Markets for freshwater fish

Ka mua, ka muri | Fish Futures Policy Brief 06

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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
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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.

Markets for freshwater fish

Tuna (eels) – packed at a processing plant near Whangārei – were destined for the European market. Photographer: unknown; 1975. Source: Archives New Zealand – Communicate New Zealand Collection; AAQT 6539 W3537 R5824.

Key messages

- Markets shape how society interacts with freshwater environments and fisheries, with different market types producing varying social and ecological outcomes.
- Traditional Māori fishing economies – grounded in place, reciprocity, barter and hospitality – have been impacted and constrained by the rise of monetary markets.
- Freshwater fish are governed by diverse market structures, from capped and uncapped commercial fisheries (e.g. tuna, whitebait) to indirect markets for recreational fishing, and aquaculture. These market structures influence fishing pressure, access, stakeholder benefits and the management of over-exploitation.
- Market structures and incentives appear to be enabling unsustainable exploitation of native freshwater fish, including longfin tuna and whitebait.
- Future market settings must recognise Māori rights and interests, invest in robust fishery data, support place-based management, and ensure fair and transparent benefit sharing.

Overview

In Aotearoa New Zealand, some freshwater fish are sold in markets that involve monetary exchange, while others may be bartered or traded, or have closely related and saleable products that affect their management. Markets include not only sales of fish, but also value generated and exchanged through licences, tourism, guiding, equipment, aquaculture and related services. Understanding the key markets in New Zealand is important for the sustainable management of freshwater fish.

Markets for freshwater fish and associated products are diverse, and the landscape is rapidly changing. Some fish, such as whitebait and tuna, are harvested, processed and sold in domestic and international markets. In contrast, while trout and wild-caught salmon cannot be sold directly, recreational fishing for these species is promoted through the tourism industry, and related products – such as guided experiences – are sold through markets. Although not as significant today, the canning industry was historically important in New Zealand. Currently, the fish farming industry is dominated by salmon aquaculture, but there are ongoing explorations into farming other freshwater fish, such as trout, giant kōkopu and īnanga. These developments, alongside others, are raising important questions about which fish should be marketed and how those markets should be governed.

This policy brief summarises information on historical and contemporary markets for freshwater fish in New Zealand, and we consider how their organisation could support sustainable fisheries and foster community stewardship of waterways. We contextualise the long history of selling fish and collate information on the scale and outcomes of their trade. We consider the problems encountered by the freshwater fish markets in New Zealand, and we explore solutions for governing such markets into the future.

Pre-markets for freshwater fish

Māori cultural economies have a long history of harvesting, trading and gifting of freshwater fish, and many species provided an important currency, even before they acquired value in dollar terms. Historically, tuna were widely consumed and valued as a food source, as were īnanga, kōaro, kōura and other freshwater fauna. When hosting visitors from other regions, hau kāinga were expected to provide food that was characteristic of their rohe, and this often included freshwater fish.

Many iwi considered specific freshwater species to be taonga (treasures) for their people, and these were served at large feasts for auspicious occasions. There are accounts of epic hākari (feasts) throughout New Zealand in the 1800s: 600 kōaro served at Arikirau (Hauraki) in 1876; 500 baskets of dried kōura and īnanga in Ōhinemutu (Rotorua) in 1873; tuna ‘by the hundreds and thousands’ in Matamata in 1846; 50 baskets of īnanga at Lake Rotorua; and a hākari with 500,000 tuna for 6,000 people.1 Importantly, the provision of freshwater kai was a reciprocal relationship between iwi – there was an expectation that hosts would provide, but also that visitors would bring gifts from their own rohe – an exchange called kaihaukai.

'A hangi (steam oven) with potatoes, eels, fish-heads, etc in position on hot stones before covering with flax mats and earth [Official opening of Raukawa meeting house]'. Photographer: L. Adkin; March 1936. Source: Te Papa; A.006978.

Outside the context of feasts, iwi also directly bartered goods that included freshwater fish; for example, inland Māori would bring freshwater fish to trade with coastal Māori for kaimoana. Bartering of freshwater fish provided access to a range of Māori and European goods, such as fruit, pounamu, butter, tobacco, or even more unusual items like carpet.[1] The exchange of freshwater fish could facilitate harmonious relationships among iwi, and between iwi and settlers – supporting cultural currency that was both material (for food, barter) and symbolic (prestige, reciprocity, hosting).

Contemporary markets for freshwater fish

Today, some freshwater fish are caught and sold directly as commodities, or they are the centre of large markets for fishing-related products. Certain species are grown in specific rohe for harvest or restoration, while others can neither be sold nor grown for markets. While the cultural exchange and barter of fish between iwi continues, a history of regulation and species decline have suppressed this trade in many places. This report reviews four major types of market relations relating to freshwater fish, highlighting their origin, the organisation of market producers and consumers, and the outcomes that are currently visible.

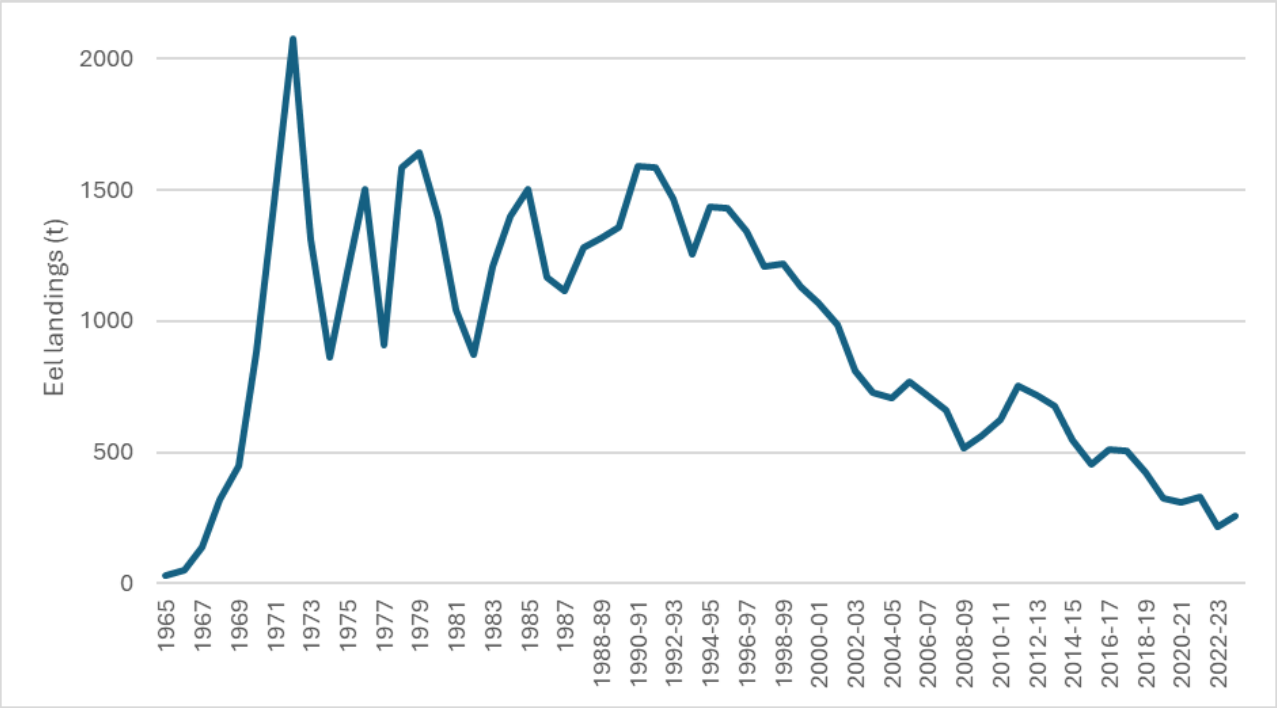
Tuna as a commercial fishery

While tuna were always important in the Māori cultural economy, after European arrival, these fish became part of the monetary economy. In the late 1800s and early 1900s, acclimatisation societies introduced trout and other species across New Zealand. Initially, these new fisheries were fragile, and the once

abundant tuna predated on the new fish. As a result, the acclimatisation societies offered financial rewards for culling tuna, effectively creating a market for their destruction. These culls became widespread, with the peak lasting from the 1920s to the 1950s. In addition, anglers promoted the commercialisation of the tuna fishery, as it was expected that this would reduce tuna numbers and benefit trout.[1,2]

Starting in the 1960s, the commercial tuna industry rapidly expanded as markets emerged in Europe and Asia.[3] Reported takes exploded from 30 tonnes in 1965 to 2,077 tonnes in 1972, declining steadily thereafter.[4] The industry's large export volumes meant that it was one of the most lucrative fisheries in the country, with new processing factories, unlimited licences and no take limits.[4]

> In just a few years eels had changed from being an abundant nuisance (i.e. vermin) for the largely Pākehā acclimatisation societies, to a highly valued export of the largely Pākehā fishing industry, leading to deep concerns among Māori about over-exploitation. (McDowall 2011, p. 218)[1]



Freshwater tuna (eel) catch data for calendar years 1965 to 1988 and fishing years 1988–89 to 2020–24; information based on Ministry of Agriculture and Fisheries Statistics Unit data, licensed fish receiver returns, quota management reports and monthly harvest returns. t = tonnes.[6]

As early as 1978, New Zealand's single largest tuna fishery, Te Waihora, was considered over-exploited and declared a controlled fishery, with a total catch limit imposed.[3] By the 1980s, concern about over-exploitation nationally led to part-time fishers being excluded. Alongside a moratorium on further licences, tuna fishers agreed not to increase effort beyond the levels recorded in the late 1980s.[4,5] In the 1990s, regulations introduced controls on fishing methods, maximum size limits and a daily bag limit of six tuna for recreational harvesting.

Industry and iwi engaged in cooperative planning to produce regional management plans for the South Island tuna harvest. In 2000, these were merged into the Quota Management System (QMS), and a total allowable catch (TAC) was assigned. In recognition of the historical and cultural importance of tuna, Māori were allocated 20% of the commercial quota and another 20% for customary harvest. In 2004, the North Island tuna fishery entered the QMS, with a TAC that was 18% lower than recent commercial catches; 14% of TAC was allocated for customary harvest.[4] Māori companies now hold the largest share of the North Island tuna quota after making additional quota purchases.[5]

Since 2000, there has been a continued decline in tuna takes. This reduction has been interpreted as consistent with the QMS and cooperative planning efforts to reduce tuna harvests.[4] When the QMS was implemented, many fishers sold their quotas and left the industry; for example, the number of tuna fishers in the South Island has reduced from 70–80 to about 20. Information about current quota holders, including their ownership and beneficiaries, is not publicly available. However, it is known that some iwi entities have decided not to fish their quota due to concerns about population declines. In 2019, the latest year with available data, the commercial value was NZ$13.2 M for longfin tuna and NZ$39.4 M for shortfin tuna.[7] The commercial tuna fishery remains an export-driven market, with 98% of tuna sent to Europe, Asia and the United States.[5,8]

Currently, management of the commercial tuna fishery involves:

- setting a total allowable commercial catch (TACC) for longfin and shortfin tuna in each quota management area each year. The TACC is used to set the annual catch entitlement of quota holders. Quota can only be purchased by tuna fishers from existing quota holders.
- setting minimum and maximum harvest size limits for tuna, to protect juveniles and migrating females.
- establishing areas that are closed to commercial harvesting (such as Whanganui River, mātaitai reserves, national parks); there is also a voluntary code of practice to return longfin tuna caught in Te Waihora.
- collecting information on the number of elvers arriving at 11 monitoring sites across New Zealand (annually), catch per unit effort (every 4 years), and type, weight and source catchment for each tuna processed (annually). No information is gathered on recreational harvesting.[6,9]

Whitebait as an unquantified but regulated market fishery

For centuries, Māori have harvested, consumed and traded whitebait, a catch-all term referring to the juveniles of īnanga, kōaro, shortjaw kōkopu, giant kōkopu, banded kōkopu and common smelt. When these juvenile fish migrate up the rivers, typically in late spring and early summer, Māori fishers would set up nets to harvest significant volumes. While whitebait have always been important for Māori fishing and culture, early European settlers also took to gathering and consuming whitebait because it was easy to access. Whitebait catches were bought and sold with little regulation, but sales were generally localised, as the fish are fragile and easily deteriorate.[1,10]

In the 1880s, whitebait canning was used to better preserve the fish and enable development of wider commercial markets. Canneries opened in the Waikato, Dunedin and in many locations along the West Coast, with factories processing massive volumes of fish and limited harvest regulations. However, the whitebait canning industry began to decline in the 1950s as transport infrastructure, refrigeration and

air freight provided other solutions to deterioration. The New Zealand industry also faced competition from the Tasmanian whitebait fishery, which developed in the late 1940s.[10]

Canning whitebait at Nolan's Canning Factory, Okuru, south of the Haast River. Photographer: unknown; c.1900–c.1947. Source: Archives New Zealand – Communicate New Zealand Collection; AAQT 6539 W3537 38/A3085.

While the demand for canned whitebait declined, the market for fresh and frozen fish continued, and the scale of the fishing industry increased. As pressure on the whitebait fishery grew, tighter regulations were implemented. As early as the 1890s, the government introduced restrictions on methods that involved major stream modifications and bounded the whitebaiting season to reduce conflict with trout anglers. Subsequent regulations stipulated the fishing seasons, net size limits and river-specific net restrictions; furthermore, certain fishing methods were prohibited, as was fishing in defined areas. The West Coast fishery was also recognised as a separate entity requiring its own governance. While the new regulations were enforced in 1932, they were vigorously contested by whitebaiters and between regions, leading to further revisions in 1947, 1951, 1964, 1970 and 1981. While some changes focused on limiting harvest to allow breeding stock survival, most involved creating place-based exceptions. Notably, the whitebait fishery proved to be difficult to manage politically.[10]

There have been widespread claims of declining whitebait fisheries across New Zealand since the 1980s.[10] Major conservation legislative reform assigned responsibility for managing the fishery to the Department of Conservation (DOC), which aimed to further extend protection with further harvesting

regulations, such as the Whitebait Fishing Regulations 2021. These recent regulations limited the whitebait season, introduced nationwide upstream limits on fishing, enabled the creation of whitebait refuges and standardised rules on fishing methods. The whitebait regulations do not apply to Māori customary fishing, which is managed by mana whenua.[11]

Whitebait fishing provides a significant industry in New Zealand, with the fish regularly selling for high prices. However, unlike tuna, there is no management of the volume harvested, nor any requirement for harvesters to hold permits or report catch data. As a result, the size of this industry has not been assessed.[12,13]

Prices for a pottle of whitebait from a range of commercial retailers in 2024.

Source (prices advertised online in November 2024)	Price in NZ$ per 250 g
Harbour Fish South Island Seafood (East and West Coast)	36.00
Oceans North Seafood (South Island)	38.50
Solander Seafood (Wairau)	39.90
Scott Seafood (West Coast)	54.99
Wellington Seamarket (West Coast)	55.00
Guytons (West Coast)	56.00
The Mainland Trader (South Westland)	57.50 (sold in 4 kg bundles)

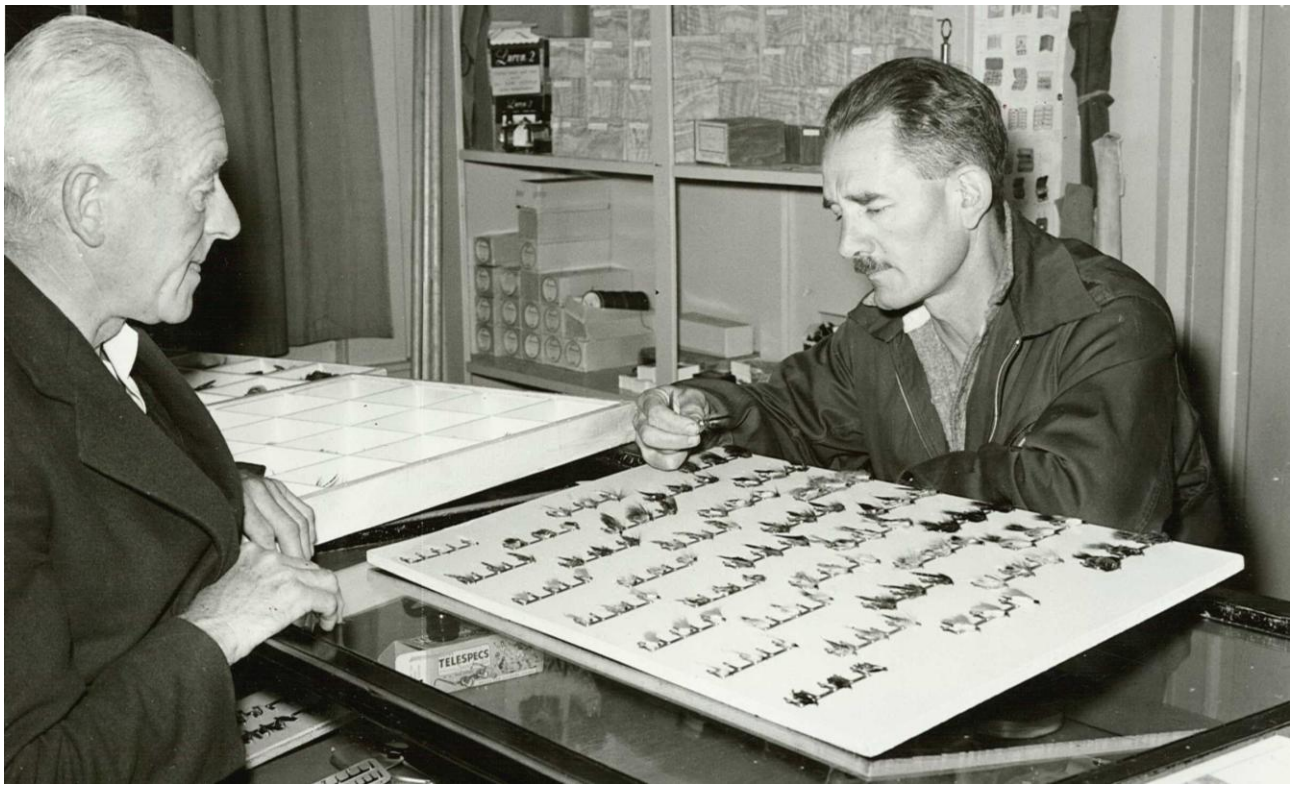
Key features of the contemporary management of the commercial whitebait fishery include:

- no limit on the volume of whitebait that can be harvested or sold by any fisher
- no requirement to hold a permit or licence to commercially harvest or sell whitebait; however, regional councils issue licences for the use of a 'stand' (structure) to harvest whitebait
- regulations that limit the timing, location and methods for whitebait harvesting.

Wild trout fishing

After salmonids were introduced in the mid-1800s, their fragile populations were protected by a licensing system that was vigorously enforced, with frequent prosecutions of people fishing without a licence.[2] This licensing system provided a way for acclimatisation societies and the government to control who fished for salmon and trout, and where and how.

In the early decades of acclimatisation, people with a licence could sell the trout they caught. For example, trout were sold in Wakatipu and Christchurch in the 1880s, and around the central North Island lakes from the 1890s. Over time, however, anglers agitated about the sale of trout, insisting that it should be a recreational fishery only. Anglers were concerned that the high numbers of trout being netted in estuaries for the market would negatively impact the recreational fishery. The government eventually banned trout netting in estuaries, and after further agitation, the commercial capture and sale of trout was banned in 1919.[2]



Mr Geoff Sanderson making and selling flies at his store in Turangi. Photographer: W. Walker; November 1955. Source: Archives New Zealand – Communicate New Zealand Collection; AAQT 6539 W3537 R156.

While trout can no longer be bought and sold commercially, trout fishing has continued to develop into an industry that generates large revenues. The sale of trout licences is profitable, and this money is reinvested into supporting the fishery; for example, the acclimatisation societies – now represented by Fish & Game New Zealand – fund habitat protection and restoration programmes. Licence fees for fishing and hunting are estimated to generate NZ$13–18 M annually.[14]

Furthermore, trout fishing generates revenue through sales of fishing gear, guided experiences, transport, hospitality services and ancillary tourism. Fishing tourism has a long history in New Zealand, and Fish & Game councils, angling advocacy groups, fishing guides and tourism entities are active in promoting the trout angling experience and lifestyle. This includes the cultivation of niche tourism markets, such as luxury angler accommodation, helicopter fishing and hydro-canal fisheries.[15] People travel domestically and internationally to participate in New Zealand's trout fishery, and this movement and expenditure contributes to the growth of certain industries and regions. A recent study estimated that freshwater anglers spend a total of NZ$113–139 M annually and support 1,168 jobs nationwide.[16] The impact of angling dollars can be even larger at a local scale; a study of the Mackenzie Basin canal fishery estimated that anglers contributed NZ$13.6 M in economic impact to the region in 2022–23.[17]

Currently, key features of managing the trout fishing industry include:

- trout cannot be bought or sold commercially, even in restaurants
- licences are required to catch trout, and fees are reinvested into supporting the trout fishery

- commercial entities, including fishing guides and tourism operators, organise to promote and funnel economic consumption related to trout fishing.

Freshwater fish aquaculture

Chinook salmon were introduced from California to the South Island by acclimatisation societies from the 1870s, with many early attempts failing. By the early 1900s, however, focused and sustained introduction efforts led to the establishment of wild populations in Canterbury and Otago. The Chinook salmon fishery is now highly valued by recreational anglers, and the wild populations continue to be supported by releases of hatchery-raised fish.[2]

Unlike trout, salmon were not permanently banned from sale. River-run salmon were augmented by hatcheries for many decades, and the fish were sometimes caught for the commercial market; however, recreational anglers voiced staunch resistance to large-scale commercial salmon fishing. As sea-cage farming became viable, marine salmon farming was successfully trialled and eventually established. From the 1970s, Chinook salmon were farmed in the inshore marine area around Rakiura / Stewart Island, expanding to the Marlborough Sounds and Akaroa Harbour. Freshwater hatcheries were set up to provide smolts for marine salmon farms, and later freshwater salmon farming was established in hydro canals and constructed raceways in Canterbury and Otago.[2,18] Several freshwater salmon farms also market tourist fishing experiences.

Currently, sea-cage salmon aquaculture is a major export industry. Two New Zealand companies produce more than 50% of the global supply of farmed Chinook salmon:[19] The New Zealand King Salmon Company Ltd produces about 8,000 tonnes annually from its farms in the Marlborough Sounds, while Sanford Ltd produces about 3,000 tonnes from its farm in Rakiura. Salmon aquaculture revenue has been estimated at NZ$260 M, with government policies aiming to increase this to NZ$500 M by 2035.[20,21]

Currently, key features of managing commercial salmon aquaculture include:

- marine pens and land-based farms require a resource consent as per the Resource Management Act 1991
- scale of production is constrained by the associated costs and the environmental conditions provided in the resource consent
- profit is largely claimed by two private New Zealand companies: New Zealand King Salmon and Sanford.

Beyond the salmon aquaculture industry, farming of other freshwater fish species is occurring on a smaller scale but attracting significant interest. Freshwater kōura are being farmed in ponds, grass carp are farmed for aquatic weed control, and there have been several, although unsuccessful, trials in tuna aquaculture.[22–24] Land-based freshwater aquaculture is emerging for whitebait species, including giant kōkopu, where the focus is on supporting restoration of native fish populations as well as commercial sales.[25]

Examining commercial markets for freshwater fish

Freshwater fish are viewed as a national treasure and part of the public commons; therefore, their commercial use is a matter of public interest. By examining commercial markets for freshwater fish and related services, we can explore how the markets contribute to freshwater fish management within New Zealand, and whether – and how – they might better reflect the country's values.

How are markets controlled?

These markets demonstrate different licensing, fishing and selling arrangements that imply different degrees of control and oversight of the fishery.

In the case of tuna and whitebait, wild fish are caught and sold by fishers to other market stakeholders such as consumers, processors and retailers. For tuna, quota rights must be obtained (purchased) to allow commercial catch of a particular volume, and there is consequently a limit on the volume of tuna that can be harvested and sold. For whitebait, however, there are no regulations controlling access to the fishery, and there are no regulatory limits on how much whitebait can be caught and sold.

For salmon and other freshwater aquaculture, fish are hatchery-reared and tank- or cage-raised for sale. Fish farmers must obtain a resource consent, which provides an indirect limit on the number and size of fish that can be produced. As the fish are all farmed, there is no direct reduction of wild fish populations. The fish are then sold direct to consumers or other market stakeholders.

Interior view of the hatching troughs at the Ngongotahā Game Farm Hatcheries. Photographer: E. Woollett; March 1953. Source: Archives New Zealand – Communicate New Zealand Collection; AAQT 6539 W3537 49/A30586.

In contrast, the trout fishery has a different form of management in New Zealand, as this species cannot be sold commercially. Nevertheless, the right to fish and the associated fishing equipment, services and experiences have contributed to a 'fishing industry' that profits from trout. Rights and regulations governing the fishery tend to promote rather than limit the trout fishing market. For example, licence fees are reinvested into programmes that support improvements of the trout fishery. Bag limits are set annually for each location, with fishers encouraged to use catch and release in certain areas to sustain the populations.[26]

Who benefits?

It is important to clarify who can participate in the markets selling fish, and how they might benefit. For salmon aquaculture, the large capital costs, space constraints and infrastructure requirements act as barriers to entry. Consequently, there are only a few firms involved in salmon aquaculture in New Zealand, namely New Zealand King Salmon and Sanford. These firms rely on international capital and ownership, with profit from fish sales going to the companies and their shareholders. Currently, aquaculture of other species is pursued by a handful of operators, but there is significant interest in growing this market, particularly among iwi and Māori entities.

Becoming a tuna fisher requires small capital costs, negotiation of access to waterways and purchase of quota. Most quota in the North Island is held by Māori entities, and 20% of the South Island quota is allocated to Māori.[27] However, several iwi do not fish their commercial longfin quota, or have placed a moratorium on harvesting, due to declining fish stocks and the status of tuna as a taonga species. Although other operators continue to harvest, these iwi do not benefit from tuna fisheries as a result of their efforts to sustain the tuna populations. While there is still a large international market for tuna, the export volume has declined, and the number of New Zealand companies and individuals benefiting from this fishery has also reduced. Most profits are accrued by the commercial operators, the two remaining processing factories and the export companies (primarily Southfish Ltd).[9,27,28]

Trout fishers can purchase a licence to harvest a limited number of fish, but the catch cannot be sold. Income from fishing licensing is reinvested in protecting and promoting recreational fishing, including employing staff. For the industries that support trout fishing, however, there are no fish-based regulatory barriers to entry – although tourism operators need consents and licences to operate their services and sales. Moreover, these operators require capital to invest in infrastructure and service provision. In some areas, iwi ownership of lakebeds and riverbeds enables them to collect fees for infrastructure development and commercial activities in their waterways. Profits from the sale of trout fishing experiences are then distributed among the adjacent industries, such as fishing guides, recreational retailers and tourism operators.[16]

Whitebaiters do not require a licence, and the capital costs associated with the industry are low. These fishers can harvest and sell as much whitebait as they want to, although they are subject to regulatory compliance around fishing methods and timing. Profits from the sale of fish go directly to the whitebaiters, often without payment of tax, and to the wholesale and hospitality companies they supply.

Rotorua International Fishing Contest. Photographer: D. Nicholson; 1967. Source: Archives New Zealand – Communicate New Zealand Collection; AAQT 6539 W3537 77/A84236.

How is over-exploitation managed?

The various commercial fish markets in New Zealand illustrate different approaches to managing over-exploitation.

Managing effects

If the commercial fishery generates unacceptable impacts on the wider ecosystem, the conditions for that fishery can be adjusted. Salmon aquaculture does not exploit wild salmon fisheries but does affect the environment surrounding the farms through water intakes, nutrient outputs and disease. These environmental effects, in theory, are contained by the provisions of the resource consent; this means if the farming operation exceeds the expected effects, it must modify its practices (e.g. reduce stocking or feeding). As consents can cover more than a decade, it can be challenging to reduce the level of acceptable environmental impact after a consent has been issued.

Controlling methods, sites and timing

Harvesting pressure can be constrained and directed by limiting fishing practices rather than the volume of catch. This approach was used by hapū and whānau to manage traditional fisheries by applying place-based knowledge and the maramataka. Such methods are uncommon among commercially valuable fisheries due to the potential for unsustainable levels of harvesting. The whitebait

fishery is unique in that it does not have a harvest limit, but rather regulations that control fishing methods and equipment, the season and timing of harvesting and the permitted whitebaiting locations. If government considers that whitebait fishing is under pressure, the DOC can reduce the length of the fishing season, as well as constrain fishing methods to practices with smaller catch rates and / or exclude additional areas from whitebait fishing. There has been ongoing debate about DOC's role in managing the fishery, and questions have been raised over whether this approach is sufficient to sustain the whitebait fishery.

'Whitebaiting, Big Bay. As much as 160 lb. of whitebait has been lifted in one net at once, this representing £100 on the early market'. Photographer: Mr Bigwood; September 1948. Source: Archives New Zealand – Communicate New Zealand Collection; AAQT 6539 W3537 40/A8466.

Limiting harvest

Harvests can be directly regulated by assigning quantities per fisher and / or for the fishery as a whole. Where fishing pressure is high relative to the fish population, such as for wild salmon, daily or seasonal bag limits and minimum legal sizes are used to ensure recreational fishing remains sustainable. Bag limits are typically set by local Fish & Game councils based on knowledge of fish population dynamics, and these vary by waterbody and / or region. For commercial fisheries, such as tuna, the government sets a maximum quantity that may be harvested per annum for each quota area, and these are adjusted annually. Tuna quota rights can be bought and sold separately across the North and South Islands, but the system ensures that despite the entry and exit of fishers, the overall catch for each area is maintained within the specified limit. It should be noted that the quota volumes for the North and South Islands are not exchangeable. Commercial fishers are also required to report their landings, which provide only a loose proxy for tuna population size. The efficacy of this approach to managing sustainable harvesting of longfin tuna has been widely questioned; in particular, the animal's complex biology and sparse information on population dynamics make it challenging to set appropriate quota limits.[29,30]

Recommendations to policy- and decision-makers

Examining the commercial markets for freshwater fish allows us to consider what management elements could strengthen New Zealand's approach to freshwater fisheries management. Such reflection is especially important as recent freshwater aquaculture developments have created new markets for consumption and conservation.[25] The four most significant areas of consideration for managing freshwater fish markets are discussed below.

Recognise Māori rights and interests in freshwater fish

Despite guarantees in Te Tiriti o Waitangi, Māori have experienced declines in their customary fisheries as well as reduced access and limited advantages. Māori also continue to have no legal benefit or management of whitebait, aquaculture, and trout and salmon fishing (except in specific areas). While Māori possess commercial quota for tuna harvest, the wider system does not ensure healthy populations across all areas; many iwi have responded by not fishing their quota.

Invest in generating data on the state of the fishery

Without information on the size and health of overall fish populations, fisheries can be over-exploited to the point of no return. Waterbody-specific data are important, as most species remain in the same system throughout their lives. The tuna fishery currently relies on basic national modelling and limited monitoring of elvers in 11 catchments to gauge population health, alongside high-level catch data.[5,31] These data indicate that there is pressure on the fishery system, but the specifics of tuna populations in each waterbody are unclear.[6] There is even less data collected for whitebait – fishers are not required to report on the volume harvested or income they receive, and there is no coordinated monitoring of the state and health of the whitebait fishery. Monitoring whitebait is particularly difficult because they comprise multiple species that vary in composition across the country.[12,13]

Develop institutions for place-based management

Tuna and whitebait are migratory species that are vulnerable to local overfishing because they spend most of their adult lives within the same waterbody. Fisheries regulations set limits on large quota management areas or on a temporal basis, and therefore do not protect local tuna or whitebait fisheries from being devastated by commercial fishing. If fishers are using the specified methods within the regulated season or annual catch entitlement, they can fish as much as they want from a given waterway. This has led to 'strip mining' of tuna from some waterways, negatively impacting recreational and customary harvest potential, local tuna reproduction and the wider ecosystem. In contrast, waterbody-specific bag limits prevent the over-exploitation of popular trout fisheries.

Create mechanisms for benefit sharing

A guiding principle is that those who benefit most from a resource should invest in its sustainability; therefore, some surplus generated from the sale of freshwater fish should be reinvested to support the sustainability and health of New Zealand's fisheries and waterways. Currently, the tuna and whitebait fisheries do not require profits to be reinvested in sustainable management programmes. In contrast, the trout fishing licence revenues have historically supported important advocacy and restoration work aimed at improving fish habitat. This model of reinvestment towards ecological improvement could be used by the tuna and whitebait industries to cultivate social licence and help ensure that fishery takes provide some reciprocal benefit for future generations.

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

- Explore options for co-governance of freshwater fish markets to ensure that the management of freshwater fisheries and their benefits accurately reflect the rights and interests that Māori were guaranteed in Te Tiriti o Waitangi.
- Invest in generating systematic data on the local and national population status and dynamics of tuna, whitebait and other freshwater fishery species.
- Develop bottom-line place-based protections for freshwater fisheries to ensure that ecological and socio-cultural needs are maintained, and commercial harvesting is sustainable over the long term.
- Create mechanisms to reinvest revenue from freshwater fish markets to support the sustainable management and health of New Zealand's fisheries and waterways.

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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