Protecting the habitat of trout and salmon

Trout and salmon habitat contributes to a healthy freshwater ecosystem!

Our NPS-FM position in a nutshell

Trout and salmon habitat values need to be identified in your regional plans. The NPS-FM directs you to protect the habitat of trout and salmon insofar as it is consistent with protecting the habitat of indigenous freshwater species[1]. You need to know where these habitats are, and they need to be mapped in your regional plans. Fish & Game have a wealth of information to assist your mapping effort.

Trout and salmon have been in Aotearoa New Zealand waters for over 100 years and in many places can live alongside indigenous freshwater species as part of a healthy freshwater ecosystem. They have more stringent habitat requirements than indigenous species, needing very high water quality and fast water flows to live and breed in. Their presence is a great sign of fresh and healthy water bodies.

Where specific cases of species interaction between indigenous fish and trout are identified as detrimental, measures will need to be taken to protect the more vulnerable species[2]. This should be a decision made with the best information available[3] to inform what action is needed. It should be in consultation with Fish & Game and the Department of Conservation.

The NPS-FM directive

You must protect the habitat of trout and salmon[4], while ensuring that indigenous freshwater species habitat is protected too[5]. This means that you must know where trout and salmon live and where they spawn, understand their life cycle, and understand how they interact with other indigenous freshwater species so that you can adequately protect them and wider ecosystem health.

Your regional plans should identify trout and salmon fishing and spawning values and protect that habitat. Fishing is a value that you must consider in your regional plan[6]. Where areas that are valued for their fishing are identified, provisions of the plan should protect both the habitat that supports that fishery, and ensure conditions are safe for people to catch and consume them in a safe[7] and sustainable way.

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[1] Link to: Policy 10 of the NPS-FM

[2] Fish and Game. (2023). Species interactions resource. *Adapted from thesis by Ami Coughlan.*

[3] Link to: Best information available PN

[4] Link to: Policy 10 of the NPS-FM

[5] Link to: Policy 9 of the NPS-FM

[6] Link to: 5 in Appendix 1B – other values that must be considered in the NPS-FM

[7] Link to: Improving water quality and access for swimming and recreation PN

Fish & Game hold a statutory role under the Conservation Act 1987 to manage introduced sport fish in Aotearoa New Zealand and their habitat. They can provide detailed information on habitat locations and advice on the attributes required specifically for trout and salmon. You should engage with Fish & Game as you develop your regional plan.

The NPS-FM directs you to include a specific fish passage objective and policies in your regional plan[8] that identify which species are desirable (or undesirable) within a particular freshwater environment. In making those decisions, you must take into account any Freshwater Fisheries Management Plan or Sports Fish and Game Management Plan. You should engage with Fish & Game to develop policy about any population management needed in that specific area.

What do we want to see?

We want to see trout and salmon fishing and spawning identified as values in your regional plans. Fishing activities often rely on species that are widespread, so you should consider fishing and spawning values at a catchment, rather than river reach scale.

Trout and salmon presence can also be a sign of a healthy ecosystem. The fish will more likely live, spawn and be caught where the conditions support a healthy catchment. In special circumstances, it will be necessary to consider fishing and spawning at the river reach scale (rather than the catchment), for example where there is a need to identify extremely popular angling spots or to plan interventions due to detrimental species interaction. See the Species interaction resource[9].

The locations of fishing and spawning areas should be mapped and included in your regional plan. Fish & Game have detailed information to support this mapping exercise.

In some areas other species will also be valued for their sports fishery, for example, perch. You should engage with your local Fish & Game office to understand if and where these other fisheries are valued, and the specific habitat requirement for those fisheries.

Environmental flows, take limits, nutrient outcomes and target attribute states must be set to provide for values identified in those locations. General guidance on flows, attributes, and limits[10] is provided in the practice notes on those topics. For more regional-specific information, engage with your regional Fish & Game Council[11] to determine the right type of habitat for trout and salmon, throughout their lifecycle, in your area. This can have wider benefits for the health and well-being of water bodies and freshwater ecosystems.

In particular, we want to see:

Trout and salmon fishing rivers and	Trout and salmon are valued sports fisheries to both New Zealanders and our visitors. These locations are well known by

[8] Link to: Clause 3.26 of the NPS-FM

[9] Fish and Game. (2023). Species interactions resource. *Adapted from thesis by Ami Coughlan.*

[10] Link to: Ecological flows and levels; and take limits PN

[11] https://fishandgame.org.nz/about/fish-and-game-structure/

spawning habitat identified in the plan.	Fish & Game. These values must be identified, and locations mapped in your regional plans.
Environmental flows and levels that provide plenty of clean, clear, cool water.	Removing water, especially large amounts from water bodies, can have multiple impacts on the habitat of trout and salmon. Not only does it limit the amount of water species can live in, feed in and move up and down the water column, but shallow water also heats more easily, further reducing the ability for them to live in these warmer environments. Fish need connecting flow to move between habitat and migrate up and down streams and rivers and out to sea. For example, a variety of riffles, runs and pools up to 100km may be required between a river mouth and headwater streams for species such as mature sea run salmon to navigate within their life cycle[12] [13]. If you do not have river specific information and models for setting appropriate water levels and take regimes that support the habitat of trout and salmon, you should use the values and risk-based framework outlined in the Ministry for the Environment Flow Guidelines (1998). More detailed information about flow and take limit setting is in the environmental flows and levels; and take limit practice note[14].
Barriers for fish passage for trout, salmon and other freshwater species removed.	Many freshwater species including trout and salmon migrate up and down rivers and need to use different habitats during different times in their life cycle to live and spawn. We want to see fish passage barriers removed or fish passage bypasses installed on all instream structures that would otherwise inhibit species migration and access to the habitat they need to survive.
Cool water below 11 degrees in trout spawning rivers during spawning season.	Trout require cool water to survive and spawn. At temperatures above 11 degrees, trout cannot spawn successfully. Water takes can cause water temperatures to rise, while riparian shading can reduce water temperatures. With climate change predicted to increase temperatures, it is critical that this is not escalated by human induced changes such as discharges, or reduced flow caused by abstraction.

[12] Thompson, K. E. (1972). Determining streamflows for fish life. Pp. 31-35. In: Proceedings of the Instream Flow Requirement Workshop. Pacific North West River Basin Commission, Portland, Oregon.

[13] Raleigh, R.F., Miller, W. J., and Nelson, P. C. (1986). Habitat suitability index models and instream flow suitability curves: chinook salmon. U.S. Fish and Wildlife Service Biological Report. 82(10.122). Pg. 64.

[14] Link to: Environmental flows and levels; and take limits PN

Water temperature below 14.5 degrees for salmon spawning and 16 degrees for egg maturation.	Salmon require water below 14.5 degrees to successfully spawn and 16 degrees for egg maturation[15]. Prior to spawning, female salmon in holding pools need temperatures below 16 degrees to successfully mature eggs.
Nutrient[16] outcomes for trout and salmon habitat inserted into the plan.	Nutrients impact the water quality and induce algae blooms that can decrease water clarity and dissolved oxygen, causing death of sensitive aquatic species. Nutrients also impact macroinvertebrate species composition, reducing food availability for trout, salmon, and indigenous fish species. These effects start to occur at nitrogen concentrations above 0.5mg/l. Phosphates are of no direct toxic significance to fish. However, like nitrogen compounds, they present a eutrophication problem. Fish appear relatively indifferent to nitrate, although the associated nitrite can be toxic to them[17].
Visual clarity greater than 3.5m in trout fishing rivers, 5m in regionally or nationally significant fishing rivers[18].	Trout are sight feeders and need very clear water bodies to see and catch invertebrates as they drift past. Suspended sediment decreases habitat availability for fish to spawn. Land use activities such as agriculture, forestry, and earthworks must be appropriately controlled to achieve this. Lower clarity in estuarine river mouth locations (1m) may be appropriate in some locations – check with Fish & Game.
Deposited sediment less than 10% cover in trout and salmon spawning streams	Trout spawning requires stoney river beds with very low deposited sediment[19]. Salmon spawning also requires clear water and stoney river beds. Salmon will generally avoid all sediment, and salmonid eggs will generally suffer mortality of 85 percent in areas with even moderate or low amount of deposited sediment[20].
High dissolved oxygen (DO) for trout and salmon	Dissolved oxygen is a critical environmental factor affecting whether fish species can survive in that aquatic habitat as they

[15] Hicks, M. (2000). Evaluating standards for protecting aquatic life in Washington's surface water quality standards. Draft discussion paper and literature summary. Revised 2002. *Washington State Department of Ecology*, Olympia, WA. Pg. 197.

[16] Link to: Setting in stream nutrient outcomes PN

[17] Bell, M. C. (1973). Fisheries handbook of engineering requirements and biological criteria. Fisheries-Engineering Research Program. *Corps of Engineers*, North Pacific Division Portland, Oregon.

[18] Water Quality Guidelines: To Protect Trout Fishery Values. Cawthron Report No. 1205. September 2006. https://www.horizons.govt.nz/HRC/media/Media/One%20Plan%20Documents/Water-Quality-Guideline-to-protect-Trout-Fishery-Values.pdf?ext=.pdf

[19] Link to: Setting sediment target attribute states PN

[20] Bell, M. C. (1973). Fisheries handbook of engineering requirements and biological criteria. Fisheries-Engineering Research Program. *Corps of Engineers*, North Pacific Division Portland, Oregon.

take in oxygen from water using their gills or skin[21]. If fish cannot take up enough oxygen to meet their energy demand for essential functions, ultimately, they will suffocate and die[22].

Trout are among the more sensitive species impacted by low dissolved oxygen and need higher DO at or near the maximum possible to function[23]. Therefore, the amount of dissolved oxygen concentration in water is a key indicator of both species' habitat quality throughout the duration of their life cycle and the health and well-being of that water body.

We expect dissolved oxygen target attribute states to be set above the national bottom line outlined in Table 7 of the NPS-FM, and applied throughout the catchment, not just downstream of point source discharges. In salmon spawning reaches during the spawning season, dissolved oxygen must not be allowed to fall below 7mg/l at any time[24].

Restricted works in rivers and during autumn and winter

Activities that disturb the bed of the river, such as gravel extraction, flood protection works, stock access to water bodies and some forestry activities can destroy spawning habitat, impede migration, and create sediment. These activities should be avoided in trout and salmon spawning and migration river reaches at the critical times of the year and when fry are in immobile life stages.

Timing works in waterways is critical so that they do not restrict and impact fish spawning during autumn and winter months as they can wipe out younger fish stocks. Consult the NIWA Freshwater Fish Spawning and Migration Periods report[25] for critical timings.

Monitoring of the physical habitat and character of rivers

Habitat is more than just water quality and quantity. The physical condition of rivers and streams, and their form, is also critical. That's the riffles, runs, pools, undercut banks, woody debris, and shading (among other things – see good habitat conditions below).

You should be monitoring the condition of important habitat in your rivers at a reach scale. And at a larger scale, you should

[21] Franklin, P. A. (2014) Dissolved oxygen criteria for freshwater fish in New Zealand: a revised approach, New Zealand *Journal of Marine and Freshwater Research*, 48:1, 112-126, DOI: 10.1080/00288330.2013.827123.

[22] Dean TL, Richardson J 1999. Responses of seven species of native freshwater fish and a shrimp to low levels of dissolved oxygen. New Zealand Journal of Marine and Freshwater Research 33: 99 106.

[23] Dean TL, Richardson J 1999. Responses of seven species of native freshwater fish and a shrimp to low levels of dissolved oxygen. New Zealand Journal of Marine and Freshwater Research 33: 99 106.

[24] Bell, M. C. (1973). Fisheries handbook of engineering requirements and biological criteria. Fisheries-Engineering Research Program. *Corps of Engineers*, North Pacific Division Portland, Oregon.

[25] NIWA. (2014). Freshwater Fish Spawning and Migration Periods. Source: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://niwa.co.nz/sites/niwa.co.nz/files/Fish_spawning_and_migration_calendar_FINAL.pdf.

also be monitoring the character of your rivers as this helps you monitor habitat-forming processes – for example sinuosity, braiding, average channel width, etc. See the Natural form and character; and river extent practice note[26].

How should the NPS-FM be implemented?

Habitat conditions for trout and salmon are recognised and provided for

Good habitat conditions are an important factor affecting wild sports fish distribution and abundance and fisheries. Providing good habitat for trout and salmon provides good conditions that support other values, including ecosystems health, and ensures clear, clean water for communities to swim in[27] and gather food from. Environmental conditions that affect salmon and trout catchability include the availability of good fishing habitat, water clarity, flow, water temperature, weather conditions, and at the river mouth – tides.

Although it is understood many indigenous freshwater species can tolerate lower water quality conditions than trout and salmon, there is limited data on their habitat requirements (The Department of Conservation is currently publishing a report to be released on their physical habitat requirements). Because trout and salmon have more stringent habitat requirements and become stressed more quickly in poor habitat, by providing good habitat conditions for trout and salmon you are also providing good habitat for indigenous freshwater species.

Good habitat conditions include[28]:

Temperature: Trout and salmon need colder water to survive, as cooler water temperatures allow water to hold more oxygen.

Vegetated banks and riparian margins[29] provide essential shade to preserve cooler water bodies. This also prevents erosion which help with greater water clarity, important for trout to visibly see their food sources.

Diverse habitat: The natural form of rivers provides diverse habitat that is required for the various life stages of trout. This includes riffles, runs, and pools, a variety of depths, velocities, and substrates to meet the species spawning and growth needs. These provide for dual values when providing for trout habitat as they can also support indigenous habitat requirements[30] and establish a more natural river and

[26] Link to: Natural form and character; and river extent PN

[27] Link to: Improving water quality and access for swimming and recreation PN

[28] Adapted from the Agency of Natural Resources: Vermont Fish & Wildlife Department: What is good trout habitat (website: https://vtfishandwildlife.com/about-us/department-divisions/fish-division/fish-management/wild-trout-management/what-is-good-trout-habitat)

[29] Link to: Riparian margins and stock exclusion PN

[30] Link to: Protect habitat of indigenous freshwater species PN

	stream environment that many communities value for their natural form and character[31].
Complex habitat:	A series of different types of freshwater environments and interactions help provide good habitat for trout and salmon. This will include messy boulders, large woody material, organic material for food, energy, and shelter. Although they may look tidy, uniform channels with managed, low cut grassed streambanks provide poor trout and salmon habitat.
Riparian cover and buffering[32]:	Vegetated riparian margins and filtration that reduces sediment, nutrients, and other pollutants from entering water bodies via surface water runoff are important to provide the high water quality and visibility trout need to feed in.
Connected habitats:	Trout and salmon need to be able to move up and down river and stream systems during different times of their lives to feed, grow and spawn. Obstacles must be removed, or fish passage provided at all times, for them to access critical habitat throughout the duration of their life cycle.
Natural hydrology:	Make enough room for river and stream systems, restore natural wetlands, and provide for the natural form of river networks to provide a natural way for trout, salmon, and other freshwater species to adjust to changing hydrological conditions. This improves redundancy in the system to cope with naturally occurring events such as flooding[33]. The more man-made changes to the water system including hydro-electric dams and abstractions, the greater the impact on the habitat of trout and salmon who have less time to respond and adapt to a change in the environment.

Trout spawning and salmon population locations are mapped and identified as values

Fish & Game have detailed information on locations of trout and salmon populations in Aotearoa New Zealand. These should be identified as values and mapped in your regional plans. The New Zealand Freshwater Fish Database (NZFFD) also contains over 50,000 freshwater fish sampling records, including the location and fish species present[34]. Many records include information on fish abundance and size as well as physical description of the site. In addition, the Fish Spawning Indicator Tool[35] shows where and when fish that are

[31] Link to: Natural form and character; and river extent PN

[32] Link to: Managing riparian margins and stock exclusion PN

[33] Link to: Natural form and character; and river extent PN

[34] NIWA. NZ Freshwater Fish Database. Source: https://nzffdms.niwa.co.nz/

[35] Link to: https://mpi_nes.cloud.eaglegis.co.nz/NESPF/

sensitive to disturbance are spawning and the Fish Spawning Indicator Database[36] provides information for North and South Islands (not offshore islands).

Trout locations

Trout were introduced from the 1860s onwards to establish recreational fisheries in Aotearoa New Zealand[37] and most are now naturally sustaining populations. Brown trout are among the most widespread and abundant fish species and trout are now located throughout Aotearoa New Zealand rivers[38]. Some trout are still bred and released into some rivers because populations do not sustain themselves to a level that supports the fishing effort, such as in Marlborough.

Salmon locations

Salmon populations are confined to the South Island. Salmon are particularly difficult to catch and one species, the sockeye salmon, are the only population found in the Southern Hemisphere (in the Mackenzie country), making them a prized catch[39]. Some species are confined to lakes, while others are known as sea run salmon.

Chinook salmon (also known as quinnat or king salmon) are one of the three Pacific Salmonidae that have been established in Aotearoa New Zealand[40] and are highly prized sports fish here. Chinook salmon are the largest Salmonidae in Aotearoa New Zealand and are mainly located on the east coast of the South Island, including from the Waiau River to the Clutha River. The main runs occur in large, braided rivers such as the Waimakariri, Rakaia, Rangitata and Waitaki[41]. However, they are also located in the Paringa, Taramakau, and Hokitika Rivers on the west coast (but records on the west coast may be stray fish). Several juvenile Chinook salmon have been caught in North Island rivers; however, no consistent runs have been identified[42].

Fish passage will be maintained and improved

Your regional plans must provide for fish passage[43] for desirable species and prohibit passage for undesirable species. The same species could be in either category, depending on the local situation and sensitivity of that place, so a blanket rule will not necessarily meet the needs for

[36] Link to: https://data-mpi.opendata.arcgis.com/search?collection=Dataset&q=nes&sort=name

[37] Jones, P. And Closs, G. (2017). The Introduction of Brown Trout to New Zealand and their impact on Native Fish Communities. *Brown Trout: Biology, Ecology and Management*. Ed. Lobón-Cerviá, J. and Sanz, N. Chapter 21. Source: https://doi.org/10.1002/9781119268352.ch21

[38] Jones, P. And Closs, G. (2017). The Introduction of Brown Trout to New Zealand and their impact on Native Fish Communities. *Brown Trout: Biology, Ecology and Management*. Ed. Lobón-Cerviá, J. and Sanz, N. Chapter 21. Source: https://doi.org/10.1002/9781119268352.ch21

[39] Fish & Game. Sockeye salmon create autumn spectacle. Source: https://fishandgame.org.nz/news/sockeye-salmon-create-utumn-spectacle/

[40] NIWA. Chinook salmon. Source: https://niwa.co.nz/freshwater/nzffd/NIWA-fish-atlas/fish-species/chinook_salmon#:~:text=Chinook%20are%20the%20largest%20Salmonidae,%2C%20Rakaia%2C%20Rangitata%20and%20Waitaki.

[41] NIWA. Chinook salmon. Source: https://niwa.co.nz/freshwater/nzffd/NIWA-fish-atlas/fish-species/chinook_salmon#:~:text=Chinook%20are%20the%20largest%20Salmonidae,%2C%20Rakaia%2C%20Rangitata%20and%20Waitaki.

[42] NIWA. Chinook salmon. Source: https://niwa.co.nz/freshwater/nzffd/NIWA-fish-atlas/fish-species/chinook_salmon#:~:text=Chinook%20are%20the%20largest%20Salmonidae,%2C%20Rakaia%2C%20Rangitata%20and%20Waitaki.

[43] Link to: Clause 3.26 Fish passage in the NPS-FM

your entire region. In locations where protecting the habitat of trout and salmon is identified, fish passage should be part of that protection to manage species interaction.

Fish passage is included as a minimum requirement of the Resource Management (National Environmental Standards for Freshwater) Regulations 2020[44]. The Department of Conservation are also responsible for managing fish passage in Aotearoa New Zealand's waterways under the Freshwater Fisheries Regulation 1983[45].

The New Zealand Fish Passage Guidelines[46] have been developed to establish the principles for good fish passage design. This should be a base reference for decision making relating to fish passage. The Fish Passage Assessment Tool[47] has also been developed to provide an easy to use, practical tool for recording instream structures and assessing their likely impact on fish movements and river connectivity.

The Fish Passage Factsheet[48] provides additional information for you to consider.

Trout and salmon life cycles and migration periods are provided for

Habitat for trout and salmon needs to be protected for all stages of their life cycles including during their critical migration times and locations. For example, Chinook salmon grow as adults to maturity in the sea before migrating upstream to spawn, at around three years old[49]. When juveniles hatch in spring, they will spend around three months in freshwater before migrating to the sea in summer.

As noted above, you must provide for fish passage[50] in waterways to allow migration and spawning to occur for salmon and to provide habitat conditions[51] that allow trout and salmon to thrive[52]. The spawning run for salmon is a notable event that also draws interest from anglers around Aotearoa New Zealand and internationally[53]. Engage your local Fish & Game to

[44] Link to: https://www.legislation.govt.nz/regulation/public/2020/0174/latest/LMS364099.html

[45] Link to: https://www.legislation.govt.nz/regulation/public/1983/0277/latest/whole.html

[46] Link to: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://niwa.co.nz/sites/niwa.co.nz/files/Final%20NZ%20Fish%20Passage%20Guidelines%20with%20Cover%20Page%2014-12.pdf

[47] Link to: https://fishpassage.niwa.co.nz/

[48] Link to: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://environment.govt.nz/assets/publications/freshwater-policy/Fish-Passage-Factsheet-Updated_Sep-22-FINAL.pdf

[49] NIWA. Chinook salmon. Source: https://niwa.co.nz/freshwater/nzffd/NIWA-fish-atlas/fish-species/chinook_salmon#:~:text=Chinook%20are%20the%20largest%20Salmonidae,%2C%20Rakaia%2C%20Rangitata%20and%20Waitaki.

[50] Link to: section 'The NPS-FM directive' above

[51] Link to: section 'The NPS-FM directive' above

[52] NIWA. Chinook salmon. Source: https://niwa.co.nz/freshwater/nzffd/NIWA-fish-atlas/fish-species/chinook_salmon#:~:text=Chinook%20are%20the%20largest%20Salmonidae,%2C%20Rakaia%2C%20Rangitata%20and%20Waitaki.

[53] Link to: https://fishandgame.org.nz/news/sockeye-salmon-create-utumn-spectacle/

determine life cycle and migration periods for specific river systems, for example Canterbury's braided rivers[54] and the large South Island East Coast glacial rivers[55] [56].

Species interactions can inform habitat protection and management

There will be places where interventions are required to separate sports fish and native species. However, in many river reaches the most helpful way to support positive species interaction intervention will be to improve the quality and quantity of habitat. See the Species Interaction Resource for guidance[57].

Predation among species does exist, however, trout and salmon mostly occupy different ecological niches to native species. For example, the current understanding is that the brown trout-galaxiid interactions depend on the extent of habitat complexity, environmental stability, and life history of galaxiid species[58]. It is therefore critical that enough of the right type of habitat for all freshwater species is provided to reduce pressures on overlapping food competition and habitat.

Reduced flow in rivers and streams reduces the area that fish can forage, especially benthic browsing species, so decisions around flow limits and take allocations play an essential role in food competition, alongside appropriate habitat provision for species[59].

In some specific areas there is an acknowledged tension between indigenous and introduced species, for example, where rainbow and brown trout have impacted native galaxiid populations, both through predation and competition. However, recent research suggests that '*the promotion of brown trout fisheries and conservation of native fish communities are not necessarily mutually exclusive objectives[60]'*.

You should work with Fish & Game and the Department of Conservation to identify any areas where species interactions are of concern and develop a plan in consultation with Fish & Game about how to address those concerns[61].

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[54] Hayes, J.W. (2005). Statement of evidence of John Hayes, Environment Court Hearing of Infinity Investment Group Holding Limited, February 2016

[55] Webb, M.W. (2023). 2022-23 Angler notice review. Central South Island Fish and Game Council internal report. Pg. 107.

[56] Sanders Garrick, H. (2023). 2022-23 Sea-run salmon harvest. New Zealand Fish and Game internal report. Pg. 15.

[57] Link to: Species interaction resource. (2023). Fish & Game

[58] Jones, P. And Closs, G. (2017). Chapter 21: The Introduction of Brown Trout to New Zealand and their Impact on Native Fish Communities. Brown Trout: Biology, Ecology and Management. Ed(s) Lobón-Cerviá, J. and Sanz, N. https://doi.org/10.1002/9781119268352.ch21

[59] Hayes, J., Hay, J., Gabrielsson, R., Goodwin, E., Jellyman, P., Booker, D. Wilding. And Thompson, M. (2019). Review of the rationale for assessing fish flow requirements and setting ecological flow and allocation limits for them in New Zealand – with particular reference to trout. *Cawthron Institute*. Prepared for NIWA, Envirolink, Greater Wellington Regional Council and Hawke's Bay Regional Council.

[60] Jones, P. And Closs, G. (2017). Chapter 21: The Introduction of Brown Trout to New Zealand and their Impact on Native Fish Communities. Brown Trout: Biology, Ecology and Management. Ed(s) Lobón-Cerviá, J. and Sanz, N. https://doi.org/10.1002/9781119268352.ch21

[61] Link to: Fish and Game. (2023). Species interactions resource. *Adapted from thesis by Ami Coughlan.*

How we know the NPS-FM is being achieved

We will know the NPS-FM is being achieved when trout and salmon fishing and spawning habitat are identified and mapped in your regional plans along with objectives and policies to provide for fish passage. The water quality, including enough water in streams and rivers, will provide great habitat conditions for trout, salmon, and indigenous freshwater species to exist in their own ecological niches, and competition will be reduced through providing sufficient physical habitat for aquatic life as a compulsory value for ecosystem health. You will be monitoring physical character of rivers over time and be able to show it is being maintained and improved.

Implementation Toolbox

The toolbox will continue to be developed as new information becomes available:

Tools:	are helpful diagrams, processes, or ways to support how you should implement the NPS-FM.
Examples:	provide text suggestions to help draft objectives (values and environmental outcomes), policies, and rules (limits) in your regional plans, including how monitoring could be achieved. They include examples of how attributes and base line states, target attribute states, environmental flows and levels, and other criteria where appropriate, can be written or presented to help achieve environmental outcomes.
Case studies:	illustrate where the NPS-FM has been well applied (or not) throughout the country and provides national or international lessons to help implement the NPS-FM.
Evidence:	provides relevant case law to support how the NPS-FM must be applied.
Resources:	provide links to supporting literature and best information available to implement the NPS-FM.

Tools

Habitat Quality Index / Natural Character Index - The Habitat Quality Index / Natural Character Index provides a way to monitor the condition of rivers over time, either at a large (geomorphological) or small (reach/site impact) scale. See:

Chapter 3 of Kay, T. (2020). A Methodology to Assess River Habitat Quality: A Thesis Presented in Partial Fulfilment tf The Requirements for the Degree of a Masters in Science in Ecology. https://mro.massey.ac.nz/handle/10179/16773

Kay, T. (2020). Habitat Quality Index Assessment for the Rangitata River. https://www.forestandbird.org.nz/sites/default/files/2021-04/Rangitata%20River%20HQI%20Report%20%28May%202020%29.pdf

Fuller et al. (2021). An index to assess the extent and success of river and floodplain restoration: Recognising dynamic response trajectories and applying a process-based approach to managing river recovery. https://onlinelibrary.wiley.com/doi/abs/10.1002/rra.3672

Fuller, I., Kay, T., Anderson, P. (2022). Maintaining River Morphology Through Policy: a Case Study from the Ngaruroro Water Conservation Order. https://www.forestandbird.org.nz/resources/maintaining-river-morphology-through-policy-case-study-ngaruroro-water-conservation-order

Examples

[When available]

Case studies

Otago

Otago provides habitat to three species of galaxiid fish, only found in this location, that have been severely impacted by the expansion of trout into these waterways[62]. In areas where threatened galaxias exist, the Otago Regional Council, private landowners, iwi, water user groups and the community are working with Fish & Game on projects to remove trout and install barriers to prevent further movement upstream, along with steps to protect the habitat[63], improve water quality and provide fish passage for the galaxiid species[64].

Zealandia[65]

The Karori Sanctuary Trust had a vision to restore Zealandia to pre-human state, as close as it possibly could. This included removing introduced species, including brown trout, from inside the fenced area[66]. Because fishing would not be allowed within the sanctuary, and in consultation with Fish & Game, removing trout from this location and water body was approved and appropriate in this instance.

Evidence

[When available]

Resources

Agency of Natural Resources: Vermont Fish & Wildlife Department: What is good trout habitat (website: https://vtfishandwildlife.com/about-us/department-divisions/fish-division/fish-management/wild-trout-management/what-is-good-trout-habitat)

Bell, M. C. (1973). Fisheries handbook of engineering requirements and biological criteria. Fisheries-Engineering Research Program. *Corps of Engineers*, North Pacific Division Portland, Oregon.

Birtwell, I. K. (1999). The effects of sediment on fish and their habitat. Department of Fisheries and Oceans Canada, Canadian Stock Assessment Secretariat Research Document 99/139 ISSN1480-4883, Ottawa, Canada. Pg. 34.

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Fish & Game, Forest & Bird and Choose Clean Water have written this practice note to communicate their expectations on how regional councils should implement the National Policy Statement for Freshwater Management 2020 (NPS-FM) into their regional plans. This is one in a series of practice notes prepared on various topics relating to NPS-FM implementation.