Management of freshwater fish species

Ka mua, ka muri | Fish Futures Policy Brief 01

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Fish Futures

The Fish Futures research project aims to improve freshwater ecosystems in Aotearoa New Zealand and the lives of people who depend on them. The project seeks to foster local relationships, empower fishery managers, enhance the mana of kaitiaki and generate new approaches that integrate mātauranga Māori and Western science.

The research examines interactions between humans, fish and ecosystems by assessing the consequences of fish introductions and removals, identifying social barriers to restoring fish passage and co-developing fish management strategies with Māori, communities and other stakeholders.

Expected outcomes:

- improve understanding of the social–ecological factors that impact freshwater fish populations
- enhance capacity for sustainable freshwater and fisheries management
- increase collaboration between scientists, iwi and policymakers.

The project's findings will inform policy development and support community-based management and collaborative decision-making for healthier freshwater ecosystems and thriving fish populations.

Policy briefs in this series

01. Management of freshwater fish species
02. Identities of freshwater fishers
03. Changing land use and freshwater fish
04. Access to freshwater fishing
05. Harvesting and consuming freshwater fish
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Cover photos: (Left) Whitebait. Photographer: D. Nicholson; October 1959. Source: Archives New Zealand; AAQT 6539 3537 57/A71885. (Centre) Drying tuna. Photographer: unknown; September 1934. Source: Auckland Libraries Heritage Collections; 1691-109. (Right) Lake Taupō. Photographer: E. Woollett; February 1954. Source: Archives New Zealand; AAQT 6539 3537 51/A33961.

Management of freshwater fish species

Government fish hatchery, Turangi. Photographer: unknown; August 1947. Source: Archives New Zealand – Communicate New Zealand Collection; AAQT 6539 3537 36/A2414.

Key messages

- Throughout history, a sub-set of freshwater fish species have been targeted for management to promote specific values of freshwater fisheries, conservation and biosecurity.
- Species management involves naming species in policy to achieve specific outcomes for freshwater fish and people. Species management is undertaken by a range of agencies, which operate under different legislation and objectives using diverse tools and methods.
- The management of some species has varied significantly over time and across agencies due to shifting values and species designations (e.g. pest, fishery), creating conflict and, at times, unfavourable outcomes.
- Species management has failed to prevent population declines in valued species, uphold Māori fisheries rights as guaranteed in Te Tiriti o Waitangi, and account for the interconnecting relationships between species, people and the wider ecosystem.
- To improve species management, we need Te Tiriti based decision-making to determine how and what species are targeted for management; objectives and strategies must be place-based with coordinated implementation across agencies in pursuit of shared goals.

Overview

Freshwater fish are named in legislation, regional plans and policies to create accountability for achieving desired outcomes for these species. *Species management* describes this 'naming' of fish for certain management actions. For example, 'the protection of the habitat of trout and salmon' is named in the Resource Management Act (RMA) 1991, which enables Fish & Game New Zealand and other groups to advocate in planning processes and the Environment Court for the retention of flows and protection of water quality and spawning habitat. In a regional context, Department of Conservation (DOC) and Waikato Regional Council policies identify seven pest freshwater fish species (including koi carp, perch, brown bullhead catfish and gambusia)[1], providing a mandate for these government agencies to use designated resources to monitor and remove these fish. In other contexts, such as fisheries management, species such as shortfin and longfin tuna are named to define rights and rules for harvesting.

Species management *aims* to secure particular outcomes for freshwater fish – but does it accomplish those goals? We know that many of the freshwater fish New Zealanders care about – from longfin tuna to whitebait and salmon – are declining, despite being regulated by a species management framework.[2–4] Furthermore, targeting a single fish species for management can generate unintended and undesirable impacts on other species and the wider ecosystem.[5] Species management can also affect relationships between people, and sometimes in negative ways.[6]

To help decision-makers, kaitiaki and managers learn from history, this policy brief considers how species management has developed in Aotearoa New Zealand. We examine the key problems that have emerged over time and outline a potential path towards flourishing fish futures.

Species management in New Zealand

Freshwater fish in New Zealand have been targeted for species management for a range of reasons. Prior to European settlement, Māori had developed cultural practices and shaped environments to access fisheries for tuna, whitebait and other freshwater fauna (e.g. kōura). A suite of fishing technologies, management practices (such local aquaculture and translocations) and social regulations (such as rāhui) were used to govern these fisheries and ensure their sustainability.[7] In 1840, Te Tiriti o Waitangi guaranteed Māori 'the unqualified exercise of their chieftainship over their lands, villages and all their treasures',[1] yet these rights were not recognised for over 150 years.[8]

Species management for fisheries

New Zealand has a long history of managing species to create and sustain valued fisheries. Acclimatisation societies first appeared in the 1860s, working to hatch, rear and release salmonids and other European and American sport fish into rivers and lakes. Hatcheries were used to stock introduced fisheries across the country, from salmon in Te Anau to trout in Rotorua.[9] To preserve and propagate

[1] The English text, the Treaty of Waitangi, guaranteed Māori 'the full exclusive and undisturbed possession of their lands and estates, forests, fisheries and other properties'.

the salmonid fishery, the Salmon and Trout Act 1867 enabled the New Zealand governor to determine the salmonid fishing season and its locations, as well as limit and direct the use of fishing technologies.

The Salmon and Trout Act 1867 also stipulated fines of up to £100 for any breaches. This resulted in prosecutions of unlicensed fishers, including Māori fishers who accidentally caught trout in their hīnaki, which had been set to catch native fish.[7] In Rotorua in 1907, prosecution of a Māori fisher for catching trout generated vigorous objection from Te Arawa iwi, who argued that they never relinquished the lakes or their right to fish from them. A settlement in 1922 confirmed the rights of Te Arawa to take native fish, but introduced species were still excluded; the Crown assumed ownership of the lakes, and a large annual sum was paid to a trust board representing Te Arawa.[10]

Ngongotahā trout hatcheries, Rotorua. Photographer: G. Riethmaier; January 1962. Source: Auckland Libraries Heritage Collections; 895-A68970.

Alongside efforts to cultivate and regulate introduced fisheries, acclimatisation societies sought to reduce predation on the salmonid fishery through culls of freshwater tuna. Although tuna were highly valued by Māori, acclimatation societies described them as 'vermin' and offered bounties during a campaign of 'eel destruction' that peaked through the 1920s and 1930s and continued until the 1960s.[2,7]

In the 1960s, a commercial export market for tuna developed, with the harvest growing from 30 tonnes in the late 1960s to 2,077 tonnes in 1972, before steadily declining to 258 tonnes in 2023.[11] Regulations

to control the tuna fishery were introduced in the 1970s and included minimum and maximum harvestable weights, a total allowable catch for commercial harvesters and a limit of six recreationally caught tuna per day.[2,11] More recently, concerns about the sustainability of the longfin tuna fishery have led to the closure of certain areas to commercial fishing and to some Māori entities voluntarily shelving their quota.[12]

Whitebait, which comprises juveniles of five native galaxiid species and common smelt, is another longstanding freshwater fishery in New Zealand. While both Māori and Pākehā have fished, traded and sold whitebait over a long period, it remains relatively unregulated compared to other freshwater fisheries.[7] Notably, there are no limits on who can fish for whitebait or how much they can take; instead, regulations focus on the location, timing and fishing methods.

Species management for conservation

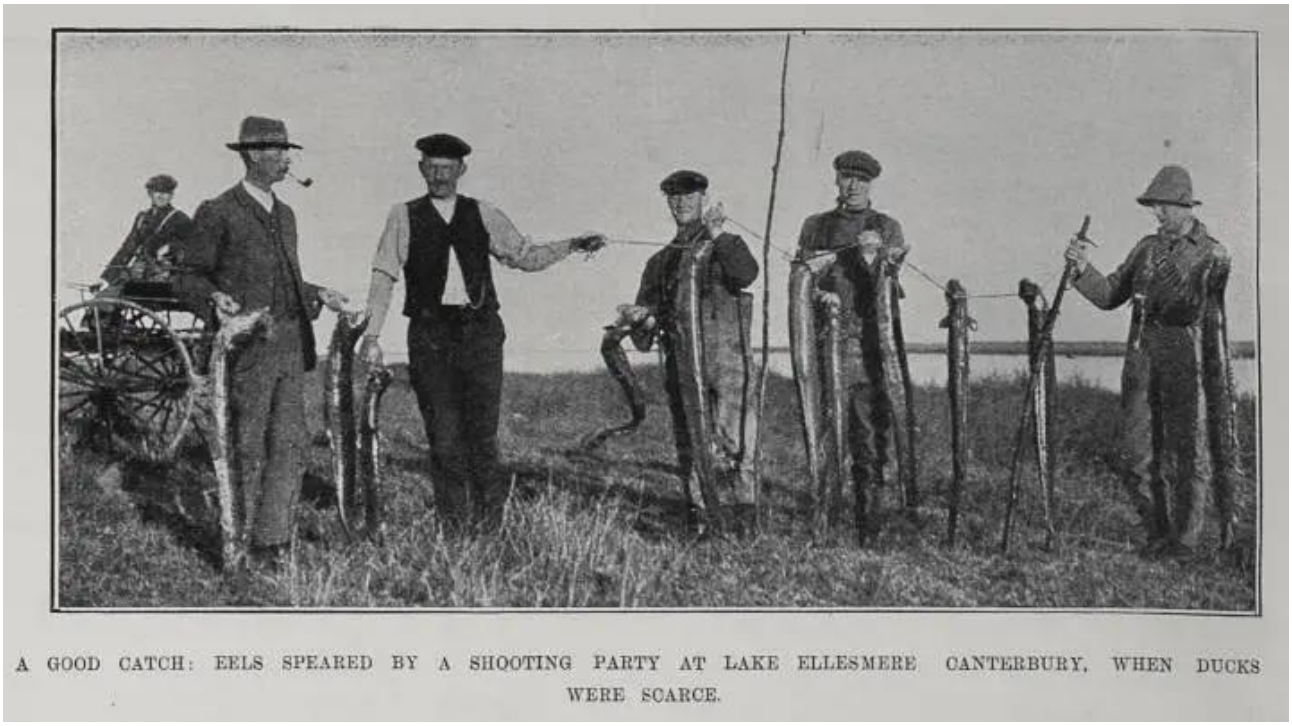
Species management has been used for freshwater fish conservation in New Zealand only relatively recently. Historically, legislation to protect species focused on introduced fisheries such as salmonids, and later – as extinctions increased – native birds. The only indigenous freshwater fish to be fully protected in legislation is the now-extinct grayling. While warnings of its decline were sounded from the 1870s, fishing for grayling was not banned until 1951, decades after the last sighting in the 1920s.[13]

Overall, indigenous freshwater fish have been largely unprotected by policy and law in New Zealand.[14,15] They were excluded from the definition of wildlife protected by the Wildlife Act 1953 and are subject to few rules or regulations under the Conservation Act 1987. This more recent legislation has, however, defined responsibilities for the preservation of indigenous freshwater fisheries, and the protection of recreational freshwater fisheries and freshwater fish habitats. In practice, this has mainly involved the management of conservation lands, preparation of threatened species recovery plans and fish passage remediation. As 90% of the habitat of threatened non-migratory species is located outside of conservation lands, habitat protection relies heavily on rules in regional plans. In 2019, new provisions were introduced governing the taking of indigenous fish within and beyond conservation areas.[16]

New Zealand's resource management system also recently incorporated policies to promote species conservation. When the RMA 1991 was introduced, it provided for the protection of the habitat of trout and salmon, with an assumption that this would also protect native fish. However, in recent years, there has been a shift in focus to indigenous and threatened species. In 2023, 47 (89%) of New Zealand's 53 native freshwater fish species were classified as threatened or at risk of extinction.[17,18] The National Policy Statement for Freshwater Management 2020 directed that 'the habitats of indigenous freshwater species are protected'. The policy also identified threatened species as a compulsory value for regional policy and planning, requiring that affected waterbodies have 'the critical habitats and conditions necessary to support the presence, abundance, survival, and recovery of the threatened species'.[19]

Species management for biosecurity

To facilitate biosecurity management, a minority of introduced fish species have been named as pests in New Zealand legislation and policy. The number of introduced fish species in the country's waterways increased from four in the 1870s to 22 in 2010, as people intentionally and unintentionally released sport, ornamental and other imported fish into the wild.[20]



A GOOD CATCH: EELS SPEARED BY A SHOOTING PARTY AT LAKE ELLESMERE CANTERBURY, WHEN DUCKS WERE SCARCE.

'A good catch'. Auckland Weekly News; 4 July 1912, p. 10. Source: Auckland Libraries Heritage Collections; AWNS-19120704-10-02.

Legislation introduced from the 1970s, the Biosecurity Act 1993 and the Hazardous Substances and New Organisms Act 1996 have assigned the government responsibility for controlling the deliberate importation of non-native species and managing their impacts. However, while legal introductions of freshwater organisms have ceased, there are continued illegal and accidental species introductions.[21] DOC, the Ministry for Primary Industries (MPI) and regional councils can designate species as pests, unwanted organisms or noxious species. On this basis, they can then control the movement of these species and propose and administer pest management plans, with objectives ranging from exclusion, eradication, progressive containment and sustained control to the protection of existing environmental values.

Contemporary species management

Freshwater fish are named in policies for objectives ranging from conservation, fisheries management and protection of habitat to removal and control of pest fish (Tables 1 and 2). These objectives are vested across many agencies:

- MPI manage the freshwater tuna fishery and have responsibilities for fish farming and biosecurity.
- DOC manage waterbodies in conservation lands, advocate for native fish protection and enhancement, regulate fish passage, and manage the Taupō trout fishery and whitebait fishery.
- Regional councils, with national direction from the Ministry for the Environment, manage freshwater fish habitat and pest species, and regulate and remediate fish passage.

- Fish & Game New Zealand manage introduced sport fisheries, such as trout, salmon, perch, tench and rudd.
- Iwi and hapū manage customary fishing in their rohe using tools like mātaitai (customary reserve) and rāhui (temporary prohibition), and in some places have taken on broader species management roles, such as fish monitoring and restoration.

By naming freshwater fish in policies, these agencies can direct investment for infrastructure (e.g. fish barriers, monitoring), design land-use rules (e.g. water abstraction) and regulate actions that directly affect fish populations (e.g. fishing methods, catch limits). Species management policies enable a broad range of management actions including:

- licensing fishers
- prescribing fishing methods
- controlling the fishing season
- controlling areas for fishing
- fish harvest rules
- catch limits
- monitoring fish populations
- protecting habitat (including water quality) from degradation
- installing fish barriers and passage
- conserving water in ecosystems
- fish translocations, e.g. trap-and-transfer, netting
- fish kills, e.g. rotenone, pest fish culls.

Table 1. Status and management of exemplar freshwater fish species, including responsible agencies and tools.[18] I = īnanga, K = kōaro, GK = giant kōkopu, SK = shortjaw kōkopu, BK = banded kōkopu, S = common smelt, DOC = Department of Conservation, MPI = Ministry for Primary Industries. Exemplar species were chosen to illustrate the range of management agencies and tools used.

	Fisheries			Conservation		Biosecurity	
Species	**Brown trout**	**Tuna**	**Whitebait (I, K, GK, SK, BK, S)**	**Clutha flathead galaxias**	**Canterbury mudfish / kōwaro**	**Koi carp**	**Grass carp**
History	Deliberately introduced in 1860s for recreation	*Longfin*: Endemic *Shortfin*: Native	*All*: native GK, SK, BK: endemic	Endemic	Endemic	Accidentally introduced 1960s	Deliberately introduced 1960s for weed control
Legal status	Sport fish	*Longfin*: At Risk – Declining *Shortfin*: Not Threatened	*K, GK, S*: At Risk – Declining *BK*: At Risk – naturally uncommon *SK, I*: Threatened – Nationally vulnerable	Threatened – Nationally critical	Threatened – Nationally critical	Unwanted organism, Noxious fish	Restricted fish
Primary responsible entities	Fish & Game NZ, Regional Fish & Game councils	Fisheries NZ, DOC, Tangata whenua	DOC, Tangata whenua	DOC, Regional councils	DOC, Regional councils	MPI, DOC, Regional councils	DOC, MPI
Key management tools	Licences Anglers notice: > bag limits > gear & method restrictions > open season > location restrictions > minimum length	Quota management system: > total allowable catch > annual catch entitlement > fishing permits Recreational daily limit Gear restrictions Location restrictions Customary management areas & rules	Gear restrictions Season restrictions Location restrictions Customary management areas & rules	Threatened species recovery plan Population mapping Monitoring Protecting & restoring habitat Fish barriers Invasive species removal	Threatened species recovery plan Habitat mapping Livestock exclusion Water abstraction limits Protecting & restoring wetlands Temporary discharge limits	Regional pest management plans Recreational fishing, including competitions Manual removal & trapping Rotenone Fish barriers Monitoring	Fish farm licences Application to possess and transfer fish Environmental impact assessment

Table 2. Key nationwide legislation and regulations contributing to the management of each species in 2026. Instrument is represented by its title and paraphrased purpose or key provisions relating to freshwater fish. Colour blocking illustrates species managed under instrument.

<table>
<tr><th colspan="4">Fisheries</th><th colspan="2">Conservation</th><th colspan="2">Biosecurity</th></tr>
<tr><th>Brown trout</th><th colspan="2">Tuna</th><th>Whitebait</th><th>Clutha flathead galaxias</th><th>Canterbury mudfish / kōwaro</th><th>Koi carp</th><th>Grass carp</th></tr>
<tr><td colspan="8">Conservation Act 1987
> Establishes department to preserve indigenous freshwater fisheries, and protect recreational freshwater fisheries and freshwater fish habitats (s5)
> Requires prior ministerial approval for the transfer of live aquatic life or release of live aquatic life into freshwater (s26ZM)</td></tr>
<tr><td>> Establishes that councils manage, maintain and enhance sport fish (p5A)
> Prohibits taking sport fish without a licence & fish farms for trout (s26ZI)</td><td colspan="2">Fisheries Act 1996
> Provide for the use of fisheries resources while ensuring sustainability

Fisheries (Amateur Fishing) Regulations 2013
> Enforces daily limit for recreational fishing for tuna</td><td>Whitebait fishing regulations 2021
> Prohibits fishing outside open season or in closed areas
> Sets gear and method restrictions</td><td colspan="3">> Requires authorisation for taking indigenous freshwater fish within a conservation area
> Restricts when indigenous freshwater fish may be taken outside conservation areas (s26ZHB)</td><td>> Requires ministerial approval for possession of restricted fish (s26ZQA)</td></tr>
<tr><td rowspan="3">Freshwater Fisheries Regulations 1983
> Regulates sport fish: licences, fisher obligations, storage, smoking and canning, fishing competitions (p1-5. 7A) and transfer (s62)</td><td colspan="3">> Sets requirements for fish passage for dams and diversion structures (p6)</td><td colspan="3" rowspan="3"></td><td rowspan="3">Freshwater Fish Farming Regulations 1983
> Regulates licensing and operation of fish farms</td></tr>
<tr><td colspan="3">Treaty of Waitangi (Fisheries Claims) Settlement Act 1992
> Settles claims for Māori fishing rights
> Provides for customary fishing
> Provides for Māori participation in fisheries management and conservation</td></tr>
<tr><td colspan="3">Fisheries (Kaimoana Customary Fishing) Regulations 1998 and South Island Customary Fishing Regulations 1999
> Recognises and provides for customary food gathering by Māori and the special relationship between tangata whenua and places of customary food gathering</td></tr>
<tr><td colspan="5">Resource Management Act 1991
> Requires all persons exercising functions and powers to: recognise and provide for the protection of significant habitats of indigenous fauna (s6); have particular regard to the protection of the habitat of trout and salmon (s7)</td><td colspan="2" rowspan="3">Biosecurity Act 1993
> Provides for the eradication or effective management of harmful organisms (s54)</td><td rowspan="3"></td></tr>
<tr><td colspan="5">National Policy Statement for Freshwater Management 2020</td></tr>
<tr><td>> Other values that must be considered include ‘Areas that support fishing’</td><td colspan="4">> Compulsory values for objective and target setting include ‘Areas that support a population of threatened species’ and ‘Areas that are used or valued for providing mahinga kai’
> Requires councils to include fish passage objectives and policies in regional plans and develop action plans</td></tr>
</table>

Problems with species management

For over 150 years in New Zealand, legislation and policy have been used for freshwater fish species management. It is now important to review what this focus has achieved. Based on our review of history, policy and experience, we identify three main areas of concern. First, although species management aims to name and therefore protect valued species, such protection has not been achieved. Second, through the practice of species management, Māori rights and interests in freshwater fish and fisheries have not been upheld. Third, the separation of species management across organisations has created a complex regulatory framework that diffuses accountability for ecosystem outcomes. Confronting these problems with species management would help New Zealand improve its freshwater fish management system.

Valued species are (still) declining despite targeted management

Despite naming various freshwater fish species for targeted management:

- 89% of New Zealand's indigenous freshwater fish species are threatened with or at risk of extinction
- most native fishery species have been designated as threatened or at risk, including longfin tuna and all six whitebait species[18]
- wild-run salmon and trout are considered smaller and less plentiful in many rivers, especially in lowland streams[22]
- pest fish such as gambusia, koi carp and catfish are swelling in numbers and expanding their ranges[20]
- mass mortality events continue to be a regular occurrence for freshwater fish.

Naming species for targeted management is perhaps the most direct way to manage vulnerable species – so, why isn't it delivering? One reason is that although species are listed for management in legislation and policies, the full and consistent implementation of these laws and principles is not guaranteed. For example, the longstanding protection of trout and salmon habitat in the RMA 1991 has not prevented the continued pollution and abstraction of rivers, especially in Canterbury where salmon populations have plummeted. Fish & Game New Zealand have used the RMA 1991 to argue in the Environment Court for the protection of water quality and flow in certain rivers; however, even in those select cases, their actions have not always been successful.[6] Effects-based legislation has also proven inadequate in preventing freshwater habitat loss through direct activities such as gravel extraction, drain management and weed removal, and indirect impacts such as sediment and nutrient run-off.

A second reason is that information about the state of freshwater fisheries is diffuse and often lacking. Scientific fisheries management, including setting sustainable catch volumes, bag limits and season lengths, requires adequate data to assess the health and trends in the fishery, yet such data on freshwater fish are limited and coverage is inconsistent.[11] Fish monitoring is a time and resource intensive activity that is undertaken regularly only in a minority of waterways; records for many sites in the New Zealand Freshwater Fish Database are years out of date. Data limitations affect even regulated fisheries, as it is costly for fisheries managers to track species management compliance through direct

monitoring, and enforcement can damage relationships between regulators and harvesters. There is no formal assessment of trends in the whitebait fishery, for example, and tuna fishery decision-making largely relies on national modelling together with monitoring at 11 sites.[11] As a result, it is difficult to detect fishery depletion or assess how well populations are faring in response to targeted management interventions.

A third reason that species management fails is that species management actions are often narrowly focused and do not necessarily control relevant drivers of population declines. For example, although each tuna stock is assigned a total allowable catch, it is calculated across a larger quota management area; therefore, there is no legal impediment to complete removal of a local tuna population. In some quota areas, concentrated exploitation is more likely due to prohibitions on commercial fishing in adjacent conservation land. As each catchment contains discrete sub-populations that can take decades to recover from overfishing, there is concern for both the sustainability of local populations and broader ecosystem health.[11] Overall, management for a single fish species needs to have a broad scope – to thrive, tuna must avoid the fishers until they can breed, and they need to have suitable food, habitat, and water quality and temperature, as well as the ability to navigate hydropower turbines or other barriers.[11] A recent study also showed, for example, that many tonnes of whitebait are needed to feed and sustain a lowland tuna fishery. Effective species management requires the careful monitoring of fishing and spawning alongside securing the ecological conditions needed for the interconnected fish species – and fisheries – to thrive.[23]

Species management has historically pursued narrow Pākehā values

Species management institutions and policies have emerged on an ad hoc basis, rarely with the consultation and consent of tangata whenua. During New Zealand's recent history, species management has typically pursued the goals of colonial settlers, which often – if unintentionally – negatively impacted Māori communities and relationships to place.[7] Species management was initiated outside government to promote culturally specific settler relationships with introduced fish, and these arrangements were later adopted and given legal power by the Crown.[9] As species management evolved to encompass conservation and biosecurity, decision-making was largely enshrined with government agencies, despite Māori rights and interests in freshwater fish and their ecosystems. For example, customary fishing on conservation land has been restricted by Crown ownership, DOC general policies and land classifications, in particular national park and scientific reserve classifications.[24] The rights and interests of tangata whenua in the management of pest fish and introduced species continue to be undermined by this limited recognition.[25] Importantly, there is a need to address the 'legitimacy deficit', which concerns the lack of wider accountability to individuals or groups whose relationships are affected by species management.

The Treaty of Waitangi (English version) explicitly guaranteed Māori 'the full exclusive and undisturbed possession' of their fisheries and other properties. However, government-backed species management has negatively impacted Māori freshwater fisheries and Māori connections with fish and fresh water:[7,8]

- Māori fishers have been prosecuted for accidentally or intentionally catching introduced fish.
- Traditional fishery species, such as tuna, were culled and commercially exploited by the Crown.

- Introduced fisheries, such as trout, salmon and perch, were established without consent of tangata whenua and led to displacement of, and restricted access to, traditional fisheries.
- Tangata whenua has been excluded from fish conservation and fishery management policies until very recently.
- While Māori commercial entities are quota holders for the tuna fishery, tangata whenua do not have the regulatory power to ensure that local tuna fisheries are sustainable. As a result, many iwi and hapū do not fish their quota to sustain the fishery.

Species management remains fragmented

As the New Zealand public and its government sought outcomes for freshwater fish beyond the scope of acclimatisation societies, new institutions were created to pursue these outcomes. In turn, new objectives – such as conservation of threatened species, preservation of fish habitat and control of invasive species – have been developed and enshrined into legislation, with various organisations assigned to manage the outcomes. As shown in Table 1, administrative responsibilities for species management are currently spread across a range of agencies:

- Fish & Game New Zealand: introduced sport fish, including salmon and trout
- Regional councils: habitat for native fish and trout and salmon, pest management
- DOC: native freshwater fish, threatened species, fish passage, whitebait fisheries
- MPI: fish farms
- MPI and DOC: pest and noxious fish.

These entities operate with different financing structures, personnel and resources, and they must balance competing legislative imperatives and varying spatial jurisdictions. The wide array of organisations and objectives for fish can place these groups at cross purposes, creating conflict as well as inconsistency and incoherence in policies, processes and actions. For example, when a rāhui was placed on Lake Ōkataina / Te Moana i kataina ā Te Rangitakaroro in 2023 to prevent the spread of golden clam, there was significant tension between some trout anglers, iwi and MPI. The goals of biosecurity and recreational angling were placed in opposition, as each objective was backed by a different entity. This conflict polarised discussion and challenged the management of the golden clam, with some individuals threatening to deliberately introduce the invasive species.[26,27]

In another example, the Environment Court allowed further extraction of water from the Lindis River in 2019, based on the reasoning that the presence of introduced trout and salmon had already compromised the river to a level where it was no longer worthy of added flow protections.[28] In a third example, DOC installed fish barriers as part of a native fish protection effort in Murihiku / Southland to prevent trout and salmon from travelling upstream and predating on and competing with native fish. However, iwi highlighted that these fish barriers could also negatively impact the lifecycle of valued native species – especially kanakana – by preventing their migration upstream.

As these examples illustrate, the fragmented nature of species management in New Zealand can be counterproductive. In particular, having separate agencies focused on the management of certain freshwater fish can result in negative outcomes for other species and values in the same location or

wider area; for example, for commercial eeling, fishing is incentivised toward maximum extraction from a location, which could leave few tuna left in an area for sustainable customary harvest. Furthermore, while tangata whenua have rights and interests in relation to all freshwater fish and waterbodies, the distribution of responsibilities across government agencies contributes to inconsistent and insufficient engagement and shared decision-making with tangata whenua on freshwater management.

Reorganising species management

There is value in the directness and simplicity of naming freshwater fish and designating established actions for species management. If you want certain outcomes for a fish species, why not name them? Moreover, many agencies have adopted this approach as an effective way to control and realise desired outcomes for valued fish species. However, as we review the history of species management in New Zealand, the outcomes from this approach are concerning. Species management has proven effective at supporting the development of introduced fisheries and providing important tools for managing both fisheries and pest fish incursions under certain conditions. At the same time, under-resourced agencies have had to battle at every step to secure practical protections for trout and salmon habitat as promised by existing legislation, and even if habitat is conserved, that does not guarantee a thriving fishery. Managing a single component of the ecosystem in isolation from other species, values and pressures does not align with the reality of the world's interconnected systems.

Alongside these questions of effectiveness and implementation are important concerns regarding ethics and justice: How have decisions about species management been made? Whose interests have such decisions served, and who has been negatively impacted? Early in its development, species management was used to enshrine colonial settler perspectives and values for fish, and decisions were often taken without the consent (or even knowledge) of tangata whenua. The issue of who makes these final decisions in species management is extremely important, as it cuts right to the question of which views and values matter in New Zealand. Finally, problems with coordination across agencies and spatial and temporal scales have led to inconsistent and ineffective decision-making. We must then ask, what are the pathways for the future of species management?

Species management should reflect the values of tangata whenua and tangata tiriti

A new foundation for decision-making is needed to repair the model where species management imposed and prioritised colonial values for fish over the protection of Māori freshwater interests. This process will need to readdress the fundamental issues about which species to name in policies and for what objectives, and how species management is administered. These decisions should involve tangata whenua alongside Crown agencies, recognising the dual imperatives of rangatiratanga (the right of tangata whenua to control their resources) and kāwanatanga (the right of the Crown to govern).[24] Each part of the species management system, and the system as a whole, should be evaluated for how it upholds Te Tiriti o Waitangi and helps to establish trusting foundations for a multicultural society. As a starting point, each decision to name a species for management should involve tangata whenua, whether it is for pest or fisheries management, habitat protection or conservation.

Species management objectives should be created for ecosystems-in-place

Objectives set for one fish species without reference to others have created problems throughout New Zealand's history. Decisions about introduced fisheries and threatened native fish species have often been made in isolation by the organisations charged with their management, when in fact introduced

fish are a key pressure on threatened native fish and place-context is important. Similarly, the application of a stock-based quota management system to the tuna fishery means that local tuna populations can be decimated, which in turn impacts other fish and ecological processes in that system. While biosecurity objectives typically incorporate the impacts of target fish on other species and ecosystems, it is also important to consider how their implementation affects people–place connections, such as mahinga kai.

To address the current fragmentation, objectives for freshwater fish should be re-composed based on consideration of other species, important ecosystem processes and people in each place. There is a need for place-based limits for tuna harvests, for example, and to consider the needs of other species such as tuna when setting rules for local whitebait harvesting. Decisions about multiple fish species, together, should be informed by knowledge of the local relationships between species and between species and people. This is an ambitious undertaking, and the challenges involved are multiple, including science and monitoring needs, compliance and enforcement. However, the National Policy Statement for Freshwater Management 2020, freshwater mātaitai and iwi customary fisheries plans illustrate that it is possible to incorporate local values and knowledge in decision-making, and set place-based objectives and rules. These examples provide insights on how wider ecological and social relationships could feed into objective setting for named species, and areas for further work.

Agencies should coordinate actions and resources to achieve multi-species objectives

Just as setting objectives for a single fish species can be inefficient and ineffective, implementing objectives for one agency in isolation can generate higher costs, conflict and adverse ecological outcomes. Governance agencies should proactively work with other organisations, including tangata whenua entities, to coordinate approaches to multi-species management. For each location, there should be objectives established for different species: various fish management agencies could then work together to allocate implementation priorities that are most closely aligned with each organisations' mandate and resources. In a recent example, DOC coordinated a workshop with Te Rūnanga o Arowhenua, Earth Sciences New Zealand, Fish & Game, and Environment Canterbury to share and socialise knowledge about the plight of Stokell's smelt in south Canterbury and to build support for remedial action. Te Rūnanga o Arowhenua and DOC subsequently pooled resources to monitor Stokell's smelt in the Ōpihi and Rangitata Rivers. Scientist Sjaan Bowie reported that 'what we aim to do is actually develop a co-ordinated action plan that we all sign up to, because DOC can't save them by themselves. We need help from others.'[29]

Recommendations to policy- and decision-makers

Naming species for management actions can help us achieve our goals for freshwater fish and fisheries, but it needs to be used with care. We must ensure that objectives are grounded in legitimate decision-making processes and ecologically holistic for each waterbody. If agencies pursue this work collaboratively, New Zealand can chart a path towards flourishing fish futures.

Reorganising freshwater fish management will not be straightforward, and there are questions requiring careful consideration: Are the current agencies the right organisations to administer and implement the species management objectives? Are new or different agencies needed? With a view to history, it seems that if freshwater fish management continues with its fragmented approach and limited frameworks for accountability, we are unlikely to see ecologically holistic and just outcomes.

What should policy- and decision-makers do with this information?

- Consider species management as a valuable policy tool but also one with limitations.
- Understand that naming species for targeted management does not necessarily lead to ecological success: implementation can be uneven, information is often insufficient and underinvested in, and management levers do not address all relevant (or even major) drivers.
- Recognise that targeted species management can produce negative outcomes for other species, the wider ecosystem and for people-environment relationships.
- Consider how different social groups a have been empowered and disempowered by species management historically.

How can policy- and decision-makers effect action and change?

- Change the system incentives through legislation and institutional change towards Te Tiriti based decision-making, place-based management and coordinated implementation.
- Review organisational policies and decision-making about freshwater species management and revise to ensure it reflects Te Tiriti partnership frameworks (attending to multiple values) and upholds Te Tiriti obligations.
- Create holistic freshwater species management objectives and plans that explicitly account for other affected species and place-based relationships.
- Collaborate with other freshwater management agencies to share information and resources to improve outcomes for freshwater fish and people.
- Invest in data collection and collation on freshwater fish populations.
- Create tools and provide support to local decision-makers to reduce the challenges, risks and costs associated with place-based holistic management.

Selected glossary

Term	Definition
Hākari	Feast, celebration
Hau kāinga / hau kāika	Home people, local people of a marae
Hīnaki	Traditional woven basket-like fish traps
Īnanga / īnaka	Main whitebait species (*Galaxias maculatus*)
Kaihaukai	A Kāi Tahu tradition involving the reciprocal exchange, bartering or sharing of food among kinship groups
Kaitiaki	Guardian
Kākahi / kāeo / torewai	Three species of freshwater mussel (*Echyridella menziesii, E. aucklandica, E. onekaka*)
Kanakana / piharau	Lamprey (*Geotria australis*)
Kōaro	Climbing galaxiid (*Galaxias brevipinnis*), a whitebait species
Kōkopu	Three species of galaxiid, also whitebait: giant kōkopu (*Galaxias argenteus*), banded kōkopu (*G. fasciatus*), shortjaw kōkopu (*G. postvectis*)
Kōura / kēkēwai / kēwai	Native freshwater crayfish (*Paranephrops planifrons*)
Kōwaro / hauhau / waikaka	Five species of mudfish (*Neochanna burrowsius, N. heleios, N. apoda, N. diversus, N. rekohua*)
Mahinga kai / mahika kai	Food-gathering sites, traditions and methods
Manawhenua	Customary authority over a particular area and use of its resources
Maramataka	Māori lunar calendar
Mātauranga Māori	The body of knowledge originating from Māori ancestors
Nohoanga	Seasonal occupation sites used by Kāi Tahu
Pā kanakana / utu piharau	Lamprey weir, used to catch lamprey swimming upstream
Pā tuna	Traditional weir for catching tuna
Porohe	Common smelt (*Retropinna retropinna*)
Rāhui	A temporary ritual prohibition, closed season, ban, reserve
Raupō	Bullrush (*Typha orientalis*), a common wetland plant
Salmonids	Trout and salmon species
Tangata whenua / takata whenua	Local Indigenous peoples
Tiriti o Waitangi	Te reo Māori text of New Zealand's founding document
Treaty of Waitangi	English-language text of New Zealand's founding document
Tuna	Freshwater eels, including the longfin eel (*Anguilla dieffenbachii*) and shortfin eel (*A. australis*)
Upokororo	Grayling (*Prototroctes oxyrhynchus*), extinct

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