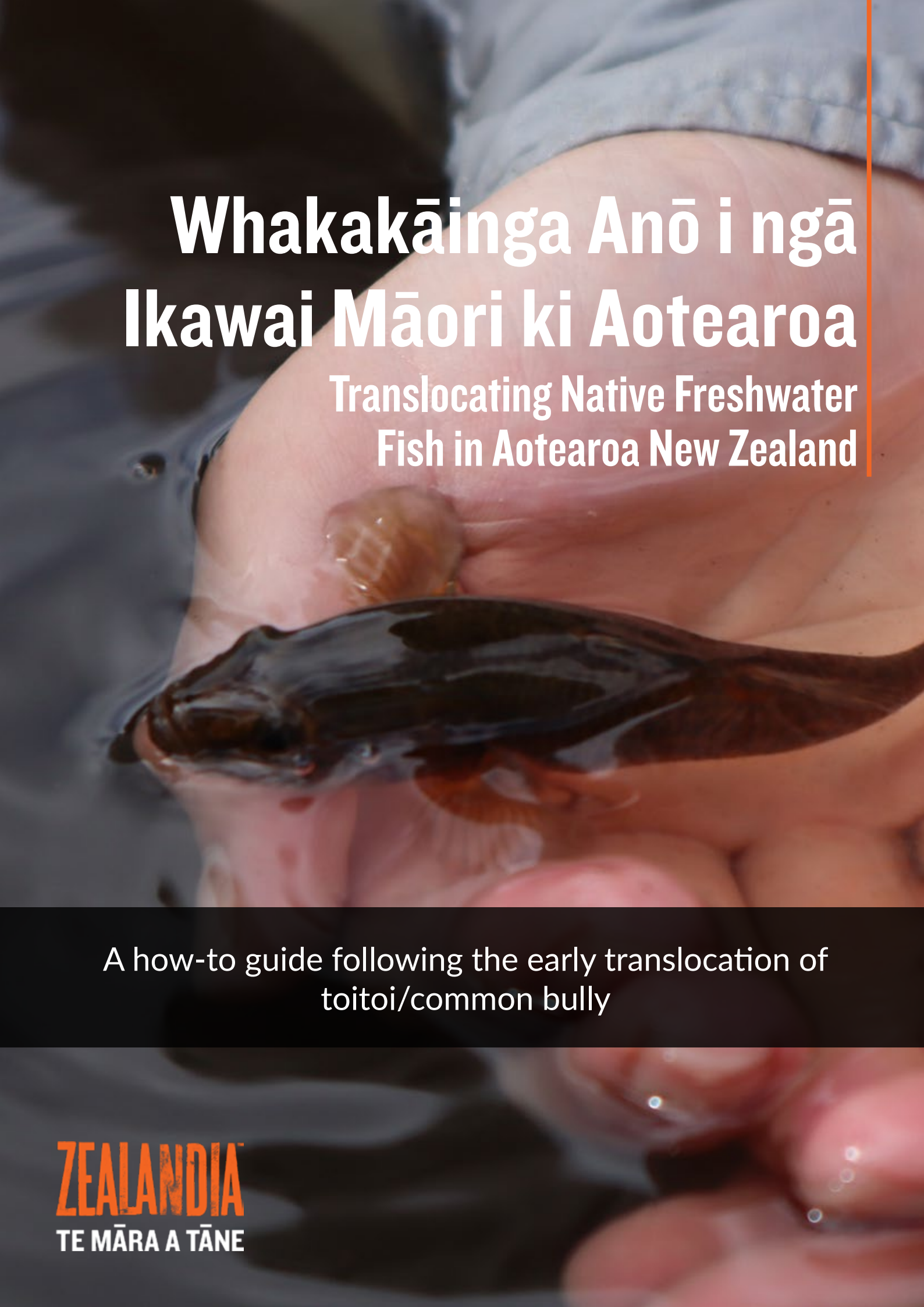


Whakakāinga Anō i ngā Ikawai Māori ki Aotearoa

Translocating Native Freshwater Fish in Aotearoa New Zealand

A how-to guide following the early translocation of toitoi/common bully

ZEALANDIA
TE MĀRA A TĀNE

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Front page: Toitoi collection.
Photo by Rebeca Chrystal.

Back page: Release site at Roto Māhanga.
Photo by J M Beltran.

This guide

This is a how-to guide for planning a freshwater fish species translocation. It has been developed following the early translocation of toitoi/common bully (*Gobiomorphus cotidianus*) from a wild population (Kōhangapiripiri in Parangārahu Lakes) to the headwaters of Te Kaiwharawhara whaitua/catchment, at Zealandia Te Māra a Tāne in Wellington.

Background

Prior to 2022, translocations of native New Zealand freshwater fish for restoration purposes were not a common occurrence. Where translocations occurred, they often involved releases of non-native species for biocontrol of aquatic weeds, translocations for commercial aquaculture, to mitigate the impacts of development or to salvage fish from drying or polluted waterways (Rayne et al., 2025).

Our goal was to establish a healthy, resilient and self-sustaining population of toitoi/common bully in Zealandia Te Māra a Tāne and ultimately, down through Te Kaiwharawhara whaitua. Their wider establishment would be an early step on the overall journey towards healing Te Kaiwharawhara, an awa/stream of cultural importance to mana whenua (Zealandia Conservation & Restoration Strategy 2018-2038).

The return of toitoi to Roto Māhanga (Zealandia's upper reservoir) would also restore their relationship with the endemic kākahi/freshwater mussel (*Echyridella menziesii)*, which had been established in Zealandia from Kōhangapiripiri in the Parangārahu Lakes in 2018 and 2021. Toitoi are a host to the kākahi glochidia (larvae) during the essential metamorphosis phase of their lifecycle, making their relationship an important one to uphold (McDowall, 2011).

This aspiration required the design of a restoration-focused translocation, which upheld the tikanga of mana whenua partners Te Ātiawa, Taranaki Whānui ki Te Upoko o Te Ika (Taranaki Whānui) and the welfare of each individual fish, as well as the welfare of each of the whaitua/catchments, by avoiding biosecurity risks.

Toitoi are a small, endemic species of freshwater fish, which typically inhabit freshwater rivers, streams and lakes across Aotearoa New Zealand. They are amphidromous but can also form populations in landlocked freshwater ecosystems. Toitoi individuals tend to be resilient to a range of environments and oxygen levels, as well as to human handling and movement. Adults live for ~3 years and grow to 12-15cm. Toitoi feed on benthic invertebrates and lay their eggs under the surface of rocks in the littoral zone of lakes and slow-moving streams.

The project was undertaken in partnership with Rōpū Tiaki, the co-management group for Parangārahu Lakes consisting of representatives of Taranaki Whānui and Greater Wellington Regional Council (GWRC).

The initial translocation in 2023 was designed with advice from the Department of Conservation (DOC), GWRC, Taranaki Whānui, Earth Sciences New Zealand (ESNZ, formerly NIWA), Ministry for Primary Industries — Fisheries New Zealand (MPI), Riverscapes Freshwater Ecology Ltd, Zealandia Te Māra a Tāne, Auckland Zoo and Te Nukuao Wellington Zoo.

Over the subsequent translocations in 2024 and 2025, we refined and learned from our experiences. We more confidently incorporated Mātauranga Māori techniques, which were researched and explored by Zealandia's Lead Ranger for Bicultural Engagement, Terese McLeod (Taranaki Whānui), Zealandia Kaitiaki Rangers Tia Button (Te Aupōuri, Ngāpuhi, Waikato Tainui, Ngāti Maniapoto, Ngāti Pukenga) and Pīata Hohaia (Ngāti Maru, Ngāti Ruanui, Ngaa Rauru Kiitahi, Ngāti Tupaia ki Te Aro Pā), and ESNZ aquatic ecologist and trustee of Te Ātiawa ki te Upoko o te Ika a Māui Pōtiki Trust, Mark Fenwick (Taranaki Whānui).

This guide is intended to be a useful tool for planning a freshwater fish species translocation, from a wild population source to a wild release catchment. It is relevant to a range of freshwater fish species.

The guide does not go into advice on relationships with, nor permissions from whānau, hapu or iwi, nor on gaining permits; however, these are essential starting places before a translocation is planned.

Helpful advice on permits required is on the DOC and MPI websites. Different translocation scenarios require different permits and often more than one permit.

We welcome questions and additions of new learning.

Contact: conservation@visitzealandia.com

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Translocation timeline

This is an example timeline to prepare for translocation of native fish for restoration purposes. We recommend guiding by the maramataka; either by selecting dates or by modifying the activity to reflect the wisdom of this lunar guide.

3 months prior to collection

- Visit proposed collection site
- Finalise major decisions around location of quarantine aquariums, water collection, biosecurity plan

1 month prior to collection

- Set whakaweku (rārahu/bracken fern habitat) at the collection site
- Set up quarantine aquarium
- Begin nitrogen cycling process

1 week prior to collection

- Nitrogen cycling should be completed
- Prep quarantine water collection
- Carry out complete fresh water exchange 1-2 days prior to collection
- Set rārahu habitat into aquariums the day prior to fish arriving

Collection period

- Collect fish
- Settle into quarantine aquarium

Quarantine period (4 weeks min.)

- Flexibility to extend should any concerns arise
- Biosecurity for water and equipment
- Separate treatment for fish with concerns

1 week prior to release

- Adjustments to prepare fish for release

Fish release

- Allow for date to be adjusted
- Allow for multiple releases

Clean up

- Biosecurity of surfaces

SECTION 1: Preparations

Upholding tikanga and biosecurity



Photo credit: Manaaki Barrett

Water is precious. It nurtures the fish in the place from which they originate, through their quarantine and into their new lives in their place of release.

Upholding the health and biosecurity of the whaitua/catchment, and ensuring that only organisms that are intended for translocation are moved with these fish is vital. This requires the release of water to a treatment facility (e.g., via reticulated drain).

Karakia

Karakia/Māori incantations are used for a vast variety of occasions, situations and intentions. A critical function for karakia for our kaupapa/project is to bring us together, to set the tone, bring mindfulness to our activities and intentions, and to regulate our behaviour. We recommend identifying a karakia to guide your project.

We used a bespoke karakia for this project composed by Dr Mike Ross (Ngāti Haua, Waikato, Tainui) and offered as a koha specific to this kaupapa.

It acknowledges the two water bodies, the cooperation and relationship taking place between them and the critical value and high regard we have for water.

Site visit prior to planning collection

The site visit is a vital part of coordinating a translocation. Plan several months ahead of the translocation to allow for unforseen delays.

Give time between the site visit and the first collection day to adapt translocation plans to any new learning gained through the site visit.

Objectives

Set clear objectives for your site visit. As an example, these are the objectives that guided our site visits.

- ☐ Whakawhanaungatanga — connect with mana whenua in their place
- ☐ Experience the species in their environment alongside kaitiaki/caretakers of the place
  - Locations and natural behaviour of individuals
  - Vegetation
  - Temperature
  - Water clarity and water levels
  - Ways to show kaitiakitanga/care for the land, water and individuals during visits.
- ☐ Consider or re-evaluate opportunities for Mātauranga Māori methods
- ☐ Draw attention to details of planning which may have been overlooked or assumed incorrectly
  - Manaakitanga — including health, safety and wellbeing for the groups physical and mental preparation
  - Access
  - Amenities
- ☐ Trial methods for collection to determine:
  - ease and rate of collection
  - the planning needs for respectful care of the fish
  - the transition from free-swimming in the lake through to ready for transit.

Notice when conditions have changed from previous years and visits, in order to plan for the changes. For example, lower water levels can impact emergent stems of sedges and other fish habitat, where fish might shelter. This in turn can impact silt movement as water levels rise again.



Kōhangapiripiri. Photo credit: Kari Beaven.



Seine net demonstration. Photo credit: Kari Beaven.

Quarantine aquarium



Photo credit: Rebecca Chrystal

Preparing a quarantine space for translocation from a wild population to a wild release site

Quarantine is advised to ensure other organisms from the source area (e.g., macrophytes or novel species such as golden clam) that may be undetected are not translocated with the fish. It should allow time for a full cycle of endoparasites and ectoparasites to be expressed and to allow for decision making around the release of individuals found to be hosting either. Balance should be sought and agreed with partners, between accepting natural biota within individuals, and excluding high-risk pathogens.

Caring for stress and quarantine biosecurity

A key early consideration is whether the quarantine aquarium should include a nature-rich environment to foster natural behaviour, or to have a more artificial environment achieved by minimising obstacles to maximise visibility and using materials that can be sterilised to help control conditions. The former could lead to individuals being hidden from view, and possibly harbour pathogenic organisms; the latter risks escalating stress and stress behaviours, as fish are not able to carry out natural behaviours nor create barriers between themselves and more dominant individuals.

Our learning example

For the toitoi project, when it came to quarantine care we placed emphasis on hauora/holistic health over controlled conditions and the assurance of visibility. We provided natural material to foster healthy behaviour and reduce stressful encounters. In turn, we searched more carefully around the bundles of ferns, logs and rocks to check on each individual for signs of ill-health, and were prepared to pivot in our decision if needed. Visibility proved to be fairly easy during times of food provision.

Importantly, we sourced the quarantine environment from the intended release area rather than the source site, to uphold quarantine intentions and to begin to introduce other local organisms into their experience.

We also considered whether to use tap or stream water in the aquarium. Our decision to use water from the stream was again based on recognising that we didn't yet know about the interaction between the living organisms within stream water and the health of individual fish, as well as the principles of welcoming and hosting the fish in transition into their new whaitua/catchment. Under the stress of captivity, fish may be more susceptible to common pathogens, including bacterial and fungal infections from naturally occurring organisms, and as such we were prepared if their health appeared to suffer.

Care should be taken to consider the behavioural characteristics of the species being translocated. For example, torrentfish individuals may prefer pumps set up to replicate the movement of stream water through the aquarium, while other species may require a lot of space for a small number of individuals.

Any unwell individuals were recognised as being at higher risk of secondary infection from environmental organisms. They were removed to a smaller treatment aquarium and cared for in dechlorinated tap water.

Aquarium selection and size

Aquarium(s) for quarantine during a translocation situation need to be much bigger than an aquarist would normally select for housing the same number of captive-bred fish permanently. This reflects the significant move these individuals are undertaking from the wild into a contained area.

The larger water volume also absorbs the impact of introducing multiple individuals on one day.

Keep in mind the girth of your fish as well as length in making calculations, and the lower metabolism of cold water fish. "An inch of fish to a gallon of water" is a very basic start.

Our learning example

In our toitoi project, we separated the toitoi into two size classes, medium-large and medium-small, to reduce stress and the risk of predation (by each other). In our first year, we did not collect any very small or large toitoi. In our second year, with increased experience in managing safe interactions between individuals in quarantine — and greater confidence in our ability to minimise stress — we translocated more small individuals.

In avian translocations, practitioners have adapted towards translocating juveniles and young birds where possible. These young birds tend to settle in the new forest sooner, and live longer than translocated adults, contributing more of their unique gene alleles to the newly establishing populations (Miller et al, 2024). We recommend further research to understand and advise on the optimal age range for translocating freshwater fish.

Approximately 80 toitoi were placed into one 750L glass aquarium, and a further 80 were held in an opaque, 1000L tub. The benefits of glass are that carers can see individuals to keep a watchful eye on their health. The benefits of opaque are that it is dark and likely to be less stressful for the acclimatising fish. There is no 'correct' decision here.



750L glass aquarium during set-up. Black-out curtain was then placed behind the aquarium.



1000L opaque tub during set-up.

Filtration

The quarantine of fish for release to a natural freshwater ecosystem necessitates a different approach from standard aquarium management. Generally, aquariums are stocked gradually, one or two fish at a time; however, when translocating, up to 100 individuals can be released into an aquarium on a single day. The water must be prepared for this drastic change, in order that it does not become toxic. This cannot be achieved by sourcing water from a healthy stream alone, nor can their environment be kept safe for them through frequent water changes.

Standard over-the-counter products for preparing aquarium water may contain bacterial cultures that should not be released into a natural waterway. For our project, we therefore designed a process of fishless cycling, which relies on collecting natural bacteria living in the stream at the release location, to grow and care for the fish during quarantine.

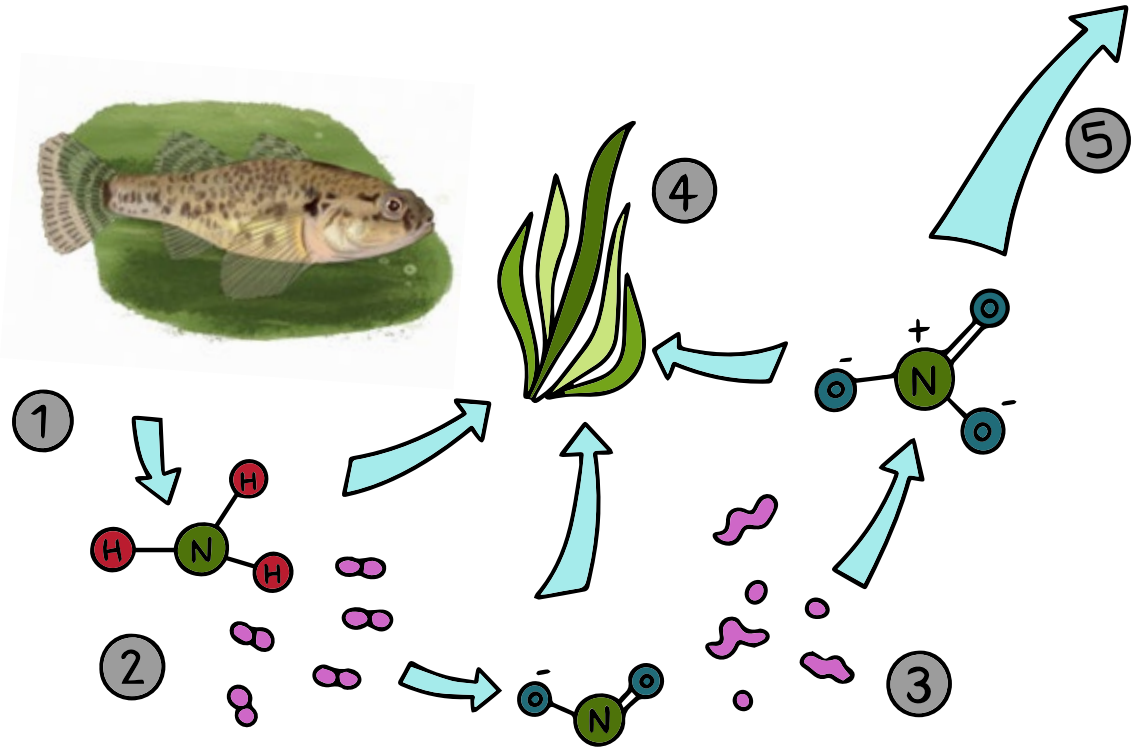
Fish release waste products by urinating, defecating and respirating. Uneaten food and decomposing plants also contribute by-product, creating a potentially toxic environment.

The key waste product is nitrogen in the form of ammonia, which can damage delicate fins and gills causing stress and making it hard for fish to respire. If waste products continue to build up, it will eventually kill them.

In natural streams, native bacteria (nitrosomonas) grow on the surfaces of rocks, logs and other surfaces. They oxidise ammonia, converting it to nitrite (and gaining energy in the process). Nitrite is still toxic to fish; however, in a natural system, nitrobacter and nitrospira bacteria then oxidise nitrite, converting it to nitrate. This process overall is called nitrification (Gee et al., 1990).

In a freshwater system, nitrogen in all forms is also taken up by aquatic plants as a nutrient source.

The cycle looks like this:



1. Fish waste and decaying food turn into ammonia
2. Nitrosomona bacteria oxidise ammonia into nitrite, gaining energy for themselves
3. Nitrobacter and nitrospira oxidise nitrite into nitrate
4. Aquatic plants and algae can make use of nitrogen in all these forms to make proteins and growth compounds.
5. In an aquarium water changes help to dilute nitrate levels

The process can be somewhat replicated in an aquarium, using biological filtration by locally collected bacteria.

Biological filtration relies on a filter unit, filled with porous material (e.g., ceramic or sponge) through which water is bubbled and returned to the aquarium. Helpful bacteria become established on this material, as well as on rocks and logs in the aquarium, carrying out the processes outlined above. The filter also removes larger particles of silt and dirt, collecting on an internal sponge and clearing the water.

Our goal was to create a set-up that most closely resembled the natural aquatic environment into which the fish would be released, making biological filtration our preferred method over chemical methods to remove dissolved wastes.

Wild bacteria only

In a translocation situation, it's important to introduce only the bacteria which occur naturally in the catchment into which the fish will be released, rather than those contained in ready-to-use products or through the use of other species, such as goldfish, due to biosecurity risks.

Our learning example

We soaked ceramic beads (a useful filter media) in the receiving stream for up to a week, allowing bacteria from the stream to establish in the media. The receiving stream for our translocation had established a balance with another native fish species (banded kōkopu) already living in the stream. We sourced rocks, logs and water from the catchment, with natural bacteria growing on their surfaces, and used these as natural habitat in the aquariums.

We then transferred the media into the filter units and began a process of 'fishless cycling'.





Ceramic beads soaked in the receiving stream were added to the filer units to begin the process of 'fishless cycling'.

Fishless cycling for translocation quarantine

Start this process EARLIER than you think.
You may need up to a month of 'fishless cycling' before fish can enter the quarantine aquariums.

1. Set up the aquarium using the prepared filter units as well as rocks, logs and water from the stream or lake into which the fish will be released. Native bacteria will naturally be present, growing on their surfaces.

2. Add a few drops of pure ammonia or ammonium chloride. We used Dr Tims ammonium chloride.
   - ☐ Do NOT use cloudy ammonia.
   - ☐ Do not overdose, it slows down the process. Instructions available via Dr Tims website.

3. Test the water regularly using test tube kits such as the API freshwater test kit for:
   - ☐ Ammonia (goal to reach 2-4ppm)
   - ☐ pH
   - ☐ Nitrite (once ammonia has been detected)
   - ☐ Nitrate (once nitrite has been detected).

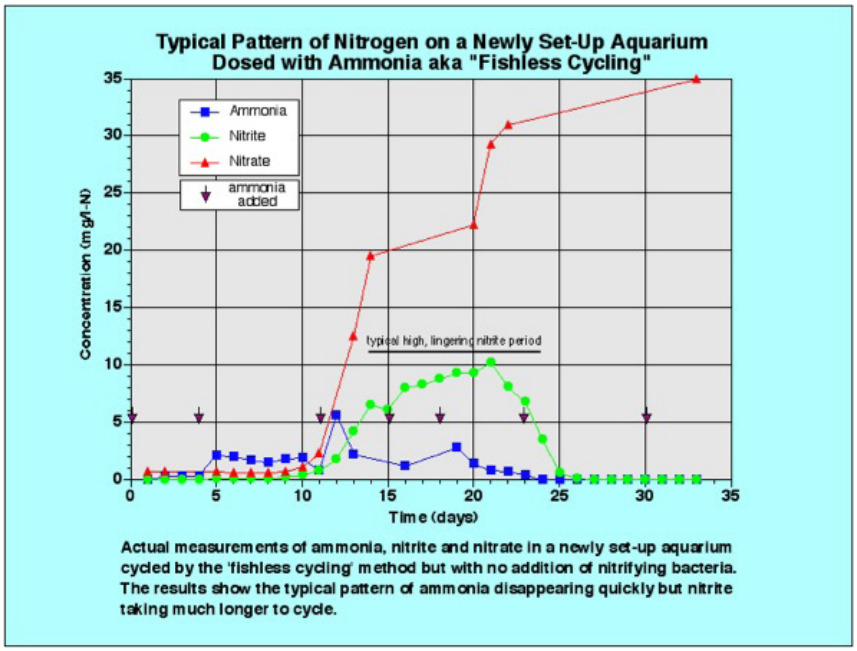
4. High nitrite levels can drop the pH of the water, slowing down the process.
   - ☐ If needed, raise the pH using small amounts of dissolved baking soda.

5. Cycling is complete when you can add the prescribed quantity of ammonia for your sized aquarium — and by the following morning, no ammonia and no nitrites are detected. Nitrate should be present as the end point in the cycle.

Our learning example

Nitrates in an aquarium can still be toxic in high amounts (40-80ppm); however, we aimed to maintain nitrate levels to below 5ppm. These molecules are removed by partial water changes (20-25% of total capacity).

Local aquatic plants can assist in the uptake of nitrogen, making use of it as an essential building block for plant proteins. They can reduce the reliance on biofiltration and water changes. However, due to biosecurity risk, the aquatic plants should never be returned to their source location once the quarantine period ends. For that reason, we opted not to use aquatic plants in our quarantine aquariums.



Typical patterns of ammonia, nitrite and nitrate in a new aquarium. Credit: Dr Tim's Aquatics.

Important: Filter cleaning and water changes

Do not swap out the filters for new ones and do not 'clean' or remove the logs and rocks for the entire period of quarantine, as this would remove the important bacteria.

Filter media can become clogged with silt or algal growth, reducing their effectiveness. Remove the sponges from the filter and rinse lightly in a bucket of water that has been taken from the aquarium. This action retains the important bacteria in the sponges but removes the clogging. Replace sponges back into the filter unit and release the water as per the biosecurity methods listed later in this guide. Top up the aquarium as needed with fresh water from the stream.

Filter size

It is vital to select filters which are designed for the quantity of water you are managing. Increasing the percentage and frequency of water changes cannot keep up when nitrite levels begin to rise.

Our learning example



We began the quarantine with the temptation to join 2x 1000L tanks, as there were two available. These were filled to approximately 1200L combined total, far in excess of the water volume needed. We used two filter units, which had been cycled, ready, but which had a combined capacity of approximately 800L. Nitrite levels rose, and in response we increased water changes to every day. With so much water it was quite an undertaking to swap out 25% of 1200L each day.

Once we disconnected the two tubs and began operating on approximately 600L only, the filters quickly brought down the level of nitrites and managed the volume effectively.

Our learning was that more water isn't better if the filters can't keep up with the volume.

Dissolved oxygen (waterfalls and bubblers)

Oxygen dissolves into the water through surface agitation. Releasing water from the filter back into the aquarium via a 'waterfall' set-up creates a regular supply of oxygen. We combined this with the use of some aeration stones, which gently circulated the water from the floor of the aquarium up to the surface.

Tolerance for dissolved O_2 and CO_2 levels varies between species. Toitoi have a high tolerance for





An extra hose tube lined with holes creates a waterfall set-up at the outlet of the filter back into the aquarium.

oxygen variance and can use their swim bladder to augment oxygen transfer through their gills. This looks like an open-mouthed intake of air from the surface. If that behaviour is noted, increasing the level of surface agitation is an effective way to increase the availability of dissolved O_2 and release of CO_2.

Our learning example

Different species have preferred habitat and water flow rates. Toitoi tend to 'perch' on the gravelly substrate or other surfaces in slow-flowing water and lake edges; however other species may prefer more water flow in the quarantine environment.

Our starting point was based on a visual assessment of the stream pools in which the toitoi live, replicating the flow of water over obstacles such as rocks and logs, and into a patch of still water.

Salt for freshwater fish

Fish bodies contain electrolytes. Adjusting to quarantine can be a stressful time, with the loss of electrolytes to the fresh water of their aquarium being just one of the challenges they encounter.

A low concentration of salt (0.1 - 0.3%) in a freshwater aquarium can:

- reduce the energy required for osmoregulation
- reduce susceptibility to fungal infections, bacteria, parasites and other common ailments
- help improve gill function, allowing them to respire freely
- reduce the impact of nitrites, serving a protective function.

Dormant and low-grade infections can surface under stress. Salt will boost the fish's resilience, support wellbeing and can be used for most freshwater fish.

It's important to note that toitoi in particular are resilient to salt fluctuations due to being amphidromous. Care should always be taken to get calculations correct for the particular species being accommodated.

Pure NaCl versus other salts

- Fish need pure NaCl salt. Do not use iodized salt. While fish need iodine, they get enough of it from their food. Giving them more through salt will likely do more harm than good.
- Do not use salt with anti-caking agents.
- Some salts, such as sea salt, contain extra trace elements. In a quarantine situation this is acceptable as the salts are not continually being provided long-term, where they can build up inside the fish.
- Take care to monitor the pH where trace elements may be having an effect.

Add salt to the 1000L refill tank

Salt is proactively added while carrying out the 1000L storage tank refill.

Adding salt to the freshwater storage tank allows us to maintain exact salt ratios of 1g/1L across all water changes.

Preparing for illness – smaller quarantine aquarium for individuals

A small filter or two set up to operate in the larger aquarium will naturally become cycled along with the larger filter, while not interfering with its operation.

This is very helpful as they can be used immediately if a fish shows signs of illness and needs to be removed to a smaller aquarium for separate quarantine or treatment.

Further information on isolating individuals for treatment and recovery is included Section 3: Acclimatising and Quarantine.



Isolation aquarium. The smaller size reduced energy expenditure and allows for easier treatment options.

SECTION 2: Collection

Maramataka



Photo credit: Scott Langdale

Maramataka is the lunar calendar cycle observed for thousands of years by Māori. Their careful observations of moon phases, the ebb and flow of the tides, alongside other environmental tohu/cues and signs formed an intimate, highly detailed body of wisdom and knowledge which provides valuable information about prime days for planting, fishing and harvesting. These environmental factors also influence people's behaviour.

The maramataka helps guide when to do high and lower energy activities and when to pay attention to activities like gathering for hui, environmental reciprocity, whānau care and rest.

Our learning example

The maramataka was considered by kaimahi Māori/Māori staff for this work and guidance was sought from kaumātua/elders, particularly to ensure we followed the correct regionally specific practice so we could optimally plan days for collecting fish. Considerations such as manaakitanga, to ensure the group's health and safety were also implemented.

Low energy days were still considered for collection but we accounted for this by ensuring more time was built into the day for rest and made sure appropriate sustenance to support energy was provided.

Biosecurity



Photo credit: Scott Langdale

Freshwater biosecurity is highly important and prevents the spread of unwanted and potentially harmful organisms between areas. Careful steps should be followed before and after your visit.

- Any natural materials used, for example rārahu for whakaweku, should be collected — with permission — from within the catchment in which they will be used, rather than brought in from outside.
- Check, clean and dry all equipment going into, out of and between water bodies.
- After use, keep all equipment away from stormwater drains or freshwater until cleaned again.
- Where possible, wear new items in the release site – wetsuits, thermal clothing etc.
- Additionally, clean waders, thoroughly rinse, then thoroughly dry before and after use.

Site specific biosecurity threats should be analysed as part of planning each individual translocation.

Our learning example

In the second year of collection, a new biosecurity threat was identified. Gold clam (*Corbicula fluminea*), an introduced freshwater species, had been identified in the Waikato River. While the risk was considered to be low, the impact of inadvertently introducing the species to Zealandia and to Te Kaiwharawhara was considered to be catastrophic. The species poses a high risk to natural freshwater habitats and is able to increase in number rapidly from a single individual. The larvae of golden clams are microscopic and therefore very difficult to detect.

Cawthron Institute used eDNA assays to test water samples collected with the toitoi specifically for gold clam. A sample of 100ml water was taken from each transport bucket, prior to the acclimatisation steps. Results were obtained showing no golden clam was present prior to release of the fish from quarantine.

Collection methods



Photo credit: Anna Fensom

Whakaweku/tau toitoi

Whakaweku is the name given to bunches of rārahu/bracken fern fronds traditionally used as a Māori fishing method for collecting kōura/freshwater crayfish (Kusabs I et al., 2018). Bunches of rārahu are collected, tied together and submerged to create temporary habitat, in which kōura will shelter. The whakaweku is pulled out of the water while a net is scooped underneath to collect the inhabitants. Stories from their use by Te Arawa iwi in Rotorua shared that toitoi also took shelter in whakaweku from time to time. With some adjustments to the technique, we were able to use whakaweku/tau toitoi to target the collection of toitoi for translocation.

Our learning example

Whakaweku were assembled from rārahu, which had been gathered from around the lake edge at Parangārahu, and were released after use to break down in the lake when ready. This ensured that as far as possible, external natural resources were not brought into the whaitua/catchment, and that nutrient and resources gathered and used in the whaitua remained in the whaitua, with the exception of the fish themselves and the water for transport.

Up to four whakaweku were connected to a string tied between two posts. They were spaced apart to allow access to each whakaweku bundle, without disturbing the fish from the neighbouring whakaweku. The set was repeated in several locations around the lake and left in place for up to four weeks.



On the day of collection, one person lifted the whakaweku towards the surface of the water, using the 'handle' created by the rārahu stems, while another person scooped underneath with a hand net big enough to surround the whole rārahu bunch. It was useful for a third person to gently pour water from the lake through the whakaweku, or to gently shake the fronds so the fish fell into the net underneath.



The great value of using whakaweku for collecting toitoi for translocation is that there is no containment stress on any individual, until the net is placed under them. Unlike traps set overnight or even a few hours, occupation of the whakaweku bundles is decided moment by moment by the individual fish. If a predatory individual swims into a fyke net, prey individuals can become stressed; however, in whakaweku bundles, the toitoi individuals are not trapped from leaving, and can return again later at will.

In any translocation, stress is one of the biggest risk factors to survival. Techniques that reduce the intensity and duration of stress are a treasured gift.

Other collection methods

Kōhangapiripiri holds a very healthy population of toitoi (Perrie, 2018).

In our first year of collection, western methods were adapted from their standardised overnight technique to create a more gentle approach, reducing the stress that overnight-set traps can cause to both toitoi and to non-target species such as pōrohe/common smelt.

Hand nets

Hand nets were the gentlest initial collection method we used, with the advantage that the technique was easy to learn and teach. Fine mesh was used to ensure fragile fins and gills did not get caught and damaged. Mana whenua, Greater Wellington and Zealandia staff worked together, using two nets per person to surround habitat such as aquatic plants. The nets were brought together and scooped upwards. Visibility through the water was low, so nets were checked near the surface of the water for any catches.



Fyke nets

Four fine-mesh fyke nets were set out during the morning along the margins of aquatic rushes. They were held in place with a wooden stake pushed into the substrate. The nets, a series of wire hoops with loose mesh leading inwards from the entrance, were checked after two hours in place, in order to allow time for toitoi to swim into them but to minimise the length of time for which individuals might be held.



Seine nets



One seine net was used. This involves the use of a wooden pole to hold one end of a fine-meshed net near the bank, while the other end is dragged out as far as water depth will safely allow, around in a semi-circle and back to meet up with the stationary end. The two ends are gathered up, creating a 'pocket' out of the remaining net. This is drawn slowly into the shallows, while a small team searches through to release any non-target species back to the water and collect the toitoi.

Holding fish in the lake during collection

The collection site itself has the optimal temperature, oxygenation and nutrient level for holding fish. Rather than placing collected fish into a bucket of water, we released them into fine-meshed nets, supported by tall washing hampers, immersed in the shallows of the collection lake.

Lake water flows through the basket and mesh, replacing oxygen, removing waste products, and maintaining a steady temperature until we were ready to move to the quarantine site.

This method does not work as well when silt is stirred up in the lake. In that case, holding up to 20 individuals per 20L bucket, placed into the shade, with an aerator running, a lid and a half hourly exchange of 50% water was used.

Noise was kept to a minimum as heavy vibration and noise was seen to cause a stress response in the fish.



Transfer and transport

Collection generally occurred from 9am to 2pm, allowing adequate time to transfer the fish into buckets, transport and acclimatise them into their quarantine aquariums. Travel times will vary between sites and collection should be influenced by daylight hours, safety and the individual characteristics of sites.

Water for carrying and supporting the fish during transit was collected from the lake and sieved through fine mesh nets into a 20L bucket. Sieving was sometimes repeated two to three times for biosecurity, to minimise any macrophytes and other organisms transferred.

Fish were lifted out of their mesh baskets by hand, again minimising the exchange of macrophytes, and released into the transport buckets with 20 fish per bucket. Care was taken to ensure each transport bucket contained fish of similar size.

Buckets were fitted with an internal lid and baffle, to reduce water movement in transit, and a portable aerator to provide continuous oxygen.

Once in their transport buckets with aerators running, the fish were moved to vehicles and secured in an upright position. Vehicles were kept cool, quiet and carefully driven to the quarantine site, a journey that took approximately 1 hour.



Transfer bucket with corflute baffle and aerator hose.

SECTION 3: Acclimatising and Quarantine

Biosecurity essentials

All water removed from around the fish on arrival to, during and after quarantine must be transported to a reticulated treatment system, not released to a stormwater drain or poured out to the ground.

All equipment in quarantine must be separated and clearly labelled either:

- for use with fresh water only
- for use after contact with quarantine individuals, water or equipment.

Pumps used to remove quarantine water must not be used to pump fresh water in from the stream.

Any person touching quarantine water, equipment or fish must first clean their hands of any lotions, fragrances, sunscreen and other chemicals, rinsing thoroughly in plain water after cleaning to remove soaps.





Water from quarantine is removed carefully and released to a treatment drain using designated and labelled pumps, hoses and containers.

Acclimatising ready to release into quarantine



Fish being gently released into aquarium by hand.

All fish are sensitive to sudden changes in temperature, pH, ammonia levels, salt and other environmental parameters. Factor these in when releasing fish into quarantine.

Our learning example

On arrival to quarantine, we were careful to ensure fish were slowly acclimatised to the water in the quarantine aquariums before being transferred into the aquarium. In addition, we needed to minimise the chances of transferring any other organism alongside the fish.

1. eDNA water samples were taken from each bucket and additional water removed to a biosecurity containment vessel, down to approximately 10cm depth remaining for each bucket of 20 fish.
2. Water from the prepared quarantine aquariums was then gravity-fed into each bucket through a thin aerator tube to slowly align their temperatures.
3. During this process, individual fish were again checked visually for physical and behavioural signs of health.
4. Once the buckets had filled, water temperatures were checked, and samples of pH taken to ensure the buckets and aquariums aligned. (Ammonia was checked, however if this had risen markedly in the buckets, then moving the fish quickly into the aquarium would be the course of action).
5. Once the process was complete, fish were lifted from the bucket by hand. This reduced the potential for additional unobserved organisms to get transferred and reduced the risk of injury to fragile fins and tails. Fish were counted off on a register to ensure all collected individuals were accounted for and placed into one of two aquariums, according to an estimate of their size.

Quarantine term



Toitoi in quarantine aquarium. Credit Melissa Boardman.

Quarantine for fish translocation should last a minimum of four weeks*, Some things to consider:

- Allow time to ensure all fish are healthy, prior to being released into the new whaitua.
- Allow time for disease and parasites to be expressed, either physically or through behaviours.
  - Decisions in response to detection of parasites, organisms and diseases are specific to each translocation and are made under advice and in communication with partners.
- Ensure tikanga is upheld. For example:
  - Respect the mana and journey of the fish, ensuring that their health and wellbeing is robust, ready to cope with the event of being released and establish themselves into their new environment.
  - Respect the mana of the whaitua receiving the new species, that it won't be damaged through the release of unknown or unwanted pathogens.

*This period must be reviewed for each translocation in order to ensure there is time for detection of biosecurity threats.

Minimising stress

Stress can be a killer for small fish. Adjusting to quarantine is a stressful time, so it's important to consider ways to minimise triggers.

Our learning example

Actions to minimise stress may differ between species. Toitoi are known to be resilient fish. Our learnings and observations are included in the recommendations below.

- Prevent noise — especially sudden, loud noise.
  - Our underwater cameras watched toitoi 'startle' at sudden voices during collection.
  - Toitoi will acclimatise to gentle noise, but this may take days.
- Begin leaving dim lights switched on in the quarantine area during the day to create a steady low level of light. Switch lights off when the last observation or feeding has occurred.
  - The goal is to gently acclimatise the fish to hours in which there is movement nearby (e.g., for water changes, food, etc), and to reduce the sudden change in ambient light from opening doors.

- At first, the toitoi hid as soon as light or movement was detected. Once they became accustomed to their safety and the daily arrival of food, their behaviour settled, and they became inquisitive. This allows excellent opportunity to observe behaviour and health of individuals.

- ☐ If possible, block sudden light changes (e.g., hang a dark curtain between the quarantine tank and any doors that open to outside).
- ☐ Provide 'habitat', such as rocks, logs and bracken fern fronds to divide up the space inside the aquarium, and fronds to line the aquarium sides.
  - Smaller individuals can find spaces amongst the fronds, away from more dominant individuals.
  - Water eddies caused by fish movements are broken up and dispersed.
  - Fern fronds lining the inside walls of the aquarium can interrupt the shimmying behaviour exhibited by stressed fish newly introduced from the more vast environment of a lake. We watched as fish responded to the introduction of fronds by stopping the shimmying and settling into a space between the surfaces.
- ☐ Keep visitation minimal in the first few days. Once the fish have visibly relaxed, visitation can be respectfully increased.

Water testing

The water in the quarantine aquariums should be tested daily at a minimum for the first week of quarantine.

After the first week, individual tests can be carried out as judged necessary, but never more than three days apart.

Test-tube sample kits designed for aquarists to check ammonia, pH, nitrites and nitrates are the most accurate and we recommend these over paper test 'strips' or indicator cards that sit inside an aquarium. It's important to follow all instructions carefully and dispose of the tested water safely down a reticulating drain.

Signs of a healthy aquarium are that nitrates slowly rise but ammonia and nitrites aren't detected.

If water quality is a concern, try exchanging up to 50% of the water in the aquarium; however, be aware that the bacteria may need time to grow in number to meet the ammonia and nitrite being produced. Repeating large water exchanges will slow this process, prolonging the time that fish are spending in toxic environments.





Water quality test results

Ammonia Oppm = healthy aquarium!

Any ammonia can be stressful to the fish; however, there may be some lingering as the aquarium 'settles' after the introduction of fish.

- ☐ Increase the filter settings if possible.
- ☐ Check the filter sponges and rinse in water from the aquarium.

Too much ammonia can damage fins, gills, cause stress and eventually lead to death.
Up to 0.25ppm, especially in days 1-5 is stressful but considered safe.

Treat any ammonia levels above 0.5ppm as a trigger to carry out a larger than usual change of water; however, too much water exchange could extend this process, meaning fish are exposed to higher concentrations of ammonia for longer. Decisions need to balance reducing the immediate harm and allowing the settling process to carry out.

Some safe products, such as Prime by Seachem or Ammo-Lock by API, convert ammonia and nitrites into less harmful compounds, such as ammonium chloride, until nitrifying bacteria have caught up.

Nitrites Oppm = healthy aquarium!

Any nitrites can be stressful to the fish; however, there may be some lingering as the aquarium 'settles'.

Up to 0.75ppm, especially in days 1-5, could mean the aquarium is adjusting and will be fine.

As with ammonia, too much water exchange could extend this process, exposing fish for longer.

Salt in the aquarium reduces the impact of nitrites on native fish, by preventing its uptake.

Once ammonia and nitrites are sitting at 0ppm, the bacteria have established. They aren't affected by the water changes, which keep the final product, nitrates, to a safe level.

Nitrates <5ppm is the goal for quarantine

Nitrates are far less of an issue to fish. They're also easily dealt with through water exchange.

Nitrate levels from 0-40ppm are generally considered safe for toitoi. Levels above 80ppm can be toxic.

Daily checks in quarantine

Daily checks of the individuals in quarantine should include a morning scope of the overall area.

- Are the filters and aerators on?
- Are there any problem leaks?
- Does the water look clear or cloudy?
- Is the lid on?

While in quarantine, fish are more vulnerable to ill health due to higher stress levels. Quiet time should be taken to observe the individuals in quarantine for signs of health or ill-health.

Healthy toitoi

- Spend long periods resting and/or hiding
- Can become 'curious' of visitors to the aquarium
- Can change colour to signal dominance
- May chase or flee from other toitoi



Relaxed toitoi rest horizontally on logs, vegetation etc.

Signs of stress or disease

- Persistently shooting up the sides (not adapting to aquarium boundaries)
- Sores, ulcers, 'white spot.
- Signs of damage to fins or eyes
- 'Gulping' air at the surface
- Rapid gill movement (compared to others)
- 'Coughing' movement
- Excess mucus
- Very dark or very pink gills
- Scratching or flicking against objects
- Abnormal posture or swellings



'Shimmying' behaviour can be an indicator of stress.

Food options during quarantine

We opted to keep food to live prey, in order to promote natural feeding behaviour in preparation for release.

Whiteworms will feed on decaying food scraps and are fairly nutritious in comparison with some options. We established a whiteworm farm, fed by compost scraps, in advance of the fish arriving.

- Aim for approximately 4 whiteworms per individual per day

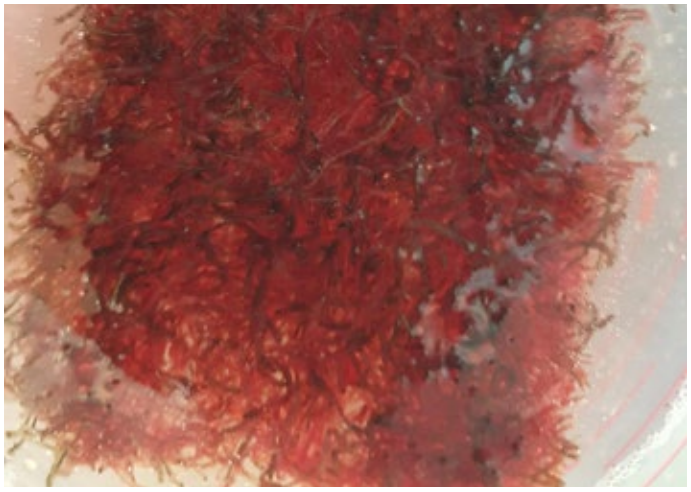
Waxmoth larvae are also relatively easy to keep, and smaller individuals are a hearty meal for larger fish.

Frozen bloodworms are easy to store and good as a back-up option if other food runs low; however, while they have plenty of energy, they aren't as nutritious as other food types.

Mealworms, while often used during bird translocations, are not a good option due to the long duration of quarantine required and their relatively poor nutritional value.

Our learning example

Frozen bloodworms are a good option for individuals in isolation. We learned in our first year that whiteworms were not suitable for individuals undergoing treatment for ill-health or injury. In one case, an individual developed a secondary infection resulting in an ulcer around the mouthparts. We believe a whiteworm, swallowed as a meal, was able to latch onto the wound and feed from the decaying wound edges. For this reason, live food is no longer used for individuals in isolation.



Frozen bloodworms were used for individuals in isolation.



Live whiteworms were used as the main food source during the quarantine period.

Water exchanges

The goal of exchanging the water in the quarantine aquarium with freshly collected water is to reduce the concentration of by-products produced by the fish, and to continue to remove any other contaminants that may have been transported with them.

It is important to minimise the disturbance to the individual fish during water exchange as big changes in the temperature, water level, salinity, pH or other parameters can all cause stress. The day-to-day set-up can be modified temporarily to cycle fresh water into the aquarium. This technique helps to minimise changes to the water level and flow rates.

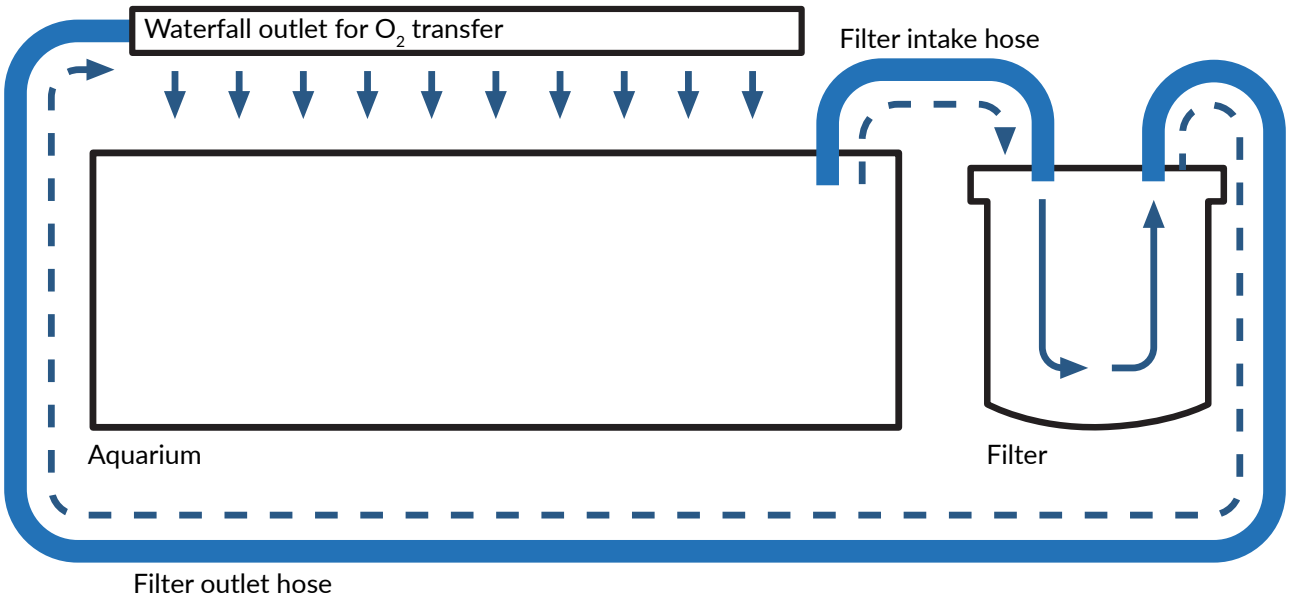
The freshly collected water must first be acclimatised to the temperature of the quarantine aquarium.

Our learning example

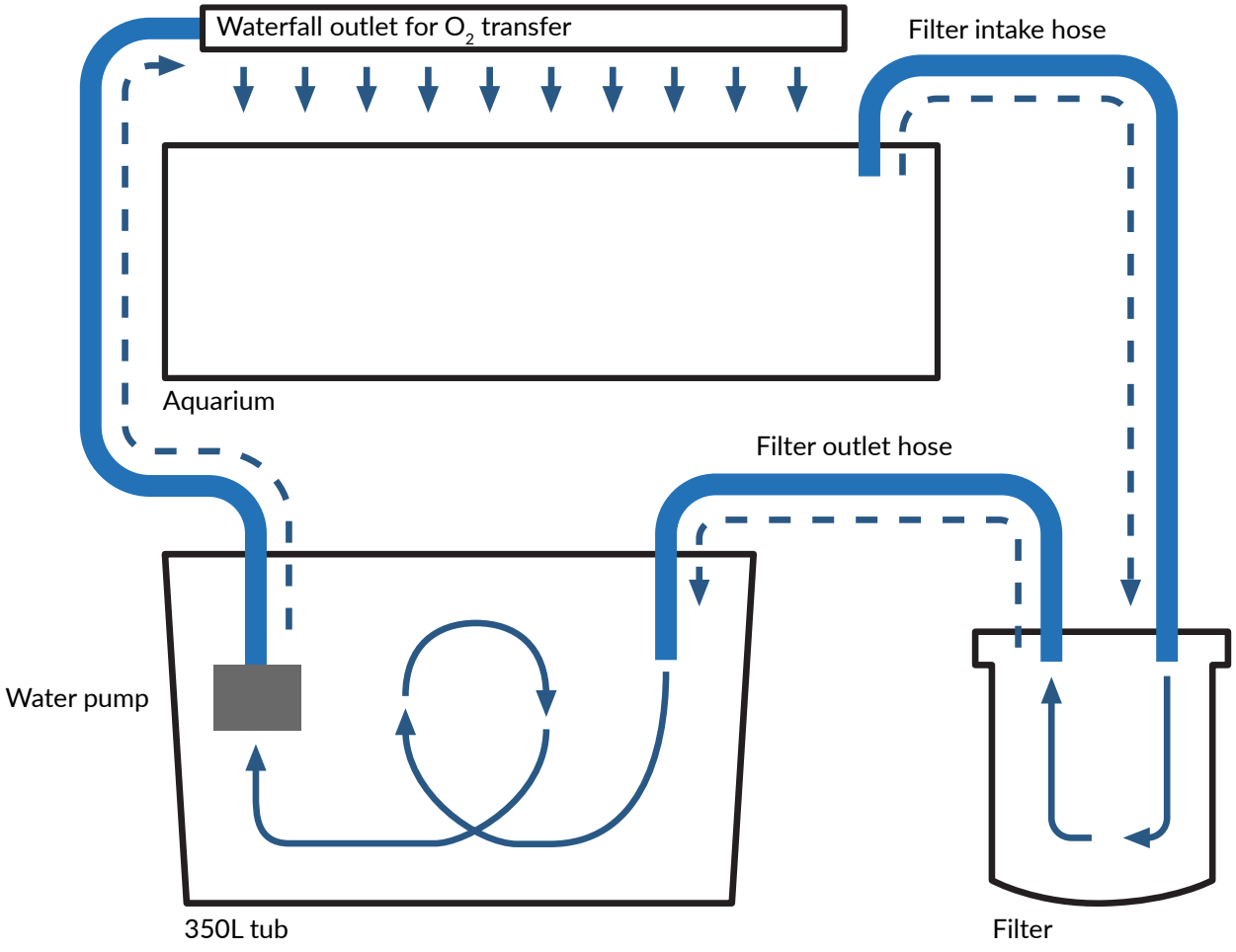
We collected fresh stream water from the headwaters of the receiving whaitua (Zealandia) and stored this in a 1000L container outside of the quarantine room ready to be used. 1kg of salt was added at this stage, in order to create a 0.1% salt solution.

Below is a diagram of the day-to-day set-up of the quarantine aquarium, filter and filter intake hose, with the outlet hose connected to a 'waterfall' design to increase the dissolved oxygen in the aquarium water.

350L tubs were placed beside each aquarium, and water from the container outside transferred into them, ready for water exchange the following day.



Below is a diagram showing the set-up for water exchange. This arrangement reduced the disturbance of water cycling, by maintaining water levels and the same water turbidity in the quarantine aquarium during the process.



To cycle:

1. The filter outlet hose is removed from the waterfall pipe and placed into the 350L tub. This acts to remove water from the aquarium to the 350L tub.
2. A water pump is submersed into the 350L tub, with the outlet hose fitted to the waterfall pipe. This acts to return water to the aquarium from the 350L tub.
3. After 15 minutes, the hoses were returned to their normal, daily set-up. The time required will depend on the speed of your filters and water pumps.

Our learning example

Fresh water exchange was carried out every day in the first week.

The water in the 350L tub was emptied after each exchange following biosecurity principles and refilled with fresh water.

After the first week, water cycling was carried out in response to water testing results and other logistical drivers.

Caring for individuals - small aquarium regime



Toitoi in quarantine aquarium

Isolation for treatment

Isolating an individual in a small aquarium reduces their stress and energy output, allows for targeted treatment and observation, and reduces the risk of spreading contagious conditions. Our learnings and observations are included in the recommendations below.

1. Switching to tap water, which has been dechlorinated with a product such as Prime protects fish with compromised health from catching secondary, water-borne infections.
   - We chose to maintain the presence of their clean, rocky substrate and cover in order to foster natural behaviour and lower the impact of stress.
2. Warmer water temperatures increase a fish's metabolism, improving self-repair and responsiveness to treatments. Acclimatisation for the individual to the new temperature must be carried out slowly and care must be taken so that cold water species are not further stressed by temperatures that are too warm.
3. Begin at the same temperature as the main quarantine aquarium. Use the small aquarium filter, prepared during cycling.
4. Introduce the individual and place the aquarium into a designated, thermostat-controlled room overnight (e.g., a room with a heatpump), to enable a slow climb in the water temperature. The following morning, add an aquarium heater set to 20°C to slowly lift and maintain the water temperature.
5. Cover the aquarium from light and minimise noise to relieve stress.
6. Feed any fish undergoing treatment with defrosted bloodworms to prevent harm. As noted previously, whiteworms feed on decomposing material, including wounds and ulcers from secondary infection and can prevent the individual's return to health.
7. Continue to exchange 25% of aquarium water as testing requires, using tap water treated with Prime.



Our learning example

Frayed fins as seen in the image to the left can be a result of poor water quality or injury, causing stress to the individual. This increases their susceptibility to natural bacteria, leading to a condition called 'fin rot', a progressive, fungal disease.

In cold water, fin rot can take some time to heal once treatment starts. This individual's condition exhibited fraying to about halfway down their fin, which, if caused by fin rot is a stage where healing is still possible. Our focus was to reduce stress, treat with Pimafix and maintain high water quality.

Fin rot can be contagious. The treatment for aquarium buddies is to exchange 50% — 100% of their water.

The individual recovered quickly, suggesting the fraying was damage only and not infection. It may be that the isolation, warmer temperatures and clarified water prevented any opportunity for fin rot and sped up their natural healing. The individual was returned to the large aquarium after 10 days.

Salt in the treatment of toitoi and other fish

Where there is a wider outbreak of infection, parasites or generalised signs of ill-health within a quarantine aquarium, supervisors may choose to treat the aquarium instead of isolating individuals. Salt is a widely-used, effective and low-cost option for broad treatment, with a comparatively mild environmental impact (The Environmental Literacy Council, 2025).

Our learning example

Firstly, become familiar with the disease progression or parasite cycle you are treating.

The treatment plan for fish is to begin by increasing salt from your maintenance percentage (0.1%-0.3%) to a 1% solution. At this concentration, many diseases should be treated effectively.

If all symptoms clear up and fish are coping well, ensure a generous amount of time has been given before returning to your maintenance solution, as there is a chance that symptoms might return when the salt is removed.

If symptoms are still present after a week at this level, you may choose to progress to a 2% solution, and beyond that, to a 3% solution. A wide range of issues related to bacteria, fungi and external parasites will be treated at this concentration.

This is a lot of salt for freshwater fish (ocean environments are 3.5% salt). During a salt treatment, keep a close eye on the fish. Observation is key.

Toitoi as a species can live in marine-level salt water as part of their lifecycle; however, research samples shared with us from the source location of the toitoi in our translocation showed that no level of salt appears to enter the lake. As such it may have been many generations since these individuals have experienced salt water. We suggest getting specialist advice before use salt in the treatment of other species.

Take care to ensure the salt concentration has been gradually reduced to 0% prior to release, using water changes. This requires some forward planning to calculate the quantity of daily water exchange required.

Public engagement during quarantine



The period of quarantine during translocation, while essential, is also a wonderful opportunity for a wider audience to experience and connect with these fish in a context they wouldn't normally be able to witness.

Our learning example

One of our quarantine tanks was a glass aquarium, which enabled us to see the individuals more clearly and keep a close eye on their wellbeing. Wild toitoi took some time to acclimatise to their new environment, and we took this process slowly and carefully. Once they were comfortable in their temporary environment, as judged by a change in their behaviour from secretive to actively responding to the presence of people by coming out into the areas where food generally arrived, we decided to allow visitors in to spend time with them, supervised by a trained member of our team.

During the translocation, Zealandia Te Māra a Tāne ran a campaign titled 'Know Your Wai' and encouraged visitors to come and get curious about the freshwater world.

The quarantine space was set up so visitors were greeted at the door by a volunteer whose task was to offer them insights into the individuals present and the overall kaupapa. They also ensured the interactions were respectful. Signage provided pictures and stories about the translocation, including the story of their relationship with kākahi, the use of whakaweku and the wider restoration of Te Kaiwharawhara whaitua.

This was a very successful way to engage people. Children could be heard chatting along the paths further into the valley, looking for toitoi in the streams after these encounters. Older visitors reminisced about when these fish were plentiful in streams during their childhoods and connected with their return to enrich the environment of tomorrow's generations.


MEET THE TOITOI

Common Bully - *Gobiomorphus cotidianus*

Freshwater biodiversity is in trouble across Aotearoa New Zealand. Poor water quality, habitat loss and disrupted connectivity are taking their toll on our unique species and ecosystems. Here at Zealandia Te Māra a Tāne we are working to create a corner of the world where New Zealand's unique freshwater animals and plants can thrive in healthy, vibrant ecosystems. That is where the toitoi come in!

Toitoi are one of the most common freshwater fish species in Aotearoa New Zealand. This small fish species reaches about 50-60mm (though individuals can be up to 120mm), are typically dark grey to brown in colour and live for around 1-4 years. While they are common, they have been completely lost from some parts of our landscape, and this has happened at Zealandia Te Māra a Tāne. This was likely due to predation from introduced fish, and the loss of migration pathways as dams and culverts were installed in the river/awa.

Photo credit: Manuaki Barrett

These particular toitoi have been collected from Lake Kohangapiripiri at the Parangarahu Lakes. These lakes are part of East Harbour Regional Park near Eastbourne and are co-managed by Rōpū Tiaki - a group made up of Greater Wellington Regional Council (GWRC) and mana whenua, Taranaki Whānui ki Te Ūpoko o te Ika.
The toitoi will be released into Roto Māhanga, but first they need to be kept in quarantine for a few weeks to allow us to check they are not bringing in any parasites or diseases into our water.

Through this translocation we are working towards whole ecosystem restoration. Each species within an ecosystem plays an important role and makes it a richer, healthier and more resilient place. Toitoi are an important species for us to introduce to Roto Māhanga because of their relationship with kākahi, the freshwater mussel.

Signage from the quarantine public engagement exhibition.

SECTION 4: Release

Release planning



Roto Māhanga at Zealandia Te Māra a Tāne where the toitoi were released

The day of release is an exciting milestone, but has several potential points of stress for the fish. Take care to ensure local tikanga is being upheld in the care for the water, for the fish and for the people attending any release.

- Allow for mana whenua to be involved in the early translocation planning conversations regarding the nature of the releases, discussions about tikanga and the day as a whole.
- As with other key days in the translocation, the maramataka can be used to guide decisions on a suitable date for release and influence the way in which the release day will be undertaken.

Preparation for release occurs in the days immediately prior, by ensuring the aquarium water and the water in the fresh 1000L storage tank is as close as possible to the pH and other measurable parameters of the release location.

The fish should be carried up to the release location in water taken directly from the location itself, and the transfer from aquarium into these transport buckets will be more comfortable if the waters are closely aligned.

Take care to assess biosecurity principles when planning for each step (e.g., if the buckets used in quarantine will also be used to transport the fish to the release site, ensure that these have been cleaned and dried).

If there is an event to be held for the release, it can be helpful to plan on releasing a smaller, more manageable number of fish at that time and releasing the remaining fish later.

Our equipment example

Catching equipment	Transport equipment	Release Equipment
6x cleaned mini hand-nets	Baffles (reduce water movement)	1x cleaned, dried 1L jug
Fresh, release-sourced water	Portable aerator kits	4x cleaned, empty 20L buckets
4x cleaned, dried, 20L buckets	Vehicle	

Before release

4 hours before release (approx.)

- ☐ Fill 4x 20L buckets to ¾-full with water collected from the release area.
- ☐ Test pH (final).
- ☐ Fit lid and set in allocated zone near to quarantine aquarium to enable temperatures to equalise.
- ☐ Collect white worms & feed all fish.

2 hours before release

- ☐ Drain ½ to ⅔ of the aquarium's water into the overflow tub, making it easier and less stressful to collect fish.
- ☐ Turn off the bubblers and filters to increase visibility.
    - **Remember to turn back on afterwards.**
- ☐ Remove habitat bundles and the largest rocks.
- ☐ Use hands/thermometer to check that the temperature feels the same between the aquarium and the transport buckets.
- ☐ Using cleaned mesh nets, collect fish from the quarantine tank and place them into buckets (20 fish/bucket).
- ☐ Fit aerators and baffles to the buckets and secure each lid.
- ☐ Return the water and shelter to each aquarium for the remaining fish.

1 hour before release

- ☐ Transport fish in their release buckets to the release location.
- ☐ Remove half of the water from each bucket to the soil to make space for temperature adjustments if needed (remembering this is now water from the release location, and the individual fish have completed their quarantine).
- ☐ Using a cleaned 1L jug, gradually top up the water in each bucket from the release location, until the temperatures are aligned and the buckets are ¾ full. Temperature can be gauged adequately using your hands. Ensure aerators are fitted.

Important

Native fish are incredibly good at remaining camouflaged.

It was our experience that we continued to find a number of fish remaining in the aquarium, until all of the substrate had been removed and the water reduced down to 20cm depth.

Removing the substrate can stir up cloudiness in the water and must be done carefully, gradually and well in advance of searching for these last remaining individuals to release, in order to allow for the cloudiness to settle or be removed through the filter.

It is recommended to plan on carrying out at least two releases for this reason.



Toitoi camouflaged on lake bed. Photo by Scott Langdale



Release



Karakia before release.Photo by Scott Langdale.

Once fish are settled in their buckets, they can remain comfortably with aerators for up to an hour.

Mana whenua should be given the opportunity to guide the release of the fish. This may include karakia, waiata, kaikōrero, speeches, poi or other elements that help to set the tone for their welcome.

When ready, release the individuals from each bucket by sinking it into the water, near to natural cover or to whakaweku if used. Lower and tip the lip downwards, allowing fish to swim out.

Alternatively, cup your hands underneath individuals to lift them out of the bucket with some water and release them individually.

Releasing to whakaweku

Whakaweku provide cover and a safe place to shelter. Releasing fish to whakaweku is a way to reduce the stress of being released into an unknown wild environment and enables the fish to venture out in their own time.



Onlookers viewing the release from above. Photo by Scott Langdale.

Clean up and biosecurity of surfaces

The methods for clean-up will reflect each project's future needs.

Substrate, logs, rocks and ferns should not be returned to the catchment, but can be carefully scrubbed in fresh water, thoroughly dried and stored if their use is part of a multi-year translocation and they will be needed again. At the time of writing, drying is a very effective method for maintaining aquatic biosecurity.

Cleaned and dried fern fronds can be returned to the soil, so long as the site is suitably far from a water course that they can't be blown or washed down into a stream.

Ceramic filter material and sponges can also be cleaned, thoroughly dried and stored for use in future years.

Care should be taken if any detergents agent are being used on pumps, sponges, filters, aquariums, nets and other equipment that comes into direct contact with fish, that the equipment is very thoroughly rinsed to ensure no residue remains.

All water used in biosecurity cleaning should be released to a treatment drain when finished.

Review and closure

A review can help to encourage curiosity about how the translocation may be improved for the future, as well as bring a collective focus on what has been achieved and closure to the work.

This document is intended as an evolving document and we welcome additions of new learning.

Kua mutu ā mātou mahi
Mō tēnei wā
Manaakitia mai mātou katoa
ō mātou hoa
ō mātou whānau
Āio ki te Aorangi

Our work is finished
For the moment
Bless us all
Our friends
Our families
Peace to the universe.

This karakia was composed by Dr Huirangi Waikerepuru (Taranaki Whānui), rangatira for Taranaki iwi. He was an esteemed and central leader in the Māori language movement and an advisor to the late Kīngi Tūheitia.

It is suitable to the occasion of closing a hui/meeting or event.

Acknowledgements and references

This translocation was designed with thanks to the partnership with mana whenua both locally, Te Ati Awa Taranaki Whānui Te Upoko o Te Ika, and iwi around the motu; Rōpū Tiaki, Dr Mike Ross, Ngāti Haua, Waikato Tainui, He Kaha Tuatinitini formerly Hem of Remutaka, and freshwater ecologists and biosecurity staff from the Department of Conservation, Greater Wellington Regional Council, Earth Sciences New Zealand (ESNZ, formerly NIWA), Ministry for Primary Industries - Fisheries New Zealand (MPI), Riverscapes Freshwater Ecology Ltd, Zealandia Te Māra a Tāne, Auckland Zoo and Te Nukuao Wellington Zoo.

The following references were also useful sources of information and learning for the design of this freshwater species translocation.

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