytime cover, flood refuges for resident fish, habitat for its prey items and creates channel form diversity. A lack of wood in streams is second only in importance to suspended sediment as a limiting parameter for giant kōkopu populations (Bruno David, pers. comm.).

Predator control around the Awaawaroa giant kōkopu site concentrates on known spawning locations. This site is one of only three confirmed giant kōkopu spawning zones in New Zealand (Franklin et al. 2015, Orchard and Wilkinson 2023). Trials of different predator control methods were started in 2018 at this site and are ongoing.

**Shortjaw kōkopu (*kōkopu, kōkopu kauae poto, Galaxias postvectis*)**

Shortjaw kōkopu is an endemic large bodied galaxiid that inhabits stable, high-energy pools in cascading, moderate sized streams with indigenous forest cover and typically large rock exposures and/or boulder habitat. Overhangs and stable undercuts beneath large boulders and bedrock provide shortjaw kōkopu with flow refugia during large scale events. This niche specificity is thought to be partly responsible for shortjaw kōkopu's scarcity, because nationally and in Tāmaki Makaurau / Auckland particularly, their preferred habitat type is underrepresented.

Nelson/Marlborough represents the national stronghold for shortjaw kōkopu, with more than 40 populations (Jack and Barrier 2000, Jack et. al., 2001). In contrast, there are currently only four known shortjaw kōkopu populations in the Auckland administrative area. One of these populations is in the Hūnua Ranges (Smith 2012) and the remaining three all occur within the Waitākere Ranges / Te Wao nui a Tiriwa. The latter three streams contain the full suite of preferred habitat characteristics including, extensive mature native forest cover throughout the adult range, large boulder cover, and moderate sized, high-energy pools.

Pressures for shortjaw kōkopu include mammalian predators, fish passage impediments, recruitment failure and climate change impacts. Extreme weather events such as storms and flooding during 2018 and Cyclone Gabrielle in 2023 have caused extensive damage to Waitākere Ranges streams through debris flows (Error! Reference source not found.). The impact on Marawhara Stream at Piha was large enough to have caused extensive destruction of shortjaw kōkopu habitat.

**Figure 3. Marawhara Stream at Piha following Cyclone Gabrielle, 2023. Photograph by Nick Brown (left image) and Jason Smith (right image).**

For shortjaw kōkopu, the management focus is to establish additional populations through a captive breeding programme. Suitable habitat and potential release sites were identified above the Waitākere Ranges / Te Wao nui a Tiriwa reservoirs. The value in establishing landlocked threatened galaxiid populations above reservoirs is that, by providing an alternative to their oceanic phase, reservoir raised larval stages are exposed to less risk than larval recruits developing planktonically in the ocean. Where in ocean-reared larvae, return rates may be as low as 1-3% (Charlie Mitchell, pers. comm.), larval survival in freshwater lacustrine environments is potentially much greater. This is because not only are larval fish situated that much closer to natal stream habitat (Cindy Baker, pers. comm.), they are also exposed to less predatory pressure. The potential to build the population quickly is, therefore, greater than in streams with uninterrupted oceanic connections. It is likely a proportion of larvae from the reservoir-based shortjaw kōkopu populations will still be carried into the Tasman Sea and will help bolster the local larval pool.

In 2019, ten sexually mature shortjaw kōkopu were collected from two streams in the Waitākere Ranges / Te Wao nui a Tiriwa that are likely sustained by the same oceanic larval source. The candidate fish were successfully bred from in Manāki Whitebait's captive rearing facility in Warkworth and a series of staged translocations into Watercare reservoir catchments are being planned. Receiver sites must be large enough and water resident times must be long enough for larval stages to be retained over the winter period where larvae can develop into juveniles (whitebait) and then for the juveniles to be able to reach natal rearing habitat upstream.

Other forest galaxiid species (kōaro – *Galaxias brevipinnis* and banded kōkopu – *Galaxias fasciatus*) have successfully established landlocked populations in Upper Nihotupu and Upper Huia reservoirs' feeder streams. Only Upper Huia Reservoir is known to be free from pest fish, however shortjaw kōkopu releases are proposed to be attempted at the others in the presence of pest fish. Monitoring of the shortjaw kōkopu populations after release will be implemented to determine the success of the programme.

**Lamprey (piharau, *Geotria australis*)**

Lamprey were assessed as Regionally Critical with a population of less than 250 mature individuals. The species is only known from Piha Stream within the Waitākere Ranges /Te Wao nui a Tiriwa but more recently, additional potential sites were identified by eDNA sampling, but remain unconfirmed through physical survey. Auckland Council is planning targeted eDNA surveys in the Waitākere Ranges / Te Wao nui a Tiriwa and on Aotea / Great Barrier Island – the importance of these sites as a potential refuge for lamprey cannot be understated.

Despite its divergent life history to our other threatened native freshwater fish species, pouched lamprey are impacted by similar habitat and water quality pressures. Juveniles and to a lesser extent, the freshwater phase of spawning adults, are potentially just as vulnerable to large-magnitude flood events. The weak dispersal of larval lamprey in freshwater means they cannot readily escape large scale perturbations and colonise new habitats. Furthermore, the modifying effect of climate change on oceanic currents and therefore also the distribution of the lamprey's host fish species, has the potential to disrupt the adult marine phase (Egan et. al., 2020).

Lamprey are also impacted by Lamprey Reddening Syndrome (LRS) – a condition which is thought to make fish more susceptible to bacterial infection and is linked to mass mortality in the South Island (Brosnahan et al., 2017). While some fish were infected by the low incidence exotic bacteria *Aeromonas salmonicida*, no causal pathogen has been identified for LRS.

Next-generation sequencing (NGS) research conducted by NIWA shows lamprey are a panmictic population across the country with no structuring. New Zealand's single population may extend all the way to Australia, suggesting that there is a high degree of genetic oceanic mixing (Cindy Baker, pers. comm.).

NIWA's research also indicates a cumulative effect may be occurring as a consequence of temperature changes and reduced chemical cues. Fewer lamprey occur in the North Island than in the South Island (Miller et al., 2019) and lamprey are anti-tropical and more sensitive to temperature (Cindy Baker, pers. comm.). While the exact mechanisms are unknown, a temperature gradient affecting dispersal up and down the country and with fewer adults in northern waters and diminished chemical cues attracting spawning adults back into Auckland streams, there is concern lamprey populations will shift gradually southwards (Cindy Baker, pers. comm.). Further elevation of ambient stream temperatures in northern areas may further diminish the long-term prospects of lamprey occupying Auckland streams.

Increasing lamprey populations is difficult as synthesising lamprey pheromone attractants in volumes sufficient to attract spawning migrants into Auckland streams is too costly (Cindy Baker,

pers. comm.). Artificial propagation, i.e., placing captive bred ammocoetes back into the streams, notionally holds greater promise for attracting adult migrants back into Auckland streams. However, this would not address the issue of temperature intolerance and avoidance. The temperature moderating effect of the Waitākere Ranges / Te Wao nui a Tiriwa's reference state forested streams holds greatest promise for maintaining the presence of lamprey in Auckland (Cindy Baker, pers. comm.).

**Īnanga (īnanga, matamata, *Galaxias maculatus*)**

Although not assessed as threatened, īnanga are now in decline due to pressures including ongoing habitat loss – particularly spawning habitat, and fish passage barriers. Auckland Council has partnered with Whitebait Connection to identify and restore īnanga spawning sites. Spawning occurs in the lowland reaches of rivers and streams, which tend to be subject to the greatest development pressure. In urban areas, the banks of realigned lowland streams are often hardened, or streams are lost altogether to reclamation. A reduction in īnanga spawning habitat nationally has created a lifecycle bottleneck for the whitebait fishery. Wetlands, the preferred habitat of īnanga, are greatly diminished in their extent in the region and so it often falls upon lowland rivers and streams to provide both spawning and rearing habitat. By spawning along discrete and truncated sections of streambank, often spanning no more than a few lineal metres, it is feasible to protect eggs and enhance spawning habitat in small coastal streams if nests can be found. Efforts to date have identified over 30 spawning sites, with many of these having management interventions implemented such as fencing, revegetation, and predator control (Briar Broad, pers. comm.).

**Eels (tuna, *Anguilla spp.*)**

Little data exists for eel populations in the region as they are not part of any monitoring programme. The catches of longfin eel (Tuna, *Anguilla dieffenbachii)* have been decreasing nationally since records began, suggesting this is reflective of a general decrease in populations and indicative of overfishing. While catch per unit effort (CPUE) in Auckland has been stable between 1991-2018, the total allowable commercial catch (TACC) has been consistently under caught and landings since 2018 have reduced considerably (Ministry for Primary Industries 2021a). While commercial catch data is useful where no population monitoring data exists for longfin eel, this information is confounded by several factors. Longfin eels are less sought after than shortfin eel (tuna, hau, *Anguilla australis)* and the majority of habitat in the region is either in reserves or in areas rarely or never commercially fished. As a result, it is difficult to assess if the commercial longfin eel fishery is a significant pressure for this species in the region due to the lack of data. Longfin eels are variously impacted by habitat loss, water quality decline and compromised fish passage.

Streams within park and reserve land are sometimes fished illegally and, using baited nets, it is possible to coax eels out of reserve reaches and into nets set outside of and upstream of reserves. Auckland Council is working on improving fish passage throughout the region and improved planning mechanisms and technical advice make it easier now for wood to be added to streams as habitat enhancement. This is relevant as long fin eel require ever larger habitat as they mature. Auckland's typically low order, over simplified streams, are often bereft of daytime large cover large enough to conceal adult longfin eel.

### Marine wanderers

Three species – estuarine triplefin (*Forsterygion nigripenne*); grey mullet (Kanae, *Mugil cephalus*); and yellow eye mullet (Aua, *Aldrichetta forsteri*), were identified as Data Deficient in this assessment.

Dunn et al. (2018), assessed these three species as Nationally Not Threatened. They have been included in this assessment for completeness as they are present and have been recorded in freshwater habitat in Tāmaki Makaurau / Auckland, but each with the qualifiers of being Data Poor on population size and trend. By occupying freshwater only occasionally/opportunistically and by being set apart from the Ministry of Primary Industries quota management system, neither yelloweye mullet nor estuarine triplefin are monitored by central or local government agencies, a situation likely to be consistent throughout the country. There was insufficient information available on the population state and trend for estuarine triplefin or yelloweye mullet for the panel to confidently assess these species for the region.

Grey mullet are a fishery stock managed by the Ministry for Primary Industries (2021b); however, there is no recent information available on the recreational catch of this species and the commercial catch data available for the region was insufficient to allow the panel to confidently assess the conservation status of this species for the region.

### Next steps

A comprehensive framework and plan for management needs for threatened species as well as species-led outcome monitoring are being developed under Auckland Council's BFA programme. The programme aims to provide more reliable population state and trend data, allow for adaptive management, and improve outcomes for threatened species in the region.

There is a significant amount of future work required to survey, manage, monitor, and protect threatened freshwater fish species within the region. Working alongside mana whenua and in continued partnership with communities, researchers, private landowners, and other agencies will be critical for ensuring the long-term survival of the freshwater fish species in Tāmaki Makaurau / Auckland.

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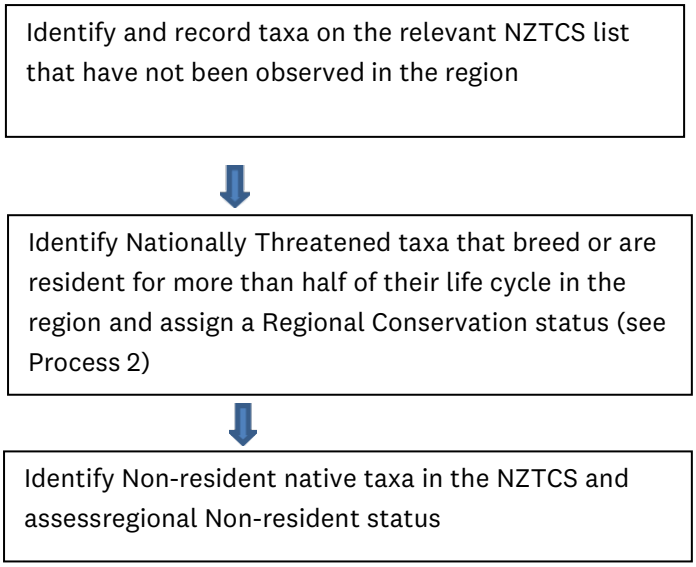
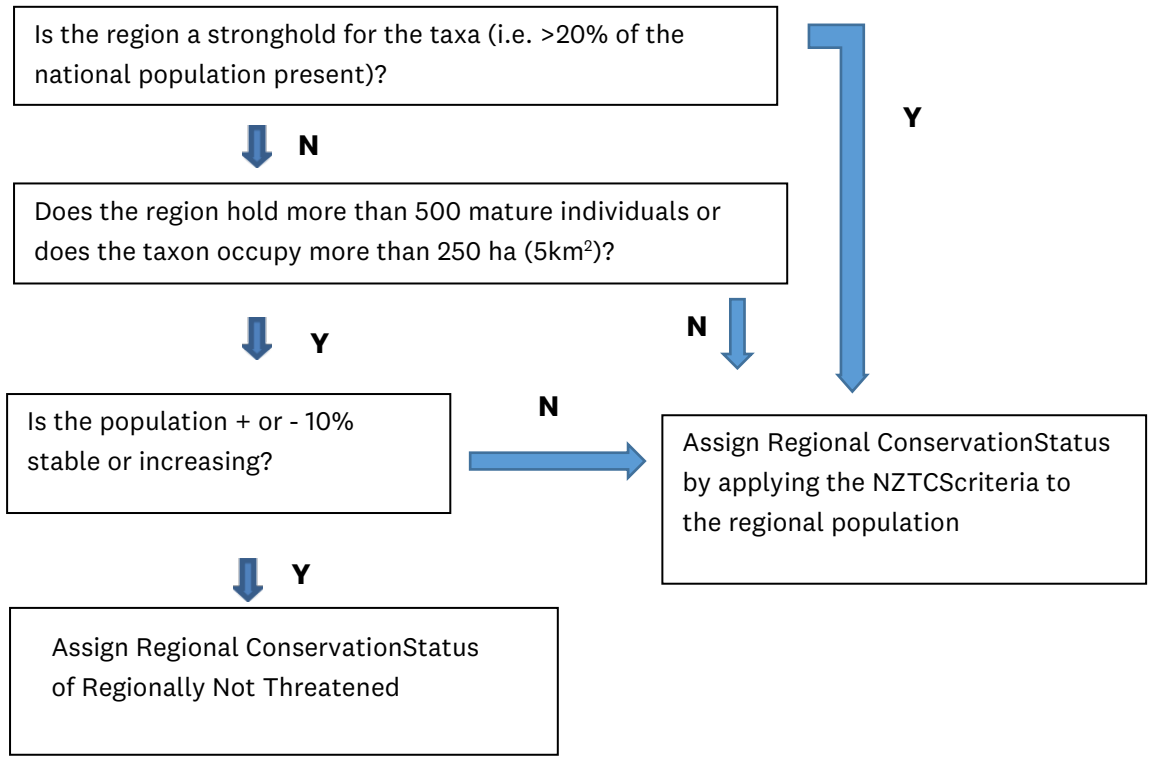
# Appendix 1: Process for determining the regional conservation status of a species

**Process 1: Determination of regional threat status**




**Process 2: Determination of strongholds and Regionally Not Threatened species**



# Appendix 2: List of national and regional qualifiers

| Code | Qualifier | Qualifier type | National / Regional | Description |
|---|---|---|---|---|
| DPR | Data Poor: Recognition | Assessment Process Qualifier | National | Confidence in the assessment is low because of difficulties in determining the identity of the taxon in the field and/or in the laboratory. Taxa that are DPR will often be DPS and DPT. In such cases, the taxon is most likely to be Data Deficient. |
| DPS | Data Poor: Size | Assessment Process Qualifier | National | Confidence in the assessment is low because of a lack of data on population size. |
| DPT | Data Poor: Trend | Assessment Process Qualifier | National | Confidence in the assessment is low because of a lack of data on population trend. |
| DE | Designated | Assessment Process Qualifier | National | A taxon that the Expert Panel has assigned to what they consider to be the most appropriate status without full application of the criteria. For example, a commercial fish stock that is being fished down to Biomass Maximum Sustainable yield (BMSy) may meet criteria for 'Declining', however, it could be designated as 'Not Threatened' if the Expert Panel believes that this better describes the taxon's risk of extinction |
| IE | Island Endemic | Biological Attribute Qualifier | National | A taxon whose natural distribution is restricted to one island archipelago (e.g. Auckland Islands) and is not part of the North or South Islands or Stewart Island/Rakiura. This qualifier is equivalent to the 'Natural' Population State value in the database. |
| NS | Natural State | Biological Attribute Qualifier | National | A taxon that has a stable or increasing population that is presumed to be in a natural condition, i.e., has not experienced historical human-induced decline. |
| RR | Range Restricted | Biological Attribute Qualifier | National | A taxon naturally confined to specific substrates, habitats or geographic areas of less than 1000 $km^2$ (100 000 ha), this is assessed by taking into account the area of occupied habitat of all sub-populations (and summing the areas of habitat if there is more than one sub-population), e.g. Chatham Island forget-me-not (*Myosotidium hortensia*) and Auckland Island snipe (*Coenocorypha aucklandica aucklandica*).<br><br>This qualifier can apply to any 'Threatened' or 'At Risk' taxon. It is redundant if a taxon is confined to 'One Location' (OL). |
| Sp | Sparse | Biological Attribute Qualifier | National | The taxon naturally occurs within typically small and widely scattered subpopulations. This qualifier can apply to any 'Threatened' or 'At Risk' taxon. |
| NO | Naturalized Overseas | Population State Qualifier | National | A New Zealand endemic taxon that has been introduced by human agency to another country (deliberately or accidentally) and has naturalised there e.g., *Olearia traversiorum* in the Republic of Ireland. |

| Code | Qualifier | Qualifier type | National / Regional | Description |
|---|---|---|---|---|
| OL | One Location | Population State Qualifier | National | Found at one location in New Zealand (geographically or ecologically distinct area) of less than 100 000 ha (1000 $km^2$), in which a single event (e.g. a predator irruption) could easily affect all individuals of the taxon, e.g. L'Esperance Rock groundsel (Senecio esperensis) and Open Bay Island leech (*Hirudobdella antipodum*). 'OL' can apply to all 'Threatened', 'At Risk', Non-resident Native – Coloniser and Non-resident Native – Migrant taxa, regardless of whether their restricted distribution in New Zealand is natural or human-induced. Resident native taxa with restricted distributions but where it is unlikely that all sub-populations would be threatened by a single event (e.g. because water channels within an archipelago are larger than known terrestrial predator swimming distances) should be qualified as 'Range Restricted' (RR). |
| SO | Secure Overseas | Population State Qualifier | National | The taxon is secure in the parts of its natural range outside New Zealand. |
| SO? | Secure Overseas? | Population State Qualifier | National | It is uncertain whether a taxon of the same name that is secure in the parts of its natural range outside New Zealand is conspecific with the New Zealand taxon. |
| S?O | Secure? Overseas | Population State Qualifier | National | It is uncertain whether the taxon is secure in the parts of its natural range outside New Zealand. |
| TO | Threatened Overseas | Population State Qualifier | National | The taxon is threatened in the parts of its natural range outside New Zealand. |
| TO? | Threatened Overseas? | Population State Qualifier | National | It is uncertain whether a taxon of the same name that is threatened in the parts of its natural range outside New Zealand is conspecific with the New Zealand taxon. |
| T?O | Threatened? Overseas | Population State Qualifier | National | It is uncertain whether the taxon is threatened in the parts of its natural range outside New Zealand. |
| CI | Climate Impact | Pressure Management Qualifier | National | The taxon is adversely affected by long-term climate trends and/or extreme climatic events. The following questions provide a guide to using the CI Qualifier:<br><br>Is the taxon adversely affected by long-term changes in the climate, such as an increase in average temperature or sea-level rise?<br><br>If NO = no Qualifier but needs monitoring and periodic re-evaluation because projected changes to the average climate and sea-level rise may adversely impact the taxon (including via changes to the distribution and prevalence of pests, weeds and predators) in the future.<br><br>If YES = CI Qualifier<br><br>Is the taxon adversely affected by extreme climate events, such as a drought, storm or heatwave?<br><br>If No = no Qualifier but needs monitoring and periodic re-evaluation because projected changes to the climate are likely to increase the frequency and/or severity of these events in the future.<br><br>If YES = CI Qualifier<br><br>Use of the Climate Impact Qualifier would indicate the need for more in-depth research, ongoing monitoring of climate impacts, and potentially a climate change adaptation plan for the taxon. |

| Code | Qualifier | Qualifier type | National / Regional | Description |
|---|---|---|---|---|
| CD | Conservation Dependent | Pressure Management Qualifier | National | The taxon is likely to move to a worse conservation status if current management ceases. The term 'management' can include indirect actions that benefit taxa, such as island biosecurity. Management can make a taxon CD only if cessation of the management would result in a worse conservation status. The influence of the benefits of management on the total population must be considered before using CD. The benefit of managing a single subpopulation may not be adequate to trigger CD, but may trigger Partial Decline (PD). Taxa qualified CD may also be PD because of the benefits of management. |
| CR | Conservation Research Needed | Pressure Management Qualifier | National | Causes of decline and/or solutions for recovery are poorly understood and research is required. |
| EW | Extinct in the Wild | Pressure Management Qualifier | National | The taxon is known only in captivity or cultivation or has been reintroduced to the wild but is not self-sustaining. Assessment of a reintroduced population should be considered only when it is self-sustaining. A population is deemed to be self-sustaining when the following two criteria have been fulfilled: it is expanding or has reached a stable state through natural replenishment and at least half the breeding adults are products of the natural replenishment, and it has been at least 10 years since reintroduction. |
| EF | Extreme Fluctuations | Pressure Management Qualifier | National | The taxon experiences extreme unnatural population fluctuations, or natural fluctuations overlaying human-induced declines, that increase the threat of extinction. When ranking taxa with extreme fluctuations, the lowest estimate of mature individuals should be used for determining population size, as a precautionary measure. |
| INC | Increasing | Pressure Management Qualifier | National | There is an ongoing or forecast increase of > 10% in the total population, taken over the next 10 years or three generations, whichever is longer. This qualifier is redundant for taxa ranked as 'Recovering'. |
| PD | Partial Decline | Pressure Management Qualifier | National | The taxon is declining over most of its range, but with one or more secure populations (such as on offshore islands).<br><br>Partial decline taxa (e.g. North Island kākā *Nestor meridionalis septentrionalis* and Pacific gecko *Dactylocnemis pacificus*) are declining towards a small stable population, for which the Relict qualifier may be appropriate. |
| PF | Population Fragmentation | Pressure Management Qualifier | National | Gene flow between subpopulations is hampered as a direct or indirect result of human activity. Naturally disjunct populations are not considered to be 'fragmented'. |
| PE | Possibly/Presumed Extinct | Pressure Management Qualifier | National | A taxon that has not been observed for more than 50 years but for which there is little or no evidence to support declaring it extinct.<br><br>This qualifier might apply to several Data Deficient and Nationally Critical taxa. |
| RF | Recruitment Failure | Pressure Management Qualifier | National | The age structure of the current population is such that a catastrophic decline is likely in the future.<br><br>Failure to produce new progeny or failure of progeny to reach maturity can be masked by apparently healthy populations of mature specimens.<br><br>Population trend qualifiers. |

| Code | Qualifier | Qualifier type | National / Regional | Description |
|---|---|---|---|---|
| Rel | Relict | Pressure Management Qualifier | National | The taxon has declined since human arrival to less than 10% of its former range but its population has stabilised.<br><br>The range of a relictual taxon takes into account the area currently occupied as a ratio of its former extent. Reintroduced and self-sustaining populations within or outside the former known range of a taxon should be considered when determining whether a taxon is relictual.<br><br>This definition is modified from the definition of the At Risk – Relict category in the NZTCS manual (Townsend et al. 2008). The main difference is that trend is not included in the qualifier definition. This enables the qualifier to be applied to any taxon that has experienced severe range contraction, regardless of whether that contraction continues or has been arrested.<br><br>This qualifier complements the 'Naturally Uncommon (NU)' qualifier which can be applied to taxa whose abundance has declined but which continue to occupy a substantial part of their natural range. |
| FR | Former Resident | | Regional | Breeding population (existed for more than 50 years) extirpated from region but continues to arrive as a regional vagrant or migrant. FR and RN are mutually exclusive. |
| HR | Historical Range | | Regional | The inferred range (extending in any direction) of the taxon in pre-human times meets its natural limit in the region. |
| IN | Introduced Native | | Regional | Introduced to the region, though not known to have previously occurred in it. |
| NS | National Stronghold | | Regional | More than 20% of the national population breeding or resident for more than half their life cycle in the region. |
| NR | Natural Range | | Regional | The known range (extending in any direction) of the taxon meets it natural limit in the region. |
| RE | Regional Endemic | | Regional | Known to breed only in the region. |
| RN | Restored Native | | Regional | Reintroduced to the region after having previously gone extinct there. |
| TL | Type Locality | | Regional | The type locality of the taxon is within the region. Ignore if the taxon is or has ever been regionally extinct. |

# Appendix 3: Species that have become extinct or may have formerly occurred in the Tāmaki Makaurau / Auckland Region

| Species | Status | Justification |
|---|---|---|
| *Prototroctes oxyrhynchus* Günther, 1870<br>Grayling | Extinct | This species has not been observed nationally since the 1920s.<br>It is the only freshwater fish in New Zealand considered to have become extinct. |

Find out more: pestfree@aucklandcouncil.govt.nz
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aucklandcouncil.govt.nz

Auckland Council
Te Kaunihera o Tāmaki Makaurau