

SHORT COMMUNICATION OPEN ACCESS

# Towards Holistic, Justice-Oriented, and Coordinated Freshwater Fish Science and Governance in Aotearoa New Zealand

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## ABSTRACT

Aotearoa New Zealand faces accelerating loss of freshwater fish biodiversity and growing pressures on culturally significant fisheries. Technical solutions alone have failed because the challenge is not only ecological, but also institutional, cultural, and relational. Change is needed across policy, research, and practice to drive better outcomes for freshwater fish, beginning with how science is conceived and undertaken. Drawing on the Fish Futures five-year transdisciplinary research programme, we outline how a transformative research approach—focused on strengthening relationships between people and freshwater fish—responds to fragmented and justice-deficient freshwater fish governance. We highlight where change is needed to better embed justice, holism, and coordination in freshwater fish science and governance. Through hui and knowledge co-production processes grounded in Te Ao Māori, we articulate six values that guide how research is designed and enacted. Sustaining freshwater fish and fisheries will require more than just more science or better science—it demands transforming the way knowledge is produced, shared, and applied to enable governance that honours Te Tiriti o Waitangi (the Treaty of Waitangi) and reflects the deep interconnections between ecological and cultural wellbeing.

## 1 | What's the Problem with Freshwater Fish in Aotearoa New Zealand?

As a Pacific island nation with diverse freshwater ecosystems, Aotearoa New Zealand has a distinctive biogeography that supports 51 native fish species, most found nowhere else on Earth. Yet one species, the upokororo (grayling; *Prototroctes oxyrhynchus*), has already become extinct. For Māori, freshwater fish such as tuna (eel; *Anguilla* spp.), kanakana/piharau (pouched lamprey; *Geotria australis*), kōura/kēwai (freshwater crayfish; *Paranephrops* spp.), and inanga (whitebait; *Galaxias* spp.) are vital inland foods, woven into cultural practices and managed

through sophisticated harvest systems (McDowall 2011; Phillips et al. 2016). European settlers, however, often viewed rivers as 'empty' of recreational value (see Knight 2019) and introduced salmonids and other species, such as perch (*Perca fluviatilis*), to create new fisheries (Collier and Grainger 2015). Over the following decades, land clearance, wetland drainage, overallocation of water, nutrient enrichment, sedimentation, fishing pressure, and climate change combined to degrade habitats and diminish fish populations, undermining both ecosystems and the human relationships tied to them (McDowall 2011; Knight 2016; Williams et al. 2017). The consequences are stark: freshwater eel catches have steadily decreased since 1990 despite quota management (Jellyman 2007; Fisheries

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New Zealand 2024), salmon runs have collapsed within a generation (Rankin et al. 2022), and three in four native freshwater fish species are now threatened or at risk of extinction, including all five whitebait species (Joy et al. 2020; Ministry for the Environment and Statistics New Zealand 2023; Dunn et al. 2025).

Freshwater fish are an irreplaceable part of the environmental, cultural, and economic fabric of Aotearoa New Zealand. They are taonga (treasured), vital to mahinga kai practices (customary food gathering), recreational fisheries, regional tourism, and to the identities of communities connected to their waterways. Our failure to safeguard this unique biological and cultural heritage should give us pause as a society and motivate collective action towards flourishing futures for freshwater fish. To do so, we must first crystallize the challenge in more specific terms.

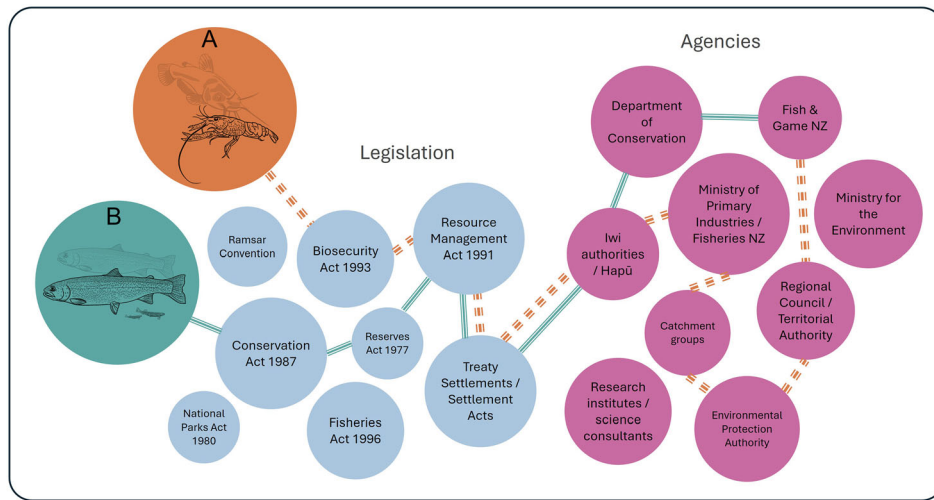
The pressures driving this crisis are complex and compounding. Climate change alters waterway flow regimes and thermal profiles; invasive species compete with and prey on native fish; intensive land use degrades habitats; and biosecurity threats accelerate. The expected spread of invasive freshwater species, such as the gold clam (*Corbicula fluminea*), will add further pressure on endemic populations (Lee et al. 2018; Canning et al. 2025; Somerville et al. 2025). These ecological challenges are layered atop equally complex institutional issues.

Freshwater fish governance in Aotearoa New Zealand is fragmented. Objectives are spread across multiple statutes, national direction, and Treaty settlement instruments, including the Resource Management Act 1991, the National Policy Statement for Freshwater Management 2020, the Biosecurity Act 1993, the Fisheries Act 1996, and the Conservation Act 1987 alongside species- and place-specific settlements that recognize Māori rights and interests in taonga freshwater species. Trout, salmon, and other sports fish are managed by Fish and Game New Zealand under a licensing framework; under the Conservation Act, the Department of Conservation holds responsibilities not only for

endangered species protection and whitebait fisheries, but also for preserving indigenous freshwater fisheries and protecting recreational fisheries and freshwater fish habitats; freshwater habitats are managed by regional councils; and commercial freshwater fisheries, primarily eels, recreational fishing for some native freshwater and estuarine species (e.g. grey mullet; *Mugil cephalus*), and invasive species are overseen by the Ministry for Primary Industries. Figure 1 illustrates this fragmentation by mapping how different legislative instruments and agencies intersect for two illustrative management scenarios, rather than by exhaustively cataloguing all species- or issue-specific responsibilities. While iwi and hapū (kinship groups and sub-groups) have rights and interests regarding all freshwater fish, Crown engagement with them remains diffuse and inconsistent. Crucially, although Te Tiriti o Waitangi enshrines partnership with Māori in law, Māori voices, values, and mātauranga Māori (Indigenous knowledge) remain marginalized in freshwater governance and management (Fisher and Parsons 2020).

Together, these dynamics highlight three areas of change needed in freshwater fish governance. First, the biophysical complexity of fish and ecosystems means fish must be understood not only individually but also in relation to other freshwater species they interact with or depend upon (holism criterion). Second, the historic and ongoing exclusion of Māori values, knowledge, and voices in decisionmaking about freshwater fish must be confronted and remedied (justice criterion). Third, the fragmentation of governance needs to be addressed through collaborative objective-setting and implementation among the many affected actors (coordination criterion).

This is a tall order for Aotearoa New Zealand and will require concerted action across policy, planning, education, science, and practice. In this paper, we focus on how researchers can begin by reshaping the way knowledge is produced and applied, drawing on lessons from the Fish Futures research programme.



**FIGURE 1** | Navigating the complexity of freshwater fish management in Aotearoa New Zealand requires engagement with multiple, overlapping legislative instruments and agencies operating across local and national scales. The figure was developed by the authors to illustrate institutional fragmentation through two illustrative scenarios: (A) a Māori organization seeking to control introduced species and restore kōura habitat and (B) an angling group wanting to promote and access trout fisheries in a national reserve. The diagram maps selected domestic legislation, Treaty settlement instruments, and the agencies commonly involved, rather than providing an exhaustive representation of all species- or issue-specific management responsibilities.

## 2 | Embracing Transformative Research for Sustainability

In what follows, we outline the research orientation, principles, and early practices of Fish Futures as a case study of how transformative research can respond to fragmented freshwater fish governance. The Fish Futures research programme was conceived as a response to the challenges facing freshwater fish in Aotearoa New Zealand. Fragmentation, exclusion, and unsustainability are embedded in current management, and our aim was to confront these dynamics directly to enable flourishing futures for fish and people.

Transformative research provides a useful orientation for this task. It seeks to reshape knowledge systems, norms, and power relations in ways that support systemic change for sustainability and equity (Horcea-Milcu et al. 2024). This reflects a growing awareness of the changing role of science in society (Gibbons 1994): science is no longer expected to provide ‘plug-and-play’ solutions, but to generate knowledge and know-how that extend beyond the ivory tower. Case studies illustrate this shift—for example, Lang et al. (2012) show how transdisciplinary research practices can themselves be transformative, reshaping research agendas and outcomes through collaboration across academic and societal boundaries, while Mertens (2021) highlights how mixed methods, researcher positioning, and community-centred design can drive more equitable outcomes.

Key features of transformative research include transdisciplinarity, co-production, reflexivity, and an orientation to action (Horcea-Milcu et al. 2024). Together, these open up possibilities that conventional disciplinary science has struggled to achieve. Scientific knowledge on its own has not stopped biodiversity declines or resolved tensions among ecological, cultural, and economic values. Transformative approaches are therefore urgently needed to reconfigure relationships among people, fish, and governance institutions.

For Fish Futures, this has meant rethinking both how and why knowledge is produced: whose values guide the research agenda, how mātauranga Māori and science are brought into dialogue, and how collective action can be mobilized.

## 3 | Principles Guiding Fish Futures

Transformative research is not just a set of abstract ideas; it requires principles that must be put into practice. For Fish Futures, these principles help inform and guide the day-to-day work of research, partnership, and action. They align directly with the three areas of change identified earlier—justice, holism, and coordination—and determine how we design and conduct our programme.

To address the justice criterion, we are committed to Te Tiriti-based partnership. We have worked, and continue to work, alongside iwi and hapū as partners, not stakeholders, supporting self-determined aspirations for freshwater fish. While our research proposal included some pre-drawn science, aspects of this were already shaped by iwi priorities. For example, our modelling of lake food webs was developed with iwi and hapū partners, with species selection and modelling choices made to support iwi and hapū decision-making. Over the first years of the programme, the

co-design approach with iwi partners helped identify broader objectives and methods. Our partnerships have been shaped to recognize the tino rangatiratanga (decision-making authority) of iwi and hapū in freshwater management.

To address the holism criterion, our research approaches freshwater fish in relation to other species, habitats, and people, rather than in isolation. This involves understanding how native and introduced fish interact—for example, how trout affect galaxiids in different lakes and rivers. It also considers how fish relate to changing habitats, such as braided rivers reshaped by climate change, and it extends to fish-people relations. As populations or communities shift, the nature of their connection changes too, with cascading ecological and cultural effects. Our research on freshwater mahinga kai and fishing in modified environments helps to trace these evolving dynamics between people and fish.

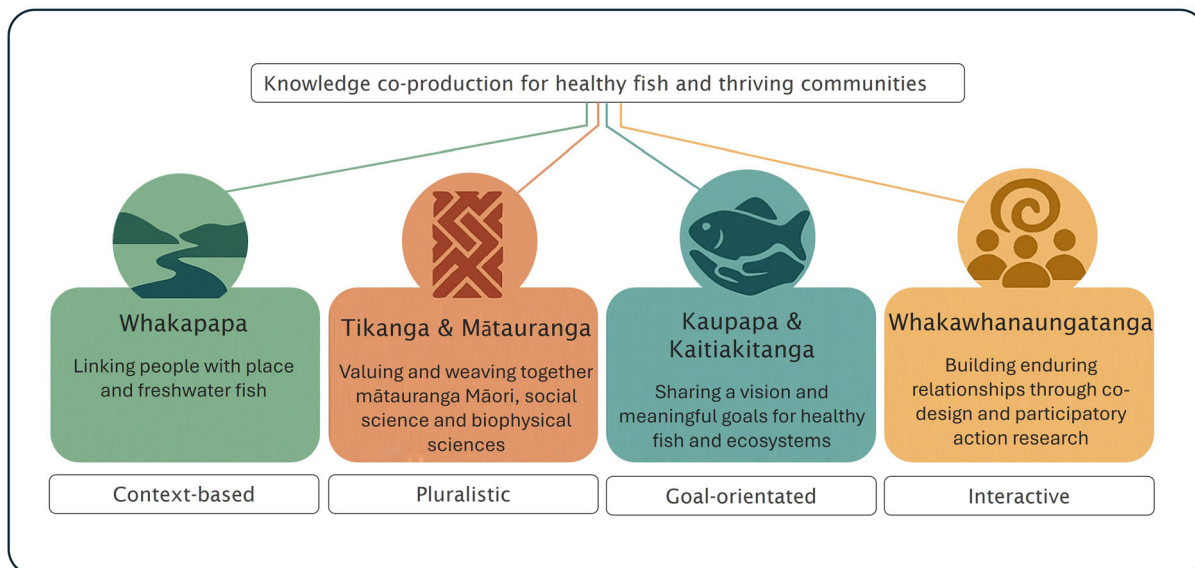
To address the coordination criterion, we have begun building knowledge with an inclusive network of people who can influence change. This has involved deep collaboration with iwi and hapū, as well as more strategic relationships with national agencies with local responsibilities, including the Department of Conservation, Fish and Game, and Te Wai Māori Trust, with Treaty partnerships remaining a primary focus. Through these collaborations, we have started to foster information sharing, activity coordination, and the development of shared objectives that are essential for freshwater fish governance in Aotearoa New Zealand.

## 4 | Values Guiding Our Research

Conducting research in partnership with Indigenous peoples means recognizing and including different knowledge systems and approaches. To build on our commitment to a partnership model, we approach sustainability research as context-based, pluralistic, goal-oriented, and interactive (Norström et al. 2020). In Fish Futures, we frame these qualities through a Te Ao Māori (Māori worldview) lens (Figure 2). This ensures that our research not only generates knowledge but also drives change in practice in ways that respect and strengthen Māori worldviews and aspirations.

Six core values guide our work with iwi and hapū partners. *Whakapapa* situates our research in place and honours genealogical and relational connections among people, species, and environments. A *mātauranga* approach recognizes plurality in how knowledge is generated, shared, and sustained, while *tikanga* ensures that research processes and practices are appropriate and determined with iwi partners. *Kaupapa* defines our shared purpose and keeps the research goal-oriented and relevant. *Kaitiakitanga* focuses that purpose on caring for land, water and taonga species and on supporting those who hold responsibilities for their protection. *Whakawhanaungatanga* emphasizes nurturing relationships, ongoing learning, and active engagement through regular interaction.

Together, these values anchor the programme in relationships, respect, and reciprocity. They are starting to drive our transformative research in ways that are meaningful for Māori partners and for the collective pursuit of more just and sustainable freshwater futures.



**FIGURE 2** | Māori values for knowledge co-production in sustainability research adopted in the Fish Futures research programme. Adapted from Norström et al. (2020).

## 5 | Fish Futures in Practice: Transformative Approaches

Across Fish Futures, our methods reflect the principles of transformative research and knowledge co-production framed by Te Ao Māori. Here we share a snapshot of some practices from the early stages of the programme.

### 5.1 | Co-Developing a Shared Vision and Values

The first year of Fish Futures was focussed on whakawhanaungatanga—building respectful relationships, and kaupapa—defining a shared purpose. These created a foundation for addressing our three research aims: (1) to understand how freshwater fish are valued and managed; (2) to predict fish community outcomes in a changing climate; and (3) to weave knowledge to enhance societal capability for decision making.

We convened a two-day hui (meeting) with researchers, iwi partners, and representatives from Crown organisations and Te Wai Māori Trust, a trust established under the Māori Fisheries Act 2004 to advance Māori interests in freshwater fisheries. For many participants, it was their first time meeting, so the agenda emphasized relationship building through shared activities and kai (food). An open session invited people to share whakapapa and previous research experiences, which also surfaced histories of harm where colonization and science had negatively impacted iwi. Acknowledging these legacies was a transformative act—demonstrating reflexivity and co-production by explicitly naming historical context, recognizing power imbalances, and building trust as a basis for equitable partnerships (Layden et al. 2025).

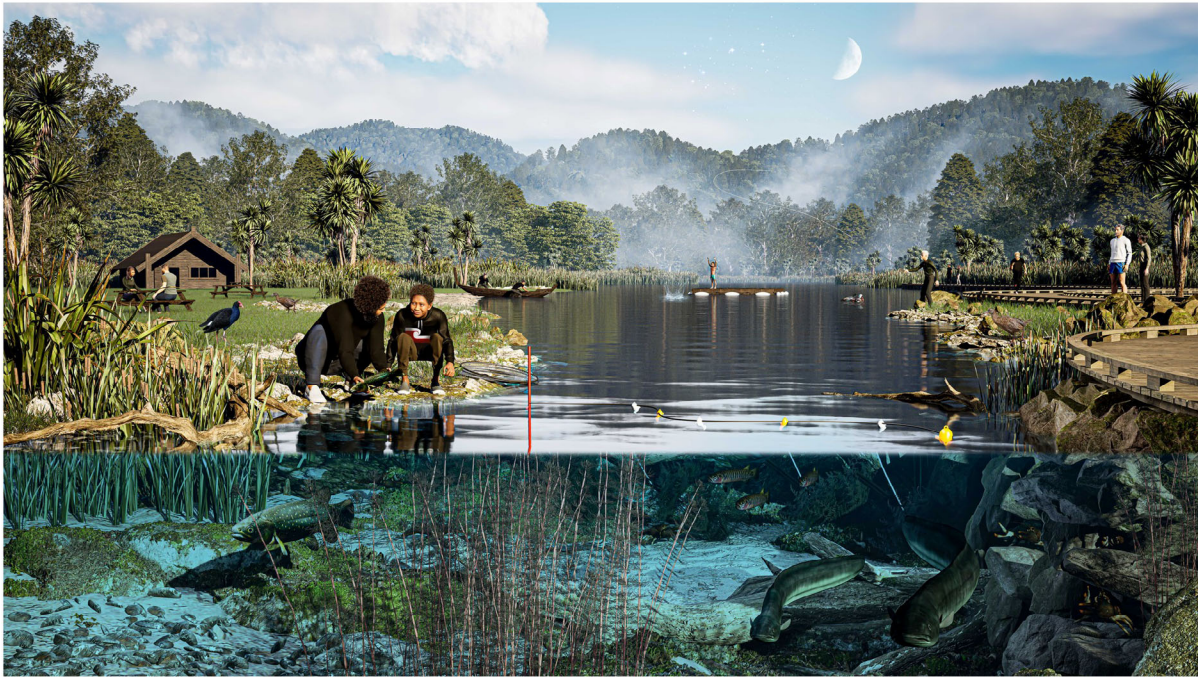
Small groups then shared personal visions for freshwater fish and ecosystems. These were synthesized into two co-developed visual representations—one for rivers and one for lakes (Figure 3). Visuals served as boundary objects to support inclusive engagements and align understanding across disciplinary and cultural

divides (Lundgren 2021). Tested and refined with the research group, they became tools for reminding ourselves why we do this work and for sharing our vision more widely. This process embodied coordination (developing a shared agenda), holism (integrating ecological, social, and cultural relationships), and justice (grounding vision-building in tikanga Māori).

### 5.2 | Mana-Enhancing Agreements and Resourcing

To redress inequities in environmental research, we co-developed mana-enhancing research principles agreements with iwi partners. In research and governance contexts, a mana-enhancing approach means designing processes that leave partners stronger, with their knowledge, relationships, and responsibilities acknowledged and supported, rather than depleted or sidelined. Our agreements clarified roles, expectations, and intellectual property while ensuring partners were resourced to lead research and community engagement. This reflects our commitment to justice, recognizing that transformative partnerships depend on equitable resourcing (Dawson et al. 2021).

Nonetheless, structural funding imbalances remained: grant criteria were weighted toward conventional measures of 'science excellence', which often failed to recognize or adequately resource iwi-led and mātauranga Māori-grounded research, despite a strong and growing evidence base demonstrating its scientific rigour and impact (Clapcott et al. 2018; Dawson et al. 2021). This underscored that equitable resourcing is not just a matter of good intent but requires institutional change. Without it, guardianship responsibilities risk outpacing the capacity of local kaitiaki. Transformative governance for freshwater fish therefore requires not only recognizing tino rangatiratanga but also backing it with appropriate resources and institutional support.



**FIGURE 3** | A visual representation of the Fish Futures shared vision for lakes developed through a knowledge co-production process.

### 5.3 | Strategic and High-Trust Communication

Transformative collaboration depends on communication that is regular, open, and adaptive. To foster this, we developed online platforms for internal (Microsoft Teams) and external (website) communications and resource sharing. We also held 6 weekly Spotlighting Sessions where team members shared updates, challenges, and reflections. These sessions deepened whanaungatanga and created a space for adaptive learning, enabling refinement of goals, methods, and relationships. Early career researchers led the design and facilitation, which both built capacity and encouraged creativity.

These forums provided more than routine updates: they created high-trust spaces where challenges could be surfaced early, opportunities for collaboration identified, and interdisciplinary links forged across projects. By fostering openness, experimentation, and critical reflection, the sessions embodied the reflexivity central to transformative research (Norström et al. 2020). In this way, they advanced both the holism criterion—by integrating diverse perspectives—and the coordination criterion—by aligning actors around emerging opportunities.

We also established the Fish Futures Working Group, co-led with Te Wai Māori Trust, as a forum where researchers, iwi partners, the Department of Conservation and Fish and Game exchange perspectives and co-develop insights. Operating at the science-policy-community interface, the group has begun connecting our place-based research with national policy and legislative reform debates. It also helps translate diverse knowledge systems, including mātauranga Māori, and gives guidance on how to inform freshwater governance and management.

Crucially, the Fish Futures Working Group provides a platform for iwi voices and aspirations to shape policy conversations that have historically excluded them. By ensuring that Māori perspectives are not simply considered, but embedded in shared agenda-setting, the group contributes to redressing imbalances in decision-making

authority. This approach advances the justice criterion and also embodies the holism and coordination needed to reform fragmented governance systems. It also encourages transformative research principles, building on concepts of salience, credibility, and legitimacy in boundary work (Cash et al. 2003).

## 6 | Future Directions and Conclusion

Fish Futures shows both the promise and the difficulties of embedding transformative research into freshwater governance in Aotearoa New Zealand. Our case studies demonstrate how equitable partnerships, co-production of knowledge, and respect for diverse values can reconfigure relationships between people, fish, and freshwater ecosystems. Through initiatives such as the Fish Futures Working Group, we have begun to link locally grounded insights with national policy and legislative processes, creating pathways for integrating mātauranga Māori, scientific knowledge, and community priorities into freshwater decision-making.

Scaling these approaches will require sustained investment in relationships, institutional flexibility, and equitable resourcing for iwi and hapū. Persistent power asymmetries and resource constraints continue to limit Māori leadership and local agency in freshwater governance, underscoring the importance of boundary spaces that foster trust, negotiation, and adaptive learning across knowledge systems.

By bridging science, policy, and community, Fish Futures offers a model for re-imagining freshwater governance in Aotearoa New Zealand. Achieving just and sustainable futures for freshwater fish will depend on expanding these approaches nationally, ensuring that decision-making honours Te Tiriti o Waitangi and empowers all partners to shape shared pathways forward. While grounded in Aotearoa New Zealand, the challenges of fragmented governance, inequitable recognition and resourcing

of knowledge systems, and insufficient coordination across fisheries management and freshwater decision-making are widely shared. The core principles and practices outlined here are therefore relevant for informing efforts to align freshwater governance with Indigenous rights, ecological integrity, and collaborative decision-making globally.

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## Conflicts of Interest

The authors report there are no competing interests to declare.

## Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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