Te Uru Kahika Regional and Unitary Councils Aotearoa

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Threatened Species Action Plans under the National Policy Statement for Freshwater Management:

Regional council perspectives

Envirolink 2506-NLCC131

Prepared for
Nelson City Council and MBIE Envirolink

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Cover photograph: A helping hand for an adult shortjaw kōkopu (*Galaxias postvectis*) being measured during a spotlighting survey on the South Island's West Coast. Photograph: Shane Orchard

Abbreviations

AC	Auckland Council
BAS	Baseline Attribute State
BOPRC	Bay of Plenty Regional Council
CBD	Convention on Biological Diversity
DOC	Department of Conservation
eDNA	Environmental DNA
ES	Environment Southland
Fish-IBI	Fish Index of Biotic Integrity (Joy & Death, 2004)
FMU	Freshwater Management Unit
GDC	Gisborne District Council
GIS	Geographic Information System
GWRC	Greater Wellington Regional Council
HBRC	Hawke's Bay Regional Council
IBI	Index of Biotic Integrity
IUCN	International Union for the Conservation of Nature
MBIE	Ministry of Business Innovation and Employment
NCC	Nelson City Council
NPS-FM	National Policy Statement for Freshwater Management
NZFFD	New Zealand Freshwater Fish Database
ORC	Otago Regional Council
REC	River Environment Classification (Snelder & Biggs, 2002)
RMA	Resource Management Act 1991
SJK	Shortjaw kōkopu (*Galaxias postvectis*)
SOE	State of the Environment
TAS	Target Attribute State
TDC	Tasman District Council
TRC	Taranaki Regional Council
TICI	Taxon-independent Community Index (Wilkinson et al., 2024)
UC	University of Canterbury
WRC	Waikato Regional Council

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Executive summary

Unitary and regional councils are addressing a range of policy, planning, monitoring and reporting responsibilities under the National Policy Statement for Freshwater Management 2020 (NPS-FM). Plans and actions must be developed in Freshwater Management Units (FMUs) where ecosystem health targets are not being achieved. These are measured on a 5-yearly cycle and include a focus on habitat critical for threatened species and other culturally important species that are dependent on freshwater. There is currently a gap in national guidance to assist the establishment of council best practice for setting and assessing management targets and identifying actions that can promote the recovery of threatened freshwater species and their habitats. Councils are seeking specific guidance on how science information can be used to address and implement these aspects of the NPS-FM, while also recognising a need to complement the work programmes and monitoring of threatened species managed by the Department of Conservation (DOC). To address these needs, work within council Special Interest Groups (SIGs) led to the development of a guidance project that was funded by MBIE Envirolink in 2024. This report presents results from the initial stage of the project which used an online survey to identify and collate regional perspectives on the potential components of action and recovery plans for threatened freshwater species with a particular focus on assisting councils with their responsibilities under the NPS-FM.

The survey was designed by the SWIM Fish Group members with input from technical and policy staff from councils and the Department of Conservation. Responses were gathered for a 9-week period to the end of 2024 and with some additional material collected in 2025 through direct correspondence. The objectives of the survey were to identify information on current approaches, information gaps, opportunities and key considerations for developing threatened species action or recovery plans using shortjaw kōkopu (*Galaxias postvectis*) as an example.

The survey questions addressed a range of topics including:

- Regional policy and planning contexts and current approaches
- Detection of shortjaw kōkopu and other threatened (target) species
- Delineation of sites, habitat and planning units
- Identifying target attributes and Target Attribute States (TAS) for NPS-FM action plans
- Information gaps or other limitations for the development of action plans and outcome monitoring
- Storing and sharing data on threatened fish species
- Perspectives on threats and pressures
- Priority topics for further consideration or clarification

Information was received from 11 regions with most of the responses being prepared by small groups of council staff who have direct experience working with shortjaw kōkopu and other native fish in their region.

1. Current planning approaches

Examples of current approaches include several regional planning mechanisms that have been developed for the protection of threatened freshwater species or their habitats with varying degrees of specificity. They include at least four different planning methods (species lists, activity classes, spatial planning and temporal controls), that can be used in isolation or in various combinations. Spatial controls specific to threatened species mostly take the form of activity rules or non-statutory guidance for habitats that are identified on maps or in descriptive schedules of sites or reaches. Temporal controls include activity rules that apply during spawning or migration periods. Combinations of spatial and temporal controls are relatively common. However, many councils reported difficulties with the design of resource consent conditions that rely on spatial and temporal controls due to their reliance on knowledge of where threatened species occur in the

region, which is often patchy or absent. This illustrates the importance of plugging information gaps in the understanding of the distribution of threatened species and their habitats.

2. Detection of shortjaw kōkopu and other threatened (target) species

The most common format for the collection of field data on threatened fish species is the completion of targeted surveys in selected catchments. Some councils also complete such surveys at their State of the Environment (SOE) monitoring sites, or a subset of those sites. Only two councils (Otago and Wellington) considered that they had surveyed all waterways/ subcatchments with suitable habitat for shortjaw kōkopu, suggesting that comprehensive survey coverage has yet to be achieved across all relevant Freshwater Management Units (FMUs) in most regions.

3. Delineation of sites, habitat and planning units

A range of methods have also been used to define sites or planning units that are used in freshwater management plans and guidance materials (both statutory and non-statutory) including the abovementioned reliance on descriptive schedules of sites or reaches, in some case supported by visual data (e.g., on council planning maps or GIS platforms). They include records held in the NZFFD, DOC and council databases, predictions from species distribution models (SDM) and citizen science observations. A consistent approach has yet to emerge and the only a few councils have developed comprehensive maps of regional fish populations and habitats. Emerging issues include the prevalence of outdated records in archived material and methods for combining data from different sources with varying uncertainties.

Some councils have identified core or 'stronghold' populations for a least one threatened freshwater species. This is a planning approach being use by DOC in the Ngā Ika e Heke migratory fish workstream and is similar to the prioritisation of sites based on the concept of ecological 'significance'. This approach is generally in the development stage and requires further criteria to consistently define the highest priority locations at a regional scale. It also presents opportunities to support and align with DOC threatened species recovery programmes. A range of data sources have used for the identification of priority sites and planning units such as 'strongholds' (e.g., NZFFD records, spotlighting surveys and eDNA sampling). It is potentially also desirable to use all the available data for conservation planning applications such stronghold assessments. This suggests that some thought should be given to the opportunities and caveats associated with combining data from different sources for these purposes.

4. Identifying target attributes and Target Attribute States (TAS)

The survey highlighted a general inertia around the topic of identifying target attributes and Target Attribute States (TAS) as required under the NPS-FM. While it is expected that these processes will occur under the auspices of regional council planning or associated collaborations, there is currently some uncertainty around the specific requirements. Council responsibilities include leading a process to identify the target attributes which must include consultation with stakeholder groups around the selection of appropriate metrics for assessment purposes and the setting of desirable targets in the degraded FMUs that are identified.

Some of the current inertia also relates to widespread concerns around the usefulness of the Fish-IBI as a target attribute or indicator of freshwater ecosystem degradation. Although the Fish-IBI might provide one indicator of aquatic ecosystem health, which is a relevant consideration for State of the Environment (SOE) monitoring, the metric is not specific to the measurement of status or trends in threatened aquatic species. There was generally agreed that it is too broad to provide a reliable indicator of specific pressures or drivers of degradation are the focus of threatened species assessments or action and recovery planning. Potential solutions include a comment from Waikato Regional Council suggesting that Fish-IBI might be best seen as a separate focus from the topic of preparing threatened species action or recovery plans, despite that the NPS-

FM requires its measurement and reporting at the scale of FMUs that may be addressed by action plans (i.e., due to its identification as a compulsory attribute). The limitations of the Fish-IBI also make it clear that additional target attributes and TAS will need to be identified to develop fit-for-purpose indicators for threaten species action or recovery planning. The development of a consistent and fit-for-purpose approach to the identification of attributes for the characterisation of degraded FMUs is an important topic to progress as soon as possible. It has a pivotal role in informing subsequent steps such as the setting of target attribute states (TAS) and measurement of baseline attributes states (BAS) to identify restoration needs and opportunities.

Perspectives on threats and pressures

A comparison of the top three ranked threats revealed considerable variation across regions. This suggests that the specific intervention points that will need to be identified and addressed by action plans are far from uniform. Combinations of multiple stressors are also likely to be commonplace and this will pose additional challenges for the development of effective recovery strategies in degraded FMUs (noting that this is also the overarching requirement of the NPS-FM). Across all regional responses, the degradation of adult fish habitat was the highest ranked factor, followed by lack of recruitment, connectivity issues, spawning habitat modification, predation, and fishing pressure. However, catchment-specific threats are common. Examples that were highlighted include the impacts of major storms on stream channel erosion and realignment, and from major hillslope erosion and associated sedimentation events as was seen in Cyclone Gabrielle. In response, Auckland Council has adopted a strategy of protecting geographically disparate populations to spread the risk of adverse regional outcomes that may from uncontrollable stochastic events, or other poorly understood stressors.

Knowledge gaps, limitations and priorities

There are significant gaps in knowledge and understanding of the distribution and management needs of many threatened species. Key information gaps and other challenges reported by councils include limited life history knowledge for several species, limited sub-population location knowledge or current extent of populations, and the lack of historical habitat data for comparisons. Current issues with the operation of the NZFFD were also noted by several councils. Most councils were of the view that further investment is needed to develop a robust data management system for collecting, storing, analysing, and reporting on freshwater species and habitat health monitoring data, including that undertaken as a requirement of resource consents.

Other reported challenges for councils include limited capacity to develop and enact action plans, limited funding and other essential resourcing, lack of coordination within and across agencies, and the need for integration between species and multi-species approaches. Several respondents also noted the importance of a ki uta ki tai mountains-to-sea approach to the design of recovery strategies, highlighting the need for the integration of assessments and actions across scales.

Four priority topics were identified for further attention:

1) Solutions to address information gaps on threatened species.
2) Procedures for identifying suitable target attributes and TAS for threatened freshwater species, including methods for consistent measurement and resolving the limitations of the Fish-IBI as a target attribute/ indicator.
3) Developing habitat-based approaches for council plans. This was seen as being consistent with the regional council mandate and could potentially benefit multiple species.
4) Aligning council plan development with the workstreams of other organisations, particularly DOC.

1. Introduction

Unitary and regional councils are addressing a range of policy, planning, monitoring and reporting responsibilities under the National Policy Statement for Freshwater Management 2020 (NPSFM). Plans and actions must be developed in Freshwater Management Units (FMUs) with degraded ecosystem health, including degraded habitat critical for threatened species dependent on freshwater. There is currently a gap in council guidance and national best practice for the identification of actions to avoid further decline of freshwater threatened species and their habitats.

Councils are seeking guidance on how science information can be used to address and implement the NPS-FM, while recognising that these responsibilities also need to complement the work programmes and monitoring of threatened species managed by the Department of Conservation (DOC) and other stakeholders. Although further reforms have been signalled, the NPS-FM was most recently updated in October 2024 (Ministry for the Environment, 2024). Some of the responsibilities it conveys include requirements to implement a National Objectives Framework (NOF) in each region and to develop plans and actions in Freshwater Management Units (FMUs) with degraded ecosystem health as measured using that framework. Four compulsory values must be considered in these assessments (ecosystem health, human contact, mahinga kai, and threatened species) (Table 1).

Threatened species are defined as any indigenous species of flora or fauna that:

(a) relies on water bodies for at least part of its life cycle; and

(b) meets the criteria for nationally critical, nationally endangered, or nationally vulnerable species in the New Zealand Threat Classification System Manual.

Some of the key tasks for councils include the identification of threatened species habitat and the assessment of habitat condition to identify degraded FMUs. These degraded FMUs are the subject of 'action plans' which must be prepared to facilitate their recovery as measured against target attribute states (TAS) that are monitored over time to track progress and demonstrate that the desired outcomes have been met. These assessment processes use the attributes that are identified through the NOF process and must also include one compulsory attribute for freshwater fish: the Fish Index of Biotic Integrity (Fish-IBI) (Joy & Death, 2004).

To address council needs, work within Special Interest Groups (SIGs) led to the development of a guidance project that was funded by MBIE Envirolink in 2024. This report presents results from the initial stage of the project which used an online survey to identify and collate regional perspectives on the potential components of action and recovery plans for threatened freshwater species with a particular focus on assisting councils with their responsibilities under the NPS-FM. In the development of the project, workshops convened by the Biodiversity SIG explored general concepts and key considerations for preparing action plans for threatened freshwater species. The SWIM Fish Group then initiated a collaborative project to develop council guidance using a migratory fish species (shortjaw kōkopu, *Galaxias postvectis*) as an example.

It was recognising that the development of such plans within unitary and regional council contexts would need to complement other work programmes for threatened species, particularly those that are managed by DOC. These are generally aligned with the requirements of other legislation such as the Conservation Act 1987 and include programmes such as Ngā Ika e Heke migratory fish workstream which has a focus on improving the security and supporting the recovery of four target species: shortjaw kōkopu, īnanga (*G. maculatus*), tuna / longfin eel (*Anguilla dieffenbachii*), and lamprey / kanakana / piharau (*Geotria australis*). Following a collaborative approach with input from DOC staff and other stakeholders, it was expected that national guidance on the preparation of council-led plans could promote the integration of efforts among groups working on threatened species and related projects such as the recovery of culturally important species.

The objectives of this first stage of the project were to identify information on current approaches, information gaps, opportunities and key considerations for developing action plans for threatened native fish species under the NPS-FM. An online survey was developed to gather information on current or desirable policy, rules or activity limits, monitoring and reporting practices, together with perspectives on information gaps, challenges and other constraints that are relevant to council responsibilities under the RMA and NPS-FM. An associated objective of the survey was to identify the key topics to be addressed in a facilitated workshop in the next stage of the project. Following the workshop a working group will develop a guidance document for the preparation of threatened species action or recovery plans using shortjaw kōkopu as an example.

Table 1. Compulsory values to be assessed under the National Policy Statement for Freshwater Management (NPS-FM) (Ministry for the Environment, 2024).

1 Ecosystem health
The extent to which an FMU or part of an FMU supports an ecosystem appropriate to the type of water body (for example, river, lake, wetland, or aquifer). There are 5 biophysical components that contribute to freshwater ecosystem health, and it is necessary that all of them are managed. They are: *Water quality* – the physical and chemical measures of the water, such as temperature, dissolved oxygen, pH, suspended sediment, nutrients and toxicants *Water quantity* – the extent and variability in the level or flow of water *Habitat* – the physical form, structure, and extent of the water body, its bed, banks and margins; its riparian vegetation; and its connections to the floodplain and to groundwater *Aquatic life* – the abundance and diversity of biota including microbes, invertebrates, plants, fish and birds *Ecological processes* – the interactions among biota and their physical and chemical environment such as primary production, decomposition, nutrient cycling and trophic connectivity. In a healthy freshwater ecosystem, all 5 biophysical components are suitable to sustain the indigenous aquatic life expected in the absence of human disturbance or alteration (before providing for other values).
2 Human contact
The extent to which an FMU or part of an FMU supports people being able to experience or connect with water through a range of activities such as swimming, waka, boating, fishing, mahinga kai, and water skiing, in a range of different flows or levels. Matters to take into account include pathogens, water clarity, deposited sediment, plant growth (from macrophytes to periphyton to phytoplankton), cyanobacteria, other toxicants, and litter.
3 Threatened species
The extent to which an FMU or part of an FMU that supports a population of threatened species has the critical habitats and conditions necessary to support the presence, abundance, survival, and recovery of the threatened species. All the components of ecosystem health must be managed, as well as (if appropriate) specialised habitat or conditions needed for only part of the life cycle of the threatened species.
4 Mahinga kai
Mahinga kai – kai is safe to harvest and eat. Mahinga kai generally refers to freshwater species that have traditionally been used as food, tools, or other resources. It also refers to the places those species are found and to the act of catching or harvesting them. Mahinga kai provide food for the people of the rohe and these sites give an indication of the overall health of the water. For this value, kai would be safe to harvest and eat. Transfer of knowledge is able to occur about the preparation, storage and cooking of kai. In FMUs or parts of FMUs that are used for providing mahinga kai, the desired species are plentiful enough for long-term harvest and the range of desired species is present across all life stages. Mahinga kai – Kei te ora te mauri (the mauri of the place is intact). In FMUs or parts of FMUs that are valued for providing mahinga kai, customary resources are available for use, customary practices are able to be exercised to the extent desired, and tikanga and preferred methods are able to be practised.

2. Methods

2.1 Council survey design

The online survey for this project was designed using a Microsoft Teams form administered by Nelson City Council. Initially a draft version was prepared to address key points identified for attention in SWIM Fish Group meetings in 2023 and 2024 that preceded this Envirolink project. These included a fish action plan hui held on 24 May 2024 which discussed regional council and DOC operational plans for shortjaw kōkopu. The background to the project was also summarised in a concept note that was distributed to SWIM group members and other interested parties during the development phase of the survey. Potential components of the survey were then discussed at meeting of the SWIM Fish Group on 3 September 2024 to attract feedback on the focus of the survey questions using shortjaw kōkopu as an example (Appendix 1). This was followed by a further round of consultation via email to develop a draft survey. The feedback was synthesised to produce a final draft version which was then tested by a group of four people in-house to check for user experience issues prior to the launch of the final public version (Appendix 2).

The survey questions were arranged in three sections addressing the following key topics:

- Existing programmes & resources
- Key considerations and opportunities for NPS-FM action plans
- Information gaps and monitoring capacity

2.2 Survey period and promotion

The survey was launched on 1 November 2024 and was open for a 9-week period through to 31 December 2024. During that time respondents were able to provide input using the online survey form and also modify previous contributions where needed before submitting a final version. The survey was promoted using email invitations distributed through the SWIM group, regional council and DOC contact lists. Email notification was sent to those who provided feedback on the draft survey together with a cover letter to invite participation from others. Reminder and follow-up emails were also sent closer to the closing date to encourage completion of the survey. By this time most of the council respondents had self-organised into small teams to prepare a collective response on behalf of their region. Following this development the survey period was extended until to allow completion of survey by the 11 councils that had expressed interest. Other than the initial and follow-up rounds of promotion that were sent to contacts in all regional councils (i.e., nationally), no further attempts to elicit responses from councils that had not provide response or made contact with the survey team prior to the closing date. This is acknowledged as a limitation of the survey and could potentially be addressed in follow-up work on this topic.

2.3 Data analysis

For this project, the survey results were not formally coded following social science research methods (e.g., Auerbach & Silverstein, 2003). Instead, the results were primarily compiled to support the identification of topics for further consideration in a follow-up workshop format in the next stage of the project. However, some of the key themes that were apparent in the survey findings were identified and summarised following a discourse of the collective subject approach (Lemos et al., 2019). Following this approach, key ideas and perspectives were identified in the survey responses, and similar concepts were then grouped together to build the collective discourse.

This summary report presents an overview of the main findings together with examples of the regional council approaches, challenges and key questions that were identified by participants in response to the survey questions. These are presented under the seven key topics that reflect the survey questions along include a selection of references to the planning methods and supporting resources that were identified in the survey results or analysis process.

3. Results

Information was received from respondents in 11 regions with most of the responses being prepared by small groups of council staff who have direct experience working with shortjaw kōkopu and other native fish in their region. There were no responses received from Horizons, Hawkes Bay, Canterbury or West Coast regions or the Chatham Islands. Only one region (Auckland) has an existing species recovery programme that is specific to shortjaw kokopu (see details in Appendix 3).

The remainder of this section presents the survey results grouped under seven major topics which address:

- Regional planning contexts and approaches
- Detection of shortjaw kōkopu and other threatened freshwater fish species
- Delineation of sites, habitat and planning units
- Identifying target attributes and Target Attribute States (TAS) for NPS-FM action plans
- Perspectives on threats and pressures
- Information gaps or other limitations
- Storing and sharing data on threatened fish species

Each of these represent different considerations for the development of threatened species action plans under the NPS-FM or recovery planning for aquatic species more generally.

3.1 Regional planning approaches for freshwater fish species

3.1.1 Statutory approaches

Responses to the question on statutory plan rules that are specific to the protection of shortjaw kōkopu (or other threatened freshwater fish species) included insights on their prevalence and perspectives on the place of such rules in the context of local government responsibilities. Several examples of regional planning approaches that have been developed for the protection of threatened freshwater species or their habitats with varying degrees of specificity. The regional planning approaches are grouped under five themes that represent methods which can be used in isolation or in various combinations (Table 2). These are: species lists, activity classes, mitigation hierarchy, spatial planning and temporal controls.

Combinations of spatial and temporal controls are relatively common. For example, the Bay of Plenty Regional Natural Resources Plan includes restrictions on river works in wet areas during spawning and migration periods at sites identified in Schedule 1 (Bay of Plenty Regional Council, 2023). As with other councils including Gisborne, such schedules of sites or areas may include entire stream catchments or tributaries that have been identified for their habitat values for one or more indigenous species. This approach demonstrates a degree of pragmatism and integration for addressing the needs of several species concurrently and may also help to provide a degree of protection for threatened species with poorly known distributions.

Comments from environmental policy staff also included the following perspective on council responsibilities in relation to habitats and species:

> *"The main thing that comes to mind is that this really needs to focus on the 'habitats of aquatic species'... as this is bit council have control over – anything species specific is more in DOC's space. This is true both from a physical restoration space and the policy space – we can create plans that protect remaining habitats, enable restoration of habitats, and require fish passage".*

Table 2. Examples of points of focus for regional planning approaches rules that have been developed for the protection of shortjaw kōkopu or other threatened freshwater fish species in different regions in Aotearoa.

Point of focus	Region	Details
Species lists		
Taonga species lists	Southland	A taonga species list identified in the plan is used to provide some additional protection alongside provisions for indigenous biological diversity and habitats more broadly. Similar approaches around the identification of a list of regional threatened or desirable species with higher conservation values are also used in other regions (e.g., Gisborne, Wellington).
Activity-classes		
Activity-based controls	All	Nearly all regions have some form of activity-based controls linked to threatened species lists (or similar) or formally defined planning units (i.e., identified sites or areas that require a higher level of protection from specified activities).
Permitted activity rules	Bay of Plenty	Permitted activity rules are often used to signify the lack of any specific controls for the purposes of protecting threatened species. For example, in the Bay of Plenty, the operative plan includes rules that apply to specific conditions if the activities are located within scheduled areas that are identified for the protection of aquatic species. Streambed work that generates sediment is limited to 48 consecutive hours. The change in the draft plan intends to introduce more protective measures (e.g. small-scale work generating sediment would be limited to 8 hours) and more comprehensive habitat sites. In comparison, activity-based controls that require a resource consent in the same areas apply to other activities including the placement of a ford, removing instream structures, or damming a waterway.
Mitigation hierarchy		
Limits to biodiversity off-setting and compensation	Wellington	The operative plan provides guidance on limits to off-setting (Schedule G2) and compensation (Schedule G3), which add specificity to the level of protection required when implementing the mitigation hierarchy. The guidance does not specifically reference the planning units used within the plan for the protection of threatened species, but does so indirectly through the use of terms such as 'habitats of threatened fauna', and reference to ecosystems or species that are 'threatened' as defined by the New Zealand Threat Classification System, or are naturally uncommon ecosystems (Williams et al., 2007). These terms are all relatively unambiguous and thereby provide useful guidance for the application of offsetting or compensation arrangements.
Spatial planning		
Indigenous fisheries classes	Waikato	Indigenous fisheries classes are used to identify streams/rivers having a higher fisheries classification based on indigenous fish values. In relation to taonga species lists (and similar) this approach provides much greater spatial specificity for the identification of sites requiring protection. This contributes to the integration of threatened / taonga species habitat protections in the wider gambit of spatial planning.
Identification of spawning habitat	Most regions	Most regions have adopted some form of spawning habitat identification that is linked to the planning approach for managing threatened, at-risk or taonga fish species in regional plans. This has mostly commonly been done for īnanga although there is considerable variance in the mapping or modelling techniques have been used for this purpose (Orchard, 2022; Orchard & Hickford, 2021). This strategy is an example of where a critical habitat (i.e., habitat of high importance for essential life stages) has been identified to facilitate the development of effective protection or restoration strategies for the species. In this sense it is similar to the abovementioned indigenous fisheries class approach used in Waikato (and similarly other expressions of ecological significance which accord higher value to certain sites) but is specifically oriented towards the identification of habitat used at a specific life stage.
Identification of migration corridors	Bay of Plenty	The critical habitat approach discussed above in relation to spawning habitat can also be usefully applied to identify the connectivity needs of migratory species by identifying the migration corridors they depend on. This has the potential to complement the current work underway on fish passage barriers that is oriented towards the remediation of threats to connectivity, which is particularly relevant to migratory fish species (Franklin et al., 2018). In this sense the mapping of migration corridors could provide a means of improving the recognition of species-specific connectivity needs that can inform the evaluation of fish passage barriers. Although there were no examples of migration corridor mapping being used within an operative regional plan identified in this study, new approaches being developed in the Bay of Plenty are exploring this avenue.

Table 2 (cont.)

Temporal controls		
Spawning seasons	Most regions	Temporal controls that are attached to activity-based rules (including permitted activity rules) are a common approach for protecting the spawning habitat of threatened fish species. They are typically applied to activities that are known or potential threats to spawning habitat with key examples including vegetation clearance (both mechanical and via grazing) and other forms of physical disturbance to the bed and banks of water bodies. It is also important to note a significant interaction with the critical habitat protection approaches discussed above in relation to spawning locations. Due to a comprehensive understanding of spawning locations being a significant information gap for most freshwater fish species, the temporal basis of spawning season controls provides an alternative strategy for affording protection at important times in the life cycle that does not depend on an in-depth understanding of actual or potential spawning habitat. In the interests of promoting the efficiency of planning approaches (e.g., RMA s32), however, it is desirable to link temporal controls with spatial specificity to avoid placing constraints on activities at locations where the anticipated outcome (i.e., protection of spawning habitat for target species) will not be generated. Examples of spawning season controls identified in survey responses include Rule 55A in the Proposed Southand Land and Water Plan (operative in part) which provides general conditions for activities in river and lake beds and requires that there is no disturbance of whitebait spawning habitat from the beginning of November until the end of May (Environment Southland, 2024).
Peak migration times	Most regions	Temporal controls that apply to certain activities at peak migration times are also a common approach used in regional plans. They are generally applied in a similar manner to the temporal controls for spawning habitat discussed above but may target different activities (i.e., those that are perceived to threats to fish migration). Examples of the use of peak migration time controls include the Tairāwhiti Resource Management Plan which identifies the peak and full range of spawning or migration times by month in schedule to the plan (Schedule G16) (Gisborne District Council, 2023).

3.1.2 Non-statutory approaches

The survey responses also indicated that there are many non-statutory approaches being used by councils for the purpose of protect shortjaw kōkopu or other threatened freshwater fish species and their habitats. These include non-regulatory strategies or plans and a variety of guidance materials that have been designed to engage with different stakeholder groups and audiences. In general, these have the objective of encouraging voluntary initiatives and 'good practice' that can help to protect or improve the recovery prospects of these species. Examples include the '*Rivers Activity Management Plan 2021-2051'* produced by Tasman District Council, which includes several recommendations that are not specific to threatened fish species but include guidance to improve fish passage (Tasman District Council, 2021). For example, it recommends that at replacement stage floodgates need to provide for fish passage. Similarly, catchment management plans for stormwater in Motueka and Richmond include aspirations and objectives for enhancing riparian habitat, stream health, and providing for fish passage. In Hawke's Bay, the '*Environmental Code of Practice for river control and waterway work*s' is another example of non-statutory guidance the is designed to reduce adverse effects on waterways but is not targeted at any particular species (Hawke's Bay Regional Council, 2017). However, a similarly focussed but more comprehensive guidance document that includes recommendations that are specific to threatened fish species has been produced by Horizons Regional Council (Horizons Regional Council, 2010).

Greater Wellington Regional Council also reports that that close collaboration between the freshwater science team and flood protection delivery department is a key strategy used to avoid known threatened species hotspots/strongholds. The demonstrates another level of non-statutory planning initiative that focuses on establishing face to face and working relationships rather than relying on passive guidance.

3.1.3 Experience with consent conditions

Responses to the survey questions on experience with developing or assessing resource consent conditions as a planning approach revealed that this is a challenging topic in practice. Contexts in which consent conditions have been used include erosion and sediment controls including the methodology and duration of instream works, fish rescue and relocation conditions, specification of water abstraction regimes, and control over the timing of disturbance activities to avoid peak spawning or migration times.

Many councils reported difficulties with the design of consent conditions that rely on spatial and temporal controls due to their reliance on knowledge of where threatened species occur in the region, which is often patchy or absent. This illustrates the importance of plugging information gaps in the understanding of threatened species and their habitats. Potential solutions were also noted by some respondents, including the strategy of protecting all fish without singling out threatened species such as shortjaw kōkopu.

As an example, a river structure resource consent issued by the Bay of Plenty Regional Council RM18-0530 includes the following consent condition:

> *"The consent holder shall ensure that any maintenance of structures is carried out to minimise the effect on fish passage and spawning by undertaking the works in accordance with the following: (a) In a manner that provides for the continued upstream and downstream movement of fish at all times; and (b) In stream works are completed outside of the fish spawning period of March to June, unless prior approval (in writing) is received from the Bay of Plenty Regional Council." More recent example include resource consent RM23-0471-AP; among a number of conditions, include "all works shall be undertaken in accordance with the certified Fish Management Plan".*

This example also aligns with the perspectives of several respondents who considered that specific provisions for threatened species were impractical as a focus for regional council management due to a combination of information gaps across all such species, and the perspective that a better focus might be the protection and enhancement of aquatic habitat for the many species that might potentially occupy an area. Thus, there is a tension between the level of need for approaches that would be effective for specific target species, and those that are capable of simultaneously protecting multiple species in the context of regional council actions and responsibilities.

3.2 Detection of shortjaw kōkopu and other threatened freshwater fish species

3.2.1 Detection methods

The survey responses indicated that a considerable range of data sources and data collection methods are being used by regional councils around the country and that there is far from a uniform approach to these data collection needs (Table 3). A consistent approach has yet to emerge and the only a few councils have developed comprehensive maps of regional fish populations and habitats. Emerging issues include the prevalence of outdated records in archived material and methods for combining data from different sources with varying uncertainties.

Field survey methods for the detection of shortjaw kōkopu and other threatened species included spotlighting surveys, electric fishing, eDNA sampling, and pheromone sampling for lamprey, complemented by community-based monitoring and casual observation recorded on citizen science platforms. All councils rely on existing records collected by other agencies including those archived in the New Zealand Freshwater Fish Database (NZFFD) or DOC records. Presence data from eDNA sampling is also becoming more commonplace and many regions are gathering eDNA sampling as an aspect of regular monitoring or using the technique to sample environments that are poorly sampled by other methods. Several councils reported the use of species distribution models to is an alternative to confirm to current data in SQL other councils indicated they were exploring opportunities to use these models in the future.

Table 3. Data collection methods and data sources used by regional councils to detect shortjaw kōkopu or other threatened freshwater fish species in the past five years.

Data collection methods and sources	Auckland	Northland	Waikato	Bay of Plenty	Gisborne	Taranaki	Wellington	Nelson	Tasman	Otago	Southland
Spotlighting	✓	✓			✓	✓	✓	✓	✓	✓	
Nets/traps		✓	✓	✓	✓	✓	✓	✓		✓	
Electric fishing		✓	✓	✓	✓	✓	✓	✓	✓	✓	
eDNA sampling	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Passive pheromone samplers for lamprey								✓	✓		
Survey data from other organisations		✓	✓	✓	✓	✓	✓	✓		✓	✓
Participatory/Citizen science data		✓	✓				✓	✓		✓	
Presence determined by modelling				✓			✓	✓	✓	✓	

3.2.2 Spatial scale of assessments

Survey results indicated that the primary mode of data collection used by most regional councils was the completion of threatened fish surveys in selected catchments. However, only two councils (Otago and Wellington) considered that they had surveyed all waterways/ subcatchments with suitable habitat for shortjaw kōkopu, suggesting that comprehensive survey coverage has yet to be achieved across all relevant FMUs in most regions. Some councils also complete threatened fish surveys at their State of the Environment (SOE) monitoring sites, or a subset of those sites (Table 4).

Table 4. Spatial scale of shortjaw kōkopu or other threatened freshwater fish species distribution mapping and assessment.

Spatial scale of assessment	Northland	Auckland	Waikato	Bay of Plenty	Gisborne	Taranaki	Wellington	Nelson	Tasman	Otago	Southland
Threatened fish surveys in selected catchments	✓	✓		✓	✓		✓	✓	✓	✓	
All waterways/ subcatchments with suitable habitat/ FMUs							✓			✓	
State of the Environment (SOE) monitoring sites			✓			✓	✓	✓	✓		
At a subset of SOE monitoring sites									✓		✓
Ad hoc assessments where information is available											✓

3.3 Delineation of sites, habitat and planning units

3.3.1 Spatial definition of sites and/or habitats

Five of the 11 regions reported examples of spatially defined sites and/or habitats for shortjaw kōkopu with the other six regions reported a lack of progress in this topic to date. The five regions are shown in Table 5 along with details of the planning contexts and factors used to define the sites and planning units that are referenced in regional plans.

Gisborne: threatened freshwater species have been identified to date using records in the New Zealand Freshwater Fish Database (NZFFD) as well as supporting regional data. It is noted that this approach requires revision. As a poorly fished region it is likely that threatened species will also be found outside of the areas that have been surveyed. The identified sites and/or habitats have been incorporated into the relevant regional plan as both regionally and nationally rare or threatened species and / or aquatic ecosystem types (e.g., as referenced in plan rules).

Bay of Plenty: the identification of shortjaw kōkopu and lamprey habitat in 21 waterways using NZFFD records. These are included in the operative plan by way of a schedule (Schedule 1 – Aquatic Ecosystem Areas). However, a draft plan change also includes maps of migration pathways based on species distribution models (SDMs).

Wellington: reports that this currently undertaken by considering the presence/absence of shortjaw kōkopu (and lamprey) based on a combination of NZFFD records, GWRC database, and eDNA surveys. Fieldwork is undertaken to confirm historic/old records and indigenous knowledge of fish populations. The operative Natural Resources Plan identifies catchments where threatened species are present in Schedule F based on these records (while also noting a high likelihood of gaps due to reliance on presence records). Additionally, Proposed Plan Change 1 gives effect to NPS-FM requirements to identify threatened species and their critical habitat attributes. It includes updates to Schedule F which identifies the presence of indigenous species within rivers and lakes in the region. The updates were made in response to new information, including new presence records for giant bully, redfin bully, lamprey, and shortjaw kokopu from recent surveys in the region.

However, this mostly reflects only two of the five Whaitua programme[1] catchments (Te Whanganui-a-Tara and Te Awarua-o-Porirua) that were a focus for recent surveys Plan Change 1 is currently in the hearing stage and includes a range of rules that use the information in Schedule F to guide the activity status of activities and determine whether resource consent is required.

Otago: reports the use of spatial data on freshwater fish habitat including records from DOC that are linked to REC segments. These have been redrawn to more closely follow water bodies visible on satellite imagery to support the development of Otago's draft Land and Water Plan 2024.

Nelson: reports that this topic is a work in progress and that the council is looking to use both fish records and modelling to produce distribution maps for the region.

Table 5. Data sources and metrics that are used to define sites or planning units for shortjaw kōkopu or other threatened fish species in regional council plans.

Region	Data sources	Metrics used to delineate/define sites	Associated planning units	Relevant plan if mentioned
Gisborne	NZFFD	Presence records	Areas of Significant Conservation Value that are identified on planning maps and referred to in plan	Te Papa Tipu Taunaki o te Tairāwhiti. Tairāwhiti Resource Management Plan (2023)
Bay of Plenty	NZFFD, DOC, species distribution models (SDMs) (Crow et al., 2014; Leathwick et al., 2008)	Presence records, SDM predictions	Water bodies identified using catchment and reach descriptions in a schedule to the plan (Schedule 1)	Bay of Plenty Regional Natural Resources Plan (2023)
Wellington	NZFFD, GWRC database, eDNA		Water bodies identified using catchment and reach descriptions in a schedule to the plan (Schedule F)	Te Tikanga Taiao o Te Upoko o Te Ika a Maui Natural Resources Plan for the Wellington Region (2023)
Otago	NZFFD, DOC,	Presence records	No specific planning units identified in operative plan. New proposed planning units in proposed Land and Water Plan identified using catchment and reach descriptions in an appendix to the plan (APP4) and visualised on planning maps	Regional Plan: Water for Otago (2022). [draft] Proposed Land and Water Plan (2024)
Nelson	NZFFD, DOC	Presence records	Schedule of sites described in an appendix to the plan (Appendix 6) and visualised on planning maps	Nelson Resource Management Plan (2024)

[1] see https://www.gw.govt.nz/environment/freshwater/protecting-the-waters-of-your-area/)

3.3.2 Critical habitat and 'stronghold' populations

The concept of critical habitat is a central component of the NPS-FM requirements. It is fundamentally informed by essential steps in the life cycle and for many aquatic species will include distinct habitat types used at different stages. For migratory species these may be widely dispersed and additional rely on migratory corridors and connections. It may also be interpreted at several spatial scales in relation to individual FMUs and collections of FMUs regionally or nationally, where for example the highest priority sites may be identified for monitoring or additional protection.

Four of the 11 participating councils have identified core or 'stronghold' populations for a least one threatened freshwater species (Northland, Auckland, Taranaki and Wellington). This is a planning approach being used by DOC in the Ngā Ika e Heke migratory fish workstream and is similar to the prioritisation of sites based on the concept of ecological significance.

Quantitative measures that were used to define strongholds and high conservation priority were most often associated with a threshold of 20% of the population over a given area. Other criteria that can be used define high priority sites include areas with high densities, low levels of habitat modification, or apparently stable populations. These quantitative measures with associated thresholds or ranking systems can be applied to single variables or ensembles at catchment or FMU scales and at regional and national scales to assess regional and national priorities. In the context of the NPS-FM they could also be used to address the focus on critical habitats where it is desirable to define the areas that provide the most benefit within each critical life stage. Some councils also reported that they have been interpreting the stronghold concept in the context of their general knowledge of where healthy populations are located, suggesting that the further development of expert-derived approaches would offer additional value and robustness.

Overall, the survey responses suggest that spatial prioritisation approaches are generally at an experimental stage in regional planning contexts and would benefit from the further guidance on the selection of the value-based criteria that provide the rationale for defining high priority locations. This practical focus shows an important socio-ecological connection in action since the weighting of preferred outcomes will markedly influence the spatial priority. Because of this, the use of spatial prioritisation approaches to allocate resources or investments in preferred outcomes requires a depth of stakeholder engagement that can be supported through co-design and collaboration. These considerations are particularly important because the priority sites that are identified will normally be subject of additional investments or more stringent protective measures. It is critical for such investments to be well designed to achieve their purposes, especially where resources are limited.

The topic of site prioritisation and stronghold populations is recommended for further consideration to identify appropriate methods for varying environmental contexts. There is also an important intersection with the availability of information on different species and the level of uncertainty inherent in existing data sources. A further aspect for consideration is the question of the appropriate scale at which to identify priority areas. For example, they could be identified at a national and/or bioregional scale through a coordinated approach, rather than at the scale of regional boundaries that may be somewhat arbitrary in relation to ecological patterns and processes. From this perspective, the identification of national priority sites could become a topic for cross-agency collaboration that is used subsequently to guide regional and local implementation.

3.3.3 Data sources and uncertainties

A range of data sources can be used for the identification of population distributions and priority sites for freshwater species (e.g., fishing and trapping methods, electrofishing, spotlighting surveys, eDNA sampling, pheromone sampling, fish tagging, tracking and recapture, historical records, and numerical model predictions). In many cases it is desirable to use all the available data for planning applications such habitat mapping and spatial prioritisation assessments. This suggests that some thought should be given to the opportunities and caveats associated with combining data from different sources, each of which has their own uncertainties.

Factors that are relevant to these considerations include the potential inaccuracies introduced by:

- False negative (Type II) error rate of each data collection method, which relates to the detectability of the species with the sampling unit and varies for each method.
- The representativeness of the spatial unit that is used in the survey protocol.
- A consistent spatial basis for the sampling unit across data sources. This is a problematic topic for the interpretation of eDNA results since it is not possible to resolve the difference between a weak eDNA source located close to the sampling point and a strong source from a much distant location. This creates difficulties for inferring abundance from eDNA and also for determining the spatial extent of the sampling unit that is represented by the protocol (Orchard, 2023).
- When combining empirical data (e.g., presence / absence) with modelled predictions, a suitable threshold is needed to calibrate the model output with expected presence, and this varies with each model (e.g., see Crow et al., 2014; Leathwick et al., 2008; Orchard 2020). Alternatively, it may be possible to base distribution and prioritisation assessments on model predictions alone if they can be considered to provide a reliable representation of the true population. This is a promising future direction for species distribution modelling but also highlights the need for the validation of models. Independent data sources are ideally used to verify a model's ability to provide reliable predictions in unsampled areas. For many species, there is a need to significantly improve the spatial coverage of field survey data to support robust model development. The acquisition of additional model training and validation data can also provide strategic direction for investments in field surveys. Targeted survey designs can help to improve adequate representation across environmental gradients or improve the understanding of site-specific factors such presence of fish passage barriers or predators).

3.4 Identifying target attributes and Target Attribute States

3.4.1 Perspectives on Fish-IBI

The fish Index of Biotic Integrity (Fish-IBI) provides a relative measure of fish diversity that is directly required by the NPS-FM. Perspectives on the use of the Fish-IBI to inform action or recovery plans for threatened freshwater species suggest that it has some significant limitations as a target attribute for the NPS-FM (Table 6). Notable limitations of the Fish-IBI include the perspective that it is too broad to provide a reliable indicator of specific pressures or drivers of degradation are the focus of threatened species action or recovery planning. Although the Fish-IBI might be useful as an indicator of the aquatic ecosystem health, which is a relevant consideration for State of the Environment (SOE) monitoring, the metric is not specific to the measurement of status or trends in threatened aquatic species.

Responses to the question on the role of the Fish-IBI in relation to other target attributes that might be used included:

- Fish-IBI is generic and we need to target SJK.
- No relationships between Fish-IBI, macroinvertebrates and water quality target attributes
- Not enough research available to make a good correlation between TAS and Fish-IBI.
- Fish IBI alone cannot be used, water quality attributes and other ecology attributes needed for action plans.
- If TAS for habitat components impacting a threatened species could be determined this would be more informative.
- No relationship unless threatened species had a higher score – otherwise just the same as other fish species.

Potential solutions include a comment from Waikato Regional Council suggesting that Fish-IBI might be best seen as a separate focus from the topic of preparing threatened species action or recovery plans, despite that the NPS-FM nonetheless requires its measurement and reporting at the scale of FMUs that may be addressed by action plans. Topics that are recommended for further consideration at the upcoming workshop include

the variation and potential standardisation of methods for the derivation of Fish-IBI from different data sources, which include the potential use of eDNA data in combination with field survey data and historical records. In addition, the limitations of the Fish-IBI also make it clear that additional target attributes and TAS will need to be identified to develop fit-for-purpose indicators for threaten species action or recovery planning.

3.4.2 Selection of target attributes

The survey results highlighted a general inertia around the topic of identifying target attributes that are additional to the Fish-IBI for the purpose of developing action plans for threatened species under the NPS-FM. It was noted that this inertia partly relates to uncertainty around the extent of council responsibilities in these processes and also the potential for further reforms of the NPS-FM.

Council responsibilities include leading a process to identify the target attributes which includes consultation with stakeholder groups around the selection of appropriate metrics and setting of desirable TAS at the scale of FMUs. There is also some uncertainty around the specific requirements and appropriate timelines due to the potential for further reforms of the NPS-FM.

Suggestions on target attributes that might be useful for regional/ FMU specific planning included:

- Cultural values (e.g., mahinga kai values).
- IUCN Green Status of Species metrics (IUCN, 2021).
- Viable populations (of the target species).
- Habitat amount (e.g., extent or similar metric).
- Habitat condition, including connectivity considerations (e.g., implications of fish passage barriers for migratory species).
- Spawning occurrences or spawning habitat locations.
- Deposited sediment.
- Pest fish metrics.

The development of a consistent and fit-for-purpose approach to the identification of attributes for the characterisation of degraded FMUs is an important topic to progress as soon as possible. It has a pivotal role in informing subsequent steps such as the setting of TAS and measurement of baseline attributes states (BAS) to identify restoration needs and opportunities.

Table 6. Regional council perspectives on the utility of the Fish-IBI in action or recovery planning for freshwater fish.

Region	Perspectives on the Fish-IBI
Northland	Fish surveys started 3 years ago, baseline yet to be calculated for target setting. Given IBI's limitations, Action plan idea based on IBI is still under discussion.
Waikato	We have issues with IBI at certain sites i.e. behind dams, pest fish - it just provides a general measure which is largely arbitrary. We see IBI as separate to SJK action plans.
Bay of Plenty	The utility of Fish-IBI is not particularly useful, because we don't know what environmental drivers affecting fish composition are at sites.
Gisborne	We have derived Fish IBI from eDNA data however we didn't pick up short-jaw or giant kokopu which suggests a disagreement between eDNA results and our freshwater plan species list[2] which raises some questions. Unsure how IBI caters to regionality. IBI is presence/absence based, not abundance-based – which can limit its specificity.
Taranaki	As the calculator only takes into consideration presence and absence and not abundance … the tool can be misleading. One lonely SJK holds the same weighting as 1000 SJK in the same stretch.
Wellington	Not directly a fan of the F-IBI. Find that index too sensitive to incidental captures. Capturing a rare or migrating species one year and not during another year has the potential to substantially affect the Fish-IBI score. This problem occurs due to the low total (max) number of species expected in any given locations.
Nelson	Fish-IBI doesn't recognise threated species.
Tasman	TDC has not yet established a network of annual monitoring sites for reporting on Fish IBI using the Joy et al. (2013) sampling protocols. Data from 21 reaches of 150 m surveyed to inform other objectives were analysed to determine a baseline attribute state (BAS) for a seven-year period 01/07/2016 to 30/06/2023. The five-year periods defined by TDC policy and science staff for water quality were not appropriate for Fish IBI given the lack of annual monitoring data; 18 of the reaches were only monitored once. The fish IBI calculated is a measure of the freshwater fish community on that occasion rather than being a median. The limited data for fish IBI suggest Tasman sites are largely in the A and B bands with only one site requiring improvement from a C band. These data, most from one survey occasion, may overestimate the health of fish communities in Tasman with a risk that regulatory and non-regulatory improvement actions are not scaled accordingly. A larger Tasman dataset (1291 NZFFD records from Tasman between 1970 and 2013) analysed in Joy et al. (2013) suggests a B band average across all sites and a C band average for urban and rural areas. The TICI from eDNA samples collected in 2023 suggests a higher proportion of waterbodies in Tasman being rated poor like a C band. Preliminary analysis of the surface water quality data collected monthly also indicates a higher proportion of sites being in the C band and requiring improvement actions. In summer 2024 TDC will establish annual monitoring for a network of wadeable streams according to national protocols to better understand the health of freshwater habitats and aquatic life and to report on Fish IBI. If our annual monitoring indicates fish IBI scores are lower in some FMU compared to others, then this information could trigger actions within FMU Action Plans.
Otago	Examination of Fish-IBI scores from a few dozen sites in Otago since 2009 showed that IBI scores jumped around within a band, and sometimes across three whole bands. This makes interpretation of the Fish-IBI tricky and the exact "trigger" of an action plan to address this even trickier. This happened at sites affected and not affected by diadromous migration. It may be hard to discern signal from noise, i.e., detecting trends of any species or of ecosystem health from this metric. Additionally, the presence of a single individual fish contributes to the score, so declining trends are detected too late through the IBI. Scores are unlikely to drop and stay low until local extirpation, by which point, an action plan may be too late to address the driver(s) of decline. The monitoring that contributes to Fish-IBI reporting is likely resource-intensive and tells regional councils so much more than required to report on through the NPS-FM. Sites where Fish-IBI is measured are often SOE sites for water quality or ecosystem health. These may poorly represent the habitats of SJK or other threatened species as they have not been established for the purposes of measuring the achievement of threatened species objectives or the effectiveness of provisions in regional plans for threatened species. In terms of a trigger for an action plan, regional councils may identify other (more relevant) triggers for an action plan to support the achievement of an environmental outcome associated with the threatened species compulsory value (e.g., NPS-FM 3.12(3)(b)).
Southland	The fish IBI may not have a strong relationship with the presence or abundance of threatened species; also too influenced by community composition.

[2] Schedule G7B, Tairāwhiti Resource Management Plan (2023)

3.5 Perspectives on threats and pressures

3.5.1 Regional ranking of threats

Survey questions that sought information on the main threats or pressures that limit the persistence and natural recovery of threatened fish included an exercise that asked respondents to rank the top three threat types in their region using a pre-established list of six factors:

- Degradation of adult fish habitat (e.g., due to water abstraction, sediment deposition, elevated water temperatures).
- Connectivity/ fish passage issues.
- Predation of fish or eggs (various factors/ predators).
- Competition for resources from introduced fish species.
- Lack of recruitment.
- Limited spawning habitat (e.g. from modification of waterways).
- Fishing/ harvesting pressure.

A comparison of the top three ranked threats revealed considerable variation across regions (Table 7). This suggests that the specific strategies and intervention points that will need to be addressed by action plans are far from uniform. Combinations of multiple stressors are also likely to be commonplace and this will pose additional challenges for the identification of effective recovery strategies in degraded FMUs (noting that this is also the overarching requirement of the NPS-FM).

Across all regional responses, the degradation of adult fish habitat was the highest ranked threat, followed by lack of recruitment, connectivity issues, spawning habitat modification, predation, and fishing pressure. Examples of other factors that were thought to be important include the stochastic effects of storm damage to waterways through processes such as the erosion and turnover of stream channels or catastrophic sedimentation from hillslope erosion as was seen in Cyclone Gabrielle. It can also be noted that many of the factors have interactions, illustrating a need to consider multiple stressors simultaneously. For example, spawning habitat degradation may generate a bottleneck that could lead to recruitment limitations or local extinctions. Connectivity issues may contribute to the lack of recruitment in habitats that would otherwise be suitable.

Table 7. Regional council perspectives on the top three threats or pressures that limit the persistence and natural recovery of threatened freshwater fish.

Threat and pressures	Auckland	Northland	Waikato	Bay of Plenty	Gisborne	Taranaki	Wellington	Nelson	Tasman	Otago	Southland
Degradation of adult fish habitat	2nd	top	3rd		top	3rd	2nd	2nd	2nd	2nd	2nd
Connectivity issues						top			top		
Predation of fish or eggs	3rd	2nd	top	top						3rd	
Competition from introduced species			2nd	2nd							
Lack of recruitment.				3rd	2nd		top	top			top
Spawning habitat modification					3rd		3rd	3rd	3rd		3rd
Fishing/ harvesting pressure						2nd					
Other (e.g., impacts of major storms)	top	3rd								top	

top ranked threat or pressure 2nd ranked threat or pressure 3rd ranked threat or pressure

3.5.2 Catchment-specific threats

Responses to the question on threats that are specific to a catchment (and might be atypical of the region) included some useful insights for the development of threatened species action or recovery plans. These include the comments from the Auckland region where many of the known shortjaw kokopu populations are found within protected reserve land, but predation pressure on spawning sites remains an issue. Similarly, the potential impacts of stream denaturing from climate change induced storm events may affect populations in legally protected area. Therefore, the focus for Auckland Council has been to establish geographically disparate populations to spread the risk of adverse regional outcomes resulting from uncontrollable stochastic events, or poorly understood pressure such as predation.

In Gisborne, council staff were of the view that shortjaw kokopu may not be prevalent due to the characteristic specific geology of the region which is associated with high sediment yields and suspended sediment concentrations in many waterways. In addition, other threats that are often catchment-specific include fish passage/culvert/structure issues, types of land use, the lasting impacts from cyclones (include woody debris/slash entering waterways), ongoing sediment input, leaching from hazardous sites/landfills impacting water quality. Northland staff also identified situations where hydrological connectivity may be good (i.e., absence of physical fish passage barriers) but water quality issues in lower reaches might present a potential barrier. This is an interesting topic for further consideration in relation to the potential for water clarity or other geochemical connectivity barriers.

3.6 Storing and sharing data on threatened fish species

A range of systems for storing and sharing data on threatened fish species are currently being used by regional councils as summarised in Table 8. It is apparent that several councils are using in-house data storage systems that now include the development of repositories for eDNA data. Several councils also provided comments on the role of the NZFFD. These generally indicated that the NZFFD remains difficult to use for their purposes. Accessibility issues and the time-consuming nature of the user interface were some of the key concerns identified in council comments. It was also noted that further investment needs to be made into a robust data management system for collecting, storing, analysing, and reporting on freshwater species and habitat health monitoring data, including that undertaken as a requirement of resource consents.

Table 8. Data storage and sharing system used by regional councils for data on threatened freshwater fish

Region	Northland	Auckland	Waikato	Bay of Plenty	Gisborne	Taranaki	Wellington	Nelson	Tasman	Otago	Southland
Internal data storage systems											
Excel spreadsheets of data collected									✓		
KiECO† database (internal)	✓		✓								✓
External data storage systems for archiving or sharing											
Council fish survey data submitted to NZFFD	✓					✓	✓	✓	✓	✓	✓
Requirement for consent monitoring to be submitted to NZFFD						✓	✓	✓		✓	
eDNA records archived by an external provided (e.g., Wilderlab)					✓						
iNaturalist platform used for data storage or sharing					✓						
In-house system for open/ public access to technical reports	✓	✓	✓	✓	✓		✓			✓	

† A proprietary ecological data management system, see https://www.kisters.net/kieco/

3.7 Information gaps or other limitations

There are significant gaps in knowledge and understanding of the distribution and management needs of many threatened species.

Reported information gaps across regions include the following comments:

- Lack of historical habitat data.
- Limited life history knowledge for several species.
- Limited sub-population location knowledge or current extent of populations.
- Lack of catchment knowledge (land use, activities).
- Lack of knowledge concerning extent of stream modification.
- Lack of understanding of the environmental drivers affecting fish community composition at micro; meso; macro scales.
- Limited knowledge of what threatened species exist within region.

Other reported challenges for councils include:

- Limited capacity to develop and enact action plans.
- Limited funding and other resourcing.
- Lack of coordination within and across agencies.
- Need for integration between species and multi-species approaches.

Several respondents also noted the importance of a mountains-to-sea approach to the design of recovery strategies, highlighting the need for integration of assessments and actions across scales.

Insights from environmental policy staff included the following perspective on the design and scope of NPS-FM action plans:

> *TDC's current policy approach is to have one Action Plan per FMU that over time can cover all the issues so they can be considered in an integrated manner – it will be an interesting consideration for how species-specific action plans and the fish passage action plans can be amalgamated. TDC have a Tākaka Freshwater Action Plan that needs to identify the causes of nitrate degradation and ways we can address these. Species specific plans are probably Phase B, while a more general "improve habitat diversity and connections" should be Phase A.*
>
> *TDC could more usefully develop Action Plans for all freshwater dependent species– including riparian species, birds, bats and plants, i.e. if we provide habitat for the fish and invertebrates this should also help meet the habitat needs for bats, and if we provide for healthy riparian margins this should help both aquatic and terrestrial species and plants with biological corridors and connections etc. One key difficulty with a species approach, is we only have the information on what threatened species we have in Tasman from the past somewhat limited investigations/monitoring (we don't know what we don't know). The DOC threatened species database includes all sorts of species (including fungi), but without spatial references on where these are found – or could be found and does not acknowledge that many of the species classed as terrestrial are dependent on riparian/waterbodies. Rather than trying to plug this massive information gap, there is a more pragmatic approach of providing for habitat diversity ('build it and they will come') while avoiding perverse outcomes, e.g. important that wetland restoration efforts do not inadvertently remove required habitat types.*

4. Summary and next steps

4.1 Key themes

The regional council perspectives collated in this project highlight some important questions and uncertainties associated with the management of threatened freshwater species in the context of regional planning.

Some of the key challenges that were identified include:

- The lack of information on the distribution of many freshwater species, which is a significant concern since the NPS-FM directly requires councils to identify the habitats of threatened species as a precursor to other actions.
- Uncertainty around the best approaches for identifying target attributes that are required to measure the status of threatened freshwater species and their habitats, and for setting appropriate targets. There are several notable sub-components of these uncertainties including widespread agreement that the only compulsory attribute for freshwater fish (Fish-IBI) is not particularly useful as a measure of the status of threatened species. This implies that other attributes, which are largely yet to be developed and standardised, will be needed for this task.
- The identification of strategies for addressing information needs is a key topic for further consideration because the opportunities to identify and measure baseline and target attributes depend considerably on the existing data sources and data collection techniques that are practical for councils to implement.
- Clarifying the role of regional plans alongside the work of other agencies, including the responsibilities and expectations around environmental data collection and future monitoring.

A notable theme in the survey results is the presence of a tension between the species-specific aspects of the NPS-FM (i.e., due to the requirements for threatened species) and the perspectives of regional council staff that draw attention to the practicalities of addressing individual species. The NPS-FM includes several nuances that contribute to these tensions. They include the need to identify target attributes and TAS to inform the design of baseline assessments and monitoring programmes that can gauge trends in those attributes.

The same conceptual approach and its component attributes could also be used to provide an indication of a species' status and recovery trends across larger spatial domains including regions, bioregions or nationally. This suggests that the identification of such attributes and potentially also the setting of TAS should be seen as shared responsibilities across all relevant stakeholders notwithstanding that regional councils are the subject of specific responsibilities set down in the NPS-FM.

Obtaining a better understanding of the complementarity of responsibilities and collaborative opportunities between the key agencies emerged as strong theme in the survey results that is recommended for further exploration in the upcoming workshop. To a degree of this is already happening, often on an *ad hoc* basis between staff in different agencies. However, there is no consistent approach or overarching framework for such collaboration between the agencies for most freshwater species. The few examples that do exist are also often outdated (e.g., with regards to the availability of new information, monitoring techniques and environmental changes) suggesting that the lead agencies that have been involved in developing those initiatives may not have had the capacity to carry them forward. Examples include the New Zealand Large Galaxiid Recovery Plan (2003 - 2013) which is now considerably outdated (Department of Conservation, 2005).

The development of inter-agency strategies for collaboration and stakeholder engagement is a key activity to support the NPS-FM requirements and future regulatory developments. Opportunities for collaborations that might improve efficiencies include the development of shared strategies for information collection and monitoring of target species, the identification of agreed metrics and indicators that could support this, the setting of appropriate targets to guide management actions, and in the development of implementation tools such as action or recovery plans. A collaborative approach with communities and tangata whenua is specifically required for the development of action plans under Section 3.15 of the NPS-FM.

It was also noted that there were often uncertainties around the permitting/concession requirements of various organisations with responsibilities in the freshwater ecosystem management space (e.g., Ministry for Primary Industries, Fish & Game and DOC) which may be needed to carry out fish and other species survey work. Mechanisms for streamlining these requirements may be beneficial.

4.2 Priority topics for further consideration

Priority topics that were identified for further consideration at the SWIM threatened species workshop include strategies for:

1) strategies for addressing information gaps on threatened species.
2) identifying suitable target attributes and TAS for threatened freshwater species, including attention to the adoption of consistent methods (e.g., for the measurement of such attributes) and the potential limitations posed by resourcing constraints. This includes exploring and resolving the limitations of the Fish-IBI as a useful indicator of threatened freshwater species status.
3) developing habitat-based approaches for action or recovery plans that could potentially benefit multiple species and make use of an appropriate combination of statutory and non-statutory approaches.
4) coordinating and aligning efforts to develop action or recovery plans to ensure that council-led planning approaches complement the workstreams of other organisations (particularly DOC).

5. Acknowledgements

We are grateful to all of the councils and individual participants who responded to the online survey and acknowledge MBIE Envirolink for providing funding under Envirolink 2506-NLCC131. Thanks to Roger Uys (GWRC) for chairing the Biodiversity Working Group meetings that discussed the initial concept with support from the Ministry for the Environment. We thank the SWIM Fish Group members for initiating and guiding this project. We also thanks Matt Bloxham (AC) for providing the case study featured in Appendix 3, and Stefan Beaumont for peer review. Members of the Steering Group that has been convened to support this project are Shane Orchard, Paul Fisher, Shirley Hayward, Ciaran Campbell, Roger Uys, Bram Mulling and Jane Goodman.

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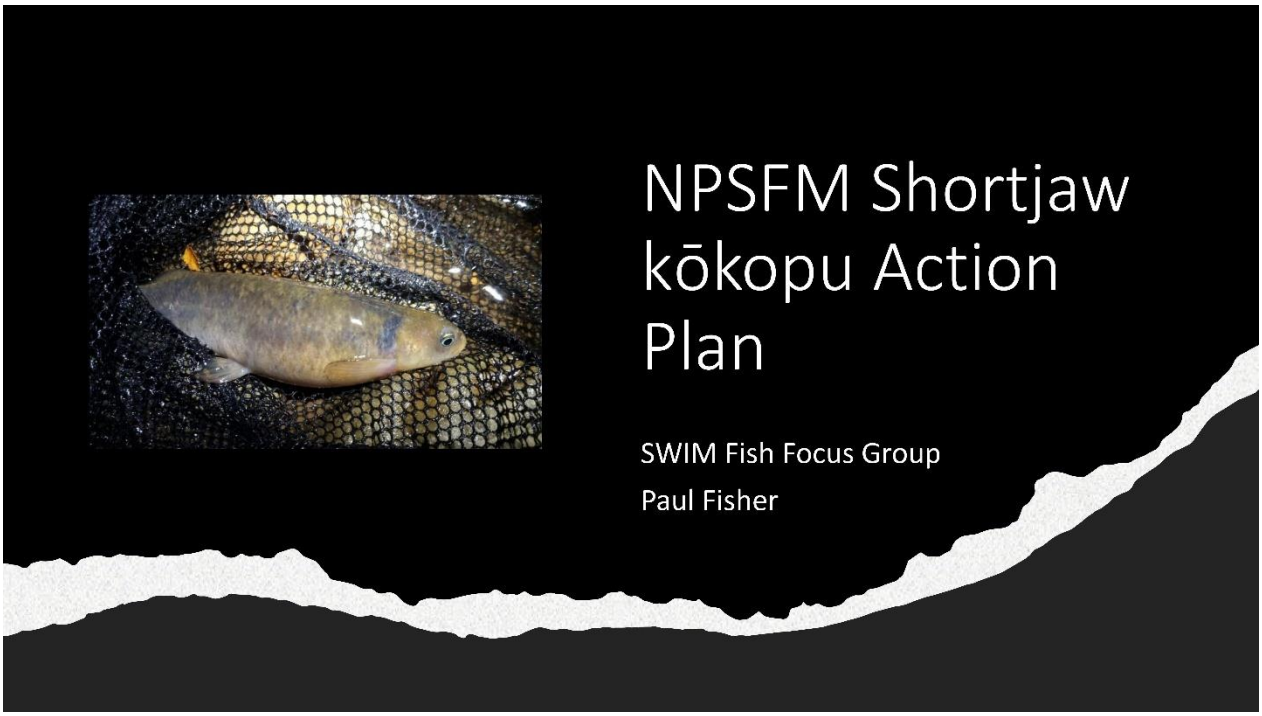
Appendix 1: Shortjaw kōkopu test case presentation



NPSFM Threatened Species Critical Habitat for Fish - Shortjaw Kōkopu Action Plan example

Guiding Principles - MFE Threatened species workshop Roger Uys (GWRC)

For any species included in NPSFM Action Plans under the NOF, the attributes are used to inform management of that threatened species and critical habitat.

Councils have been encouraged to apply an ecological lens when interpreting lifecycle in the NPSFM definition of Threatened Species (e.g. fish spawning, migration, juvenile/adult distribution and habitat requirements)

Baseline states and a timeline established to achieve the defined environmental objective. Threatened species will require improvement.

Set target attribute states (TAS) to monitor the progress and whether council policies or interventions (i.e., Plan rules/Action Plan) are effective in achieving the objective.

Why choose shortkjaw kōkopu?

- Already a lot known about the species ecology, threats, monitoring
- Well defined habitat requirements
- Fragmented distribution – defined subcatchments
- Largely migratory – fish passage / catchment scale management to estuaries
- Protection of shortjaws also protect other fish species
- Mitigation and management of adverse effects

DOC Migratory Species Action Plan - setting objectives and outcomes

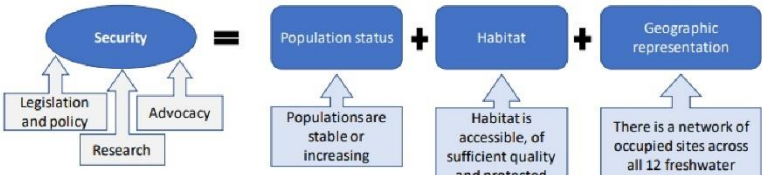
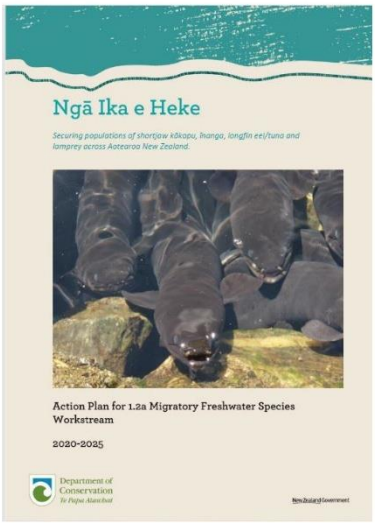


Figure 1. The elements of 'security' and how it is supported, as set out in the Biodiversity Contingency Business Case 2018, and associated statement of priorities for migratory freshwater fish.

DOC Action Plan based on national objectives to protect threatened fish species and habitat

Ngā Ika a Heke A project to secure populations of shortjaw kōkopu, īnanga, longfin eel/tuna and lamprey across Aotearoa New Zealand.



DOC guidance for Shortjaw kōkopu Monitoring Approach based on bioregions (landscape scale), J. Goodman et al.,

Includes:

Critical habitat

Threats and pressures

Mitigation options

Site selection

Monitoring methods

Data collection

Refinement and validation of eDNA surveys for detecting shortjaw kōkopu (*Galaxias postvectis*) in New Zealand streams

Shane Orchard

Environmental objective: The freshwater habitats of threatened species are protected, and threatened species have persisted and recovered in the [Blank] FMU.

Shortjaw kōkopu—**attributes** that tell us about the **species**, aligned with the **environmental outcome**

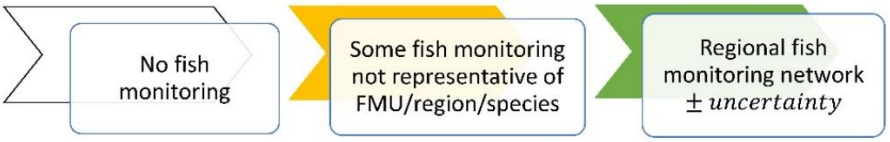
Attribute (what):	Attribute (how):
Presence in an FMU	Observation records in NZFFD, iNat, regional council monitoring, DOC monitoring, etc. Annual presence in each FMU.
Area of occupancy (ha)	The area within a taxon's range which is occupied by the taxon, excluding cases of vagrancy. Annual AOO based on the last 5yrs observations in each FMU.
Recovery (green status)	IUCN green score: • A taxa occurs in a representative set of ecosystems within its range. • A species is viable (i.e., Least Concern) and the taxon is not undergoing decline in the region. • Ecological functional. The degree to which the taxa performs its role as an integral part of the ecosystem(s).
Others??	Review current data and see which measures would make good attributes that you have enough information to set baselines/targets Review survey and monitoring protocol, and see which measures would make good attributes that you may have data on already, or will be in a position to collate/collect data on shortly.

Simple ---> Complex

Shortjaw kōkopu—**attributes** that tell us about the **habitats** of the species aligned with the **environmental outcome**

Attribute (what):	Attribute (how):
Ecosystem health attributes (Appendix 2A and 2B)	Aquatic life, water quality, ecosystem processes, habitat attributes for lakes and rivers within sites
Security (Dependent on regional threats/pressures and existing habitat condition)	Habitat loss and degradation (altered hydrology, pollution, food supply, spawning habitat, riparian cover, others Whitebait present (river mouth) Fish passage maintained Introduced pest species/predation Pathogens & parasites Climate change Instream works (local) Level of protection provided by tenure Consents nearby
Shortjaw kōkopu habitat specifics	Quality of instream and riparian habitat for adult and juveniles Extent of habitat Absence of introduced predators? Others?

Regional council fish challenges



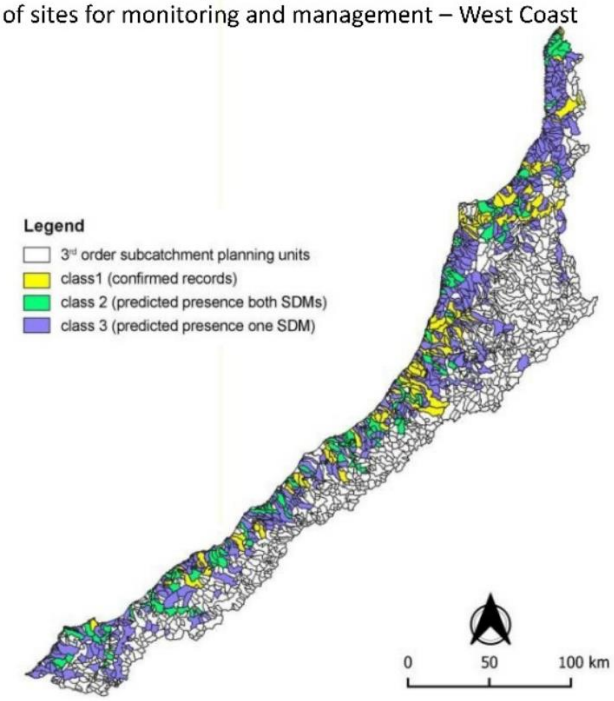
- Progressive approach – development of Action Plan and monitoring programme
- *Presence/absence of threatened species* - populations and identifying strongholds

e.g. eDNA surveys at historical and potential new sites

- Establish *FMU/catchment specific priorities* for the protection of critical habitat and hydrological connectivity

Geospatial representation of shōrtjaw sites in FMU Action Plan or Regional Plan

e.g. DOC/Orchard (2023)
Use species distribution models (SDMs), Leathwick et al. (2008) and Crow et al. (2014)
Prioritisation of sites for monitoring and management – West Coast



Appendix 2: Survey format and questions

SWIM Threatened Species Action Plan / Recovery Plan Survey

Key considerations for developing a Threatened Species Action Plan or Recovery Plan for shortjaw kōkopu and other freshwater fish species

Objectives
The objectives of this survey are to identify information on current approaches, information gaps, opportunities and key considerations for developing a Threatened Species Action Plan for threatened native fish under the National Policy Statement for Freshwater Management (NPS-FM) using shortjaw kōkopu (*Galaxias postvectis*) as an example.

The survey questions ask for information that is relevant to the development of such Plans for threatened native fish in general, including opportunities to provide examples or highlight issues for particular species.

The final set of questions are specific to shortjaw kōkopu and have the objective of identifying the key topics to be addressed in a facilitated workshop with an expert science and policy panel, which will develop a guidance document that uses shortjaw kōkopu as an example.

It is hoped that results from this survey and the workshop process will assist regional councils and other stakeholders involved in the development of Threatened Species Action Plans or similar Recovery Plans for shortjaw kōkopu and other threatened freshwater fish species in Aotearoa.

Background
The questionnaire content has been informed by Special Interest Group (SIG) led workshops chaired by Roger Uys (Greater Wellington Regional Council/Biodiversity SIG) in which six topics were identified as key elements for further consideration in the context of preparing Threatened Species Action Plans under the NPS-FM.

These topics are:

- Integrating science and policy in regional plans
- Identifying spatial planning units for management actions (including monitoring), and policy/outcomes reporting
- Target Attributes and Target Attribute States (TAS) to be identified in policy for the species and habitat
- Identifying habitat requirements and threats to the species / habitat
- Selection of actions to address key threats
- Monitoring programme design and field survey protocols

Survey Privacy Statement

Thank you for participating in this survey.

This survey is open access to anyone with the link and does not require a login or other identifying information to participate. The survey includes a brief set of demographic questions that are designed to provide information on the skills/ experience background and regional coverage of the information provided by survey participants. The information collected will not be used for any other purpose other than to inform the development of a Threatened Species Action Plan for shortjaw kōkopu. Your responses will not be available to anyone other than the researchers who are involved in this project. Any personal identifiable information that is (intentionally or unintentionally) shared in survey responses will be stored in secure systems for the duration of the project and destroyed at project completion.

Anonymised data will be presented in a survey report to be shared with stakeholders in the SWIM group and all survey participants should they wish to receive a copy. This same anonymised information will also be used as the basis for a further workshop process to develop a Threatened Species Action Plan for shortjaw kōkopu (scheduled for early 2025).

Please see further instructions below for completing the survey.

Instructions

It is not necessary to provide an answer to all questions.
Please answer any questions you can provide information on.
Please simply skip questions that are outside of your area of expertise or reply with 'N/A'.

Collective responses
Several questions ask for information on current or desirable approaches for a particular context or region with a particular focus on the responsibilities of, regional councils. We encourage you to collaborate with colleagues in your organisation when preparing responses, which can be provided as a collective response from one or more people.

Editing your response
This Teams survey format allows you to edit your survey responses at any time up until the closing date. This will support the preparation of collective responses and the inclusion of additional information that may come to find after considering the survey questions.

Closing date
The closing date for the survey is 31 December 2024

Survey time
We suggest allowing at least 1 hour to complete the survey, which will partly depend on the level of detail you wish to provide on the survey questions.

Demographics Information

1. Name / Nickname

2. Region you are providing information on

(Select all that apply)

- Northland
- Auckland
- Waikato
- Bay of Plenty
- Gisborne
- Taranaki
- Horizons
- Hawkes Bay
- Wellington
- Marlborough
- Nelson
- Tasman
- West Coast
- Canterbury
- Otago
- Southland
- National
- Other

3. Institution / Affiliation (select the option(s) that should be associated with your survey responses)

	Select
Research Institute/CRI	◯
Council	◯
DOC	◯
Central government agency	◯
NGO	◯
Environmental contractor/ consultancy	◯
Individual perspective (no institutional affiliation is associated)	◯
Other	◯

4. Your background / experience

	Select all that apply
Technical / Science	◯
Policy / Planning	◯
NGO / Community sector	◯
Other (please provide details)	◯

A. EXISTING PROGRAMMES & RESOURCES

5. Does your organisation (or any you were involved with) already have NPS-FM Threatened Species Action Plans or other/ related Threatened Species Recovery Plans for shortjaw kōkopu (SJK) or other threatened freshwater fish species?

◯ Yes

◯ No

6. Please provide details of your plan in the text box below, including URL. Plans and supporting documents can also be emailed to Dr Shane Orchard s.orchard@waterlink.nz

Policy and planning approaches

7. Have you spatially defined sites for SJK or other threatened freshwater fish species and/or habitats for planning or management purposes?

   ◯ Yes

   ◯ No

8. What factors were used to define the above mentioned sites or planning units?

9. Can you provide examples of statutory plan rules that are specific to the protection of SJK or other threatened freshwater fish species or their habitats in your region?
   If yes, please provide a summary or links to these examples

10. Please include details of any temporal controls (e.g., critical periods during which certain activities are to be avoided) for SJK or other threatened freshwater fish species in your region

11. Please include details of any non-regulatory plans, agreements or guidance that are designed to protect SJK or other threatened freshwater fish species and their habitat

12. Have you used or assessed consent conditions that directly or indirectly protect SJK or other threatened freshwater fish species and their habitat (e.g., during river works for flood protection, gravel removal and restoration activities).

    If yes, please provide links to examples (or details) under each of the following categories:

    (i) avoids potential or known fish spawning areas during breeding

13. (ii) avoid and minimise adverse effects to fish habitat from sedimentation

14. (iii) have the objective of addressing connectivity issues (i.e., fish passage) for migratory species at critical stages of their life cycle

Detection and monitoring of threatened (target) species

15. Which methods have you used to detect SJK or other threatened freshwater fish species in your region in the last five years?

- [ ] spotlighting
- [ ] electric fishing
- [ ] nets / traps
- [ ] eDNA
- [ ] participatory / citizen science approaches
- [ ] survey data from other organisations
- [ ] presence determined by modelling
- [ ] Other

16. At what spatial scale have SJK or other threatened freshwater fish species been assessed in your region?

- [ ] all waterways/ subcatchments with suitable habitat (entire Freshwater Management Unit (FMU))
- [ ] at State of the Environment (SOE) monitoring sites
- [ ] threatened fish surveys in selected catchments
- [ ] unsure
- [ ] Other

17. Have you (or your organisation) identified core / stronghold populations for these species?

- ◯ Yes
- ◯ No

18. If yes, what methods were used to detect the presence or model the distribution and what factors were used to determine a 'core/stronghold' population?
(Please include separate answers for each species where required/ relevant)

B. KEY CONSIDERATIONS FOR THREATENED SPECIES ACTION/RECOVERY PLAN DEVELOPMENT

19. Selecting Target Attributes and States for NPS-FM action plans

The workshop will consider the attributes that are most useful for regional/ FMU specific planning for SJK and other threatened freshwater fish species. This discussion will include:

- Selecting Target Attributes
- Setting a Target Attribute State (TAS)
- Setting a trigger value for TAS and method to measure success

Are you aware of any existing attributes defined in regulatory plans or non-regulatory guidance practice that you would recommend using as a TAS for SJK or other threatened freshwater fish species?

i) Please list examples or suggestions together with your rationale/ comment on their utility.

20. ii) For your recommended/example TAS, have the baseline or current Attribute States been defined, and what data and timeframes were used (or should be used) for these measurements?

21. Comments on Fish-IBI

The fish Index of Biotic Integrity (fish-IBI) provides a relative measure of fish diversity that is directly required by the NPS-FM to monitor the diversity of fish communities over time. It was included as a compulsory attribute of ecosystem health for wadeable rivers in the NPS-FM in 2020. However, its focus on community diversity may have limited value for the planning or monitoring of recovery/ action plans for target species (e.g., threatened fish species such as SJK).

Please comment on the following topics:

(i) the utility of fish-IBI as a trigger for Action Plans under the NPS-FM

22. (ii) the relationship of fish-IBI to other Target Attributes and TAS that could be used (e.g., are other TAS more appropriate and if so why?)

23. **Development of NPS-FM Action Plans and outcome monitoring**

List the top three information gaps or other limitations for developing NPS-FM Action Plans:

24. How do you store and share data on threatened fish species in your organisation/ region?

- [ ] submit your fish survey data to NZFFD
- [ ] require consent monitoring records to be submitted to NZFFD
- [ ] in-house system for open/ public access to downloadable datasets
- [ ] in-house system for open/ public access to technical reports
- [ ] Other

25. Please provide additional details on data storage and sharing if necessary

C. KEY TOPICS FOR INCLUSION IN UPCOMING WORKSHOP (with focus on shortjaw kōkopu)

26. What do you consider the main threats or pressures that limit the persistence and natural recovery of SJK in your region?
Please rank the threats in order of severity on a regional basis with the highest threat at the top (move each box up or down)

- Degradation of adult fish habitat (e.g., water abstraction, sediment deposition, elevated water temperatures)
- Limited spawning habitat (e.g. from modification of waterways)
- Connectivity/ fish passage issues
- Low abundance/scarcity of SJK – lack of recruitment potential
- Fishing/ harvesting pressure
- Predation of fish or eggs (various factors/ predators)
- Competition for resources from introduced fish species
- Other factor not mentioned above
- Insufficient information to prioritise and answer this question

27. If some threats are specific to a catchment (and atypical of the region) then please comment/draw attention to them here.

28. Do you have a restoration case study or planned project to restore a site, translocate SJK (or other threatened species) that could be included as a case study for describing methods and options for this guide?

29. Please provide details on any other topics you would like to cover in the SWIM workshop

30. Additional comments

Appendix 3: Regional council action plan example

TĀMAKI MAKAURAU SHORTJAW KŌKOPU RECOVERY PROGRAMME

Prepared by Matt Bloxham
Auckland Council

1. Is shortjaw kōkopu distribution adequately known?

The distribution of shortjaw kōkopu is moderately well known in the region and most populations centre around our two largest regional parks, Waitakere Ranges and Hunua Regional Parks. Both regional parks contain streams with the large high energy pools bounded by large substrate, a habitat type that shortjaw kōkopu prefer, but which is underrepresented in other parts of Auckland.

Waitakere Ranges: Shortjaw kōkopu are present in Piha Stream/Glen Esk Stream, Karamatura and in Mangatawhiri reservoir (Hunua) and in tributaries feeding the reservoir and mainstem below the reservoir. Shortjaw kōkopu have also been observed intermittingly in Marawhara and Wekatahi Streams, although they disappeared from Marawhara Stream following Cyclone Gabrielle. Shortjaw kōkopu could be reintroduced into Marawhara Stream and Wekatahi Stream (if no longer present) but not until instream and riparian habitat reforms. The riparian corridor and instream habitat in Marawhara Stream were substantially denatured by Cyclone Gabrielle.

Aotea (Great Barrier Island): There have also been reliable historic shortjaw kōkopu observations from Rosalie Bay (Aotea). Two sampling rounds using separate eDNA methods and analysis (Cawthron and Wilderlab), have cast doubts on whether shortjaw kōkopu are still present on Aotea. However, in the second sampling round, giant kokopu (Cawthron) were detected here (when none had been observed from this stream previously). eDNA's efficacy in distinguishing between shortjaw kōkopu and giant kōkopu with the assays available has been problematic previously. This and the fact that rudd (Wilderlab) and red finned perch (Cawthron) eDNA have been detected in the stream, have increased the importance of sampling this stream by spotlight (i.e., to corroborate the eDNA results). An initial scoping survey has confirmed the suitability of this stream for shortjaw kōkopu (and potentially giant kōkopu as well) and a spotlight survey is being undertaken in Rosalie Bay Stream on the 23rd Feb 2025.

Waiheke Island's flourishing giant kokopu fishery suggests that the Hauraki Gulf islands may hold the key to the salvation of large bodied kōkopu species, especially given the Aotea's relatively intact headwater to coast forest sequence.

North Auckland: Shortjaw kōkopu eDNA signatures have been detected in Glen Esk Stream (Matakana) which have yet to be corroborated by survey.

Hunua: A small shortjaw kōkopu population is also known from and the tributaries feeding in Mangatawhiri reservoir (Hunua) and in the mainstem and side streams below the reservoir. Since the 2010 Hunua regional boundary adjustment (when Auckland Council came into being), the reservoir population now falls outside Auckland and is instead situated within the Waikato region. The two councils have an informal agreement to work together to investigate options for sustaining the Hunua population. Key to this is understanding the impact of rainbow trout in this system given the potential for niche overlap in the reservoir inflows' large pools. These were formerly stocked by Fish and Game, but now thought to have naturalised.

Wee would like to establish:

- whether trout are trending down now that they are no longer stocked.
- whether trout are currently having an impact on shortjaw kōkopu and is this impact going to get worse or will it likely decrease?

Otolith work done by NIWA confirmed Mangatawhiri reservoir shortjaw kōkopu as a lacustrine population. Shortjaw kōkopu are also found in low numbers in the streams *below* the reservoir in Mangatawhiri River (situated within Auckland Council boundaries). The presence of barriers further downstream in Mangatawhiri River suggests that recruitment into these streams is more likely to be from the reservoir rather than from sea-run adult fish. In future work we will investigate whether the mainstem's inflows hold value as shortjaw kōkopu habitat and whether there is any potential to improve their potential for shortjaw kōkopu by excluding rainbow trout.

Further survey priorities:
Shortjaw kōkopu are possibly present in Rosalie Bay, Kakamatua, Anawhata, Karekare, Wekatahi, and Glen Eden (Matakana) Streams.

2. Is decline understood?

The causes of past decline and ongoing pressures in shortjaw kōkopu populations is moderately well understood in the region. Unlike giant kōkopu populations that have declined and disappeared from numerous mainland Auckland streams, shortjaw kōkopu has undergone no obvious range contraction.

This is probably more a reflection of the following factors:

- shortjaw kōkopu are not widespread in Tamaki Makarau and unlikely to have ever been, because they are habitat specialists and, as with other regions, the amount of optimal shortjaw kōkopu habitat is relatively limited.
- little archetypal shortjaw kōkopu habitat exists outside of Hunua and Waitakere Ranges, Auckland's two largest regional parks.

However, with an estimated wild population of <250 mature individuals, shortjaw kōkopu are thought to be in decline in Tāmaki Makaurau. More tellingly, seldom are more than 30 fish ever encountered in surveys, even in their regional strongholds in the Waitākere Ranges.

Several streams are awaiting survey, or survey results to confirm presence including in Mangatawhiri in the Hunua. Here, overlapping niches (large stable pools) suggest trout may be a major predator of juvenile shortjaw kōkopu in the Mangatawhiri reservoir and in the mainstem above and below the reservoir (Mangatawhiri River). Although their prime deep pool habitat bounded by large substrate confers some level of protection from (streamside) ambush, there is a concern that terrestrial predators including cats, and stoats may predate adult fish (as per adult giant kōkopu).

There is now documented evidence from Northland that ship rats predate shortjaw kōkopu nests (eggs are laid over open ground on forest litter, moss and in crevices) and, that a single rat can eliminate an entire nest over several nights. The implications therefore are that no shortjaw kōkopu population is invulnerable, even those occurring within regional park habitat, where small rodent populations abound. Intensive predator management is an absolute requirement but remains a challenge in linear stream habitat.

Red-eared slider turtles present as an emerging threat for large bodied kōkopu (of both eggs and adult life stages), particularly given the pest's catholic diet and the varied habitat they occupy and are capable of exploiting. However, as yet, red-eared sliders are not believed to overlap Auckland's known shortjaw kōkopu populations.

3. Have pressures been adequately identified?

Pressures on shortjaw kōkopu adult populations are relatively well understood in the region. Larger magnitude/frequency storm and flood events (of the type expected more with climate change) can have a major impact on local populations and transformative impacts on their habitat (both instream and riparian). For example, Cyclone Gabrielle denatured one Waitākere shortjaw kōkopu stream, impacting a small population.

Urban development in the Waitākere occupies reaches downstream of known adult shortjaw kōkopu habitat. Therefore, potential impacts (wastewater contamination and impassable instream structures) are more likely to register on juvenile stages, i.e., migrants travelling up from the ocean. However, Karakare Stream, the site of a former population, has several fish passage barriers (associated with private crossings) downstream that have obviously prevented oceanic migrants from reaching adult habitat.

In the Hunuas, Mangatawhiri dam and potentially other structures downstream, restrict the passage of oceanic migrants. Although as yet unconfirmed, the possibility remains that shortjaw kōkopu populations found *below* the dam may have recruited from Mangatawhiri's lacustrine population upstream. If true, this would increase the importance of protecting the reservoir population from trout impacts (as without this, downstream populations would eventually suffer). Although work done by Ecoquest has confirmed the presence of shortjaw kōkopu in some of Mangatawhiri River's side streams *below* the dam, more needs to be done to fully understand shortjaw kōkopu population dynamics and distribution both upstream and downstream of the dam. This work scheduled for summer 2024-2025 when ESU will join with Ecoquest and Environment Waikato colleagues and use eDNA and spotlighting to survey for shortjaw kōkopu.

The potential for shortjaw kōkopu egg predation by rats, mice, and hedgehogs is acknowledged and in the case of rats, is increasingly well understood.

4. Management options

Captive breeding programme:
Captive bred shortjaw kōkopu (parent stock obtained from neighbouring Waitakere catchments) have been released into streams feeding the Waitākere's upper and lower Huia Reservoirs. This has been done to create geographically disparate populations (which are separated from the more westerly population strongholds), as a nest egg and to buffer Waitākere shortjaw kōkopu from future storm events. Following the June 2024 release, the first task is to monitor the survival shortjaw kōkopu at the release sites. Further releases may be required (to form a self-sustaining Huia population).

Habitat improvement:
Shortjaw kōkopu occupy 'reference state' regional park sites, so none of the usual interventions (fencing, planting riparian vegetation, and introducing large wood to create cover and refuges in homogenous stream environments) are necessary (i.e., due to good habitat conditions at present)[3]. Sustained and effective pest animal control along with 'spreading the risk' by creating additional populations are the most pressing needs for regional park shortjaw kōkopu populations presently. As with the other large bodied galaxiids, shortjaw kōkopu spawn throughout their adult range. So, unless spawning areas have been identified and we are able to focus our control effort on discrete spawning sites, we face the challenge of maintaining predators at a low biomass throughout the adult range. This isn't practicable when the predator's home range is also relatively small (e.g. mice 10m). Spending time identifying and protecting spawning sites must therefore become a priority, because only then can we remove this life history bottleneck. It may also be feasible undertaking captive breeding programs by harvesting eggs and milt in situ. Pilot studies have shown how challenging it is striking upon adults in breeding condition (i.e., with females with fully developed eggs and males with active milt). However, this remains preferable to removing adults from otherwise small populations to breed from. Trout barriers, which exploit the climbing advantage shortjaw kōkopu have over trout, may be one way to protect the Mangatāwhiri population in the Hunua (to be investigated).

Legally protected habitat:
Legally protected habitat is present in the Mangatawhiri River network and Reservoir (Hunua), Piha, Glen Esk, Karamatura, Marawhara and Wekatahi (Waitākere).

[3] Although it may be necessary to remove fish passage barriers associated with crossings in some catchments.