8. RESTORING AND ENHANCING TUNA

ERINA WATENE-RAWIRI (WAIKATO, MANIAPOTO, NGAAI TE RANGI – TAIHORO NUKURANGI)

Ngaa mihi

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Kua ngaro te kai, kua ngaro te taangata

As the kai is lost, so too are the people

Kia ora taatou, this article builds on many projects completed over several years by many people. In particular, I would like to acknowledge: Taroi Rawiri, Dr Jacques Boubee, Dr Erica Williams, Waikato-Tainui, Waahi Whaanui Trust, Genesis Energy, Waikato-Tainui College for Research and Development, Waikato River Authority, Taihoro Nukurangi (NIWA), and all the many iwi partners I have had the priviledge of working with over the years.

– Ngaa mihi, naa Erina

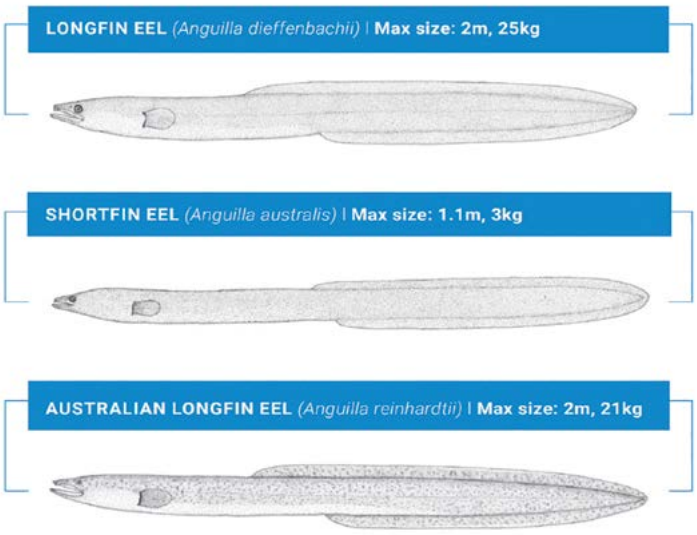

Figure 1. Three tuna species found in Aotearoa, species, maximum size and weight. Photo: NIWA

Tuna or freshwater eels are remarkable fish. Worldwide, there are 18 recognised species, three of which are found in Aotearoa New Zealand (Fig. 1): the endemic longfin eel (*Anguilla dieffenbachii*); the shortfin eel (*A. australis*); and a more recent arrival, the Australian longfin eel (*A. reinhardtii*). These tuna are generally longer lived and slower growing than many other species around the world; longfin tuna in particular, has been recorded as living up to 80 years, whilst the shortfin tuna lives between 15 and 30 years. In terms of their size: longfin tuna reach 2m in length and weigh up to 25kg, shortfin tuna reach a maximum length of 1.1m and weight of 3kg.

Longfin tuna. Photo: Erina Watene-Rawiri

Previous page: Tuna in a net. Photo: Erina Watene-Rawiri

He ua ki te poo, he tuna ki te ao

Rain at night, eels in the morning[1]

This whakataukii reflects ecological understanding by describing the movement of tuna across the whenua (land) during rain as they move to spawn.

Kaitiaki is a pou carved by Johnson Taoho (Ngaati Whaawhaakia), the carving symbolises how tuna populations sustained the people of Raahui Pookeka. Photo: Erina Watene-Rawiri

Tuna were highly valued by Maaori in pre-European times, as shown by their prevalence in place names, whakataukii (proverbs), puuraakau (legends), waiata (songs), and mahi toi (artwork). The importance of tuna for many hapuu (sub-tribes) and iwi (tribes) cannot be underestimated. Tuna are connected to Maaori through whakapapa (geneaology). In some cases, the identity and mana of hapuu and iwi, and access to tuna are intertwined. Due to their abundance, the relative ease with which they were caught, and their high nutrient values, they provided an important source of fat and protein, and in many cases were essential for the survival of Maaori communities. Tuna were so highly regarded that inter-tribal wars were often fought over access to tuna fishing grounds.

Kua kaheko te tuna i roto i aku ringaringa

The eel has slipped through my hands[2]

This whakataukii recognises the morphological characteristics of the slippery skin of a tuna and its status as a prized food to represent a loss where something worthwhile has slipped away.

Although the term 'tuna' is a common name to refer to these valued species, there are distinctive names used among different hapuu and iwi that also reference different stages in their lifecycles. Table 1 provides some examples, but this is not an exhaustive list. For those seeking to work with Maaori, it is important that the unique dialect and science of each hapuu and iwi regarding their tuna maatauranga (knowledge) are acknowledged where appropriate and agreed upon.

Table 1. Some examples of Maaori names for tuna

Maaori name	Possible species
Ika paewai	Longfin, shortfin
Paewai	Longfin, shortfin
Paraharaha	Longfin
Puhi	Shortfin
Rino, ringo	Shortfin
Tuna	Longfin, shortfin, Australian longfin
Tuna pahu	Longfin
Tuna tuoro	Longfin

[1] Mead & Grove, 2001: 305

[2] Mead & Grove, 2001: 131

Maaori knowledge, or maatauranga Maaori, was acquired over many generations. Maaori gained extensive hapuu and iwi specific maatauranga of tuna, which extended well beyond catching tuna for survival. This involved in-depth maatauranga acquired from observation and experience, including understanding the relationship between environmental parameters (rainfall) and life cycle, migration patterns, preferred habitats, and development of sustainable harvesting techniques, as well as preparation, cooking and preservation methods, fisheries conservation practices, traditional names, and relationships with astronomy such as maramataka (Maaori lunar calendar).

Me te raparapa tuna

Like eels split open for drying[3]

This whakataukii outlines a preparation technique where tuna is split and hung on a stick in the sun to dry.

An example of knowledge gained from observation and experience is evident in the following quote:

'Long before the question had begun to interest European Scientists the Maaoris knew that the eels went to sea to spawn, and they had a regular lore built up about their times and manner of migration. So accurate was their knowledge that they could tell to a day when the migrations would commence, and on what nights they would be running…'

– McDonald[4]

Tuna have a complex lifecycle and are diadromous, which means that they spend part of their life in the ocean and part in freshwater (Fig. 2). This is supported by narratives from hapuu and iwi that highlight the depth of understanding that our tuupuna (ancestors) had about this as well as other aspects of tuna ecology.

[3] Mead & Grove, 2001: 305
[4] Best, 1986: 100

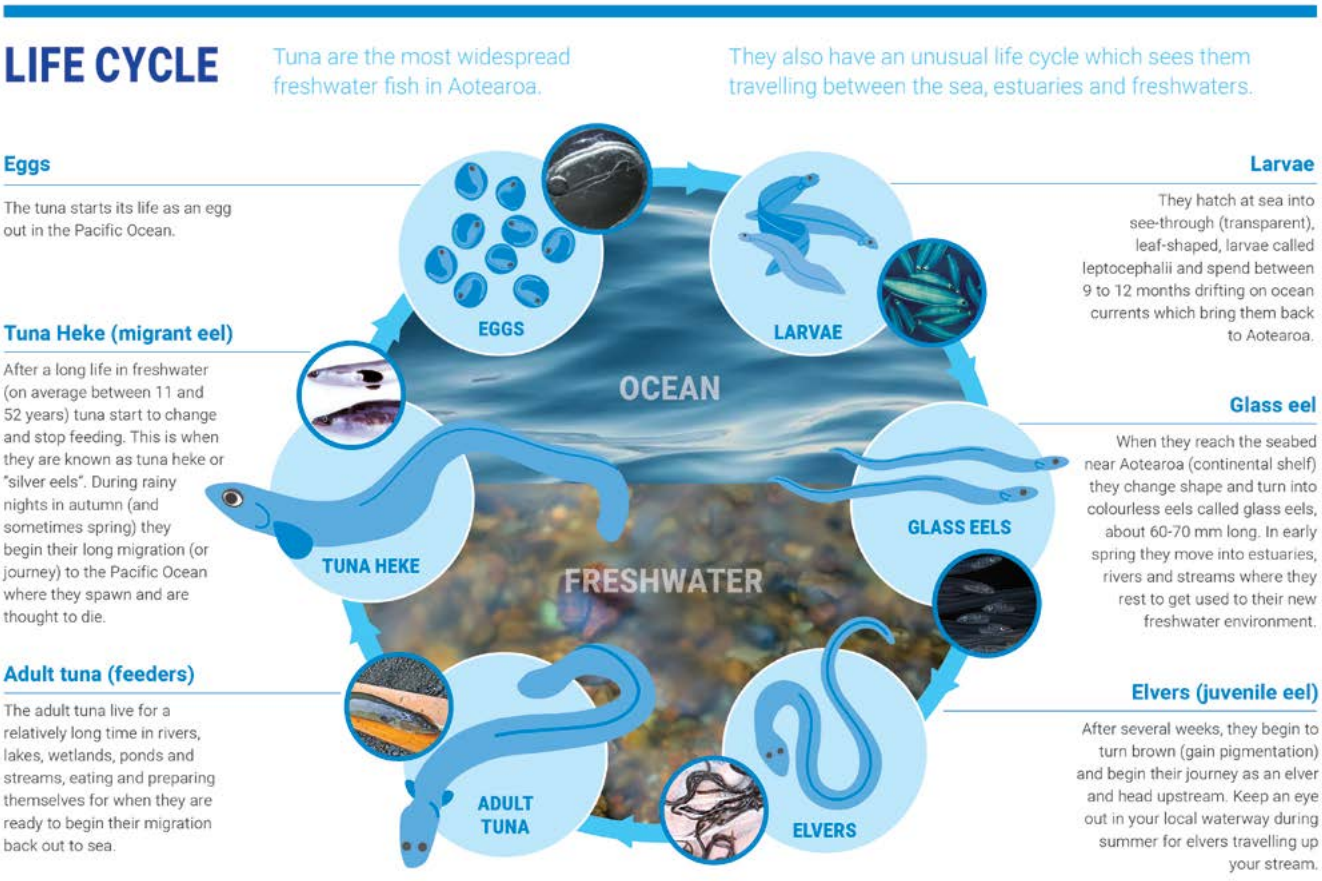

Figure 2. Tuna lifecycle. Illustration: Aarti Wadhwa, NIWA

TUNA – AA TAATOU TAONGA

Tuna are found in all sorts of freshwater habitats including awa (rivers and streams) and repo (wetlands). They like to hide in the mud, or under banks, rocks, boulders, and weeds. As tuna are the top predator in these freshwater systems, they are opportunistic feeders and will eat pretty much anything they can catch and fit in their mouths. Younger and smaller tuna eat aquatic invertebrates (such as small insect larvae, snails, midges, and crustaceans), small fish under 10 cm (such as smelt (*Retropinna retropinna*) and bullies (*Gobiomophus* spp.)), and worms and other small insects. Older and larger tuna can eat larger prey over 25 cm in length such as giant kookopu (*Galaxias argenteus*), koura (freshwater crayfish; *Paranephrops* spp.), other tuna, and even small birds, and rats!

Me te whata raparapa tuna e iri ana te tutu

The tutu berries are hanging like split eels[5]

This whakataukii outlines a preparation technique where tuna is split and hung on a stick in the sun to dry.

Taroi Rawiri preparing a shortfin tuna for smoking.
Photo: Erina Watene-Rawiri

RESTORATION AND ENHANCEMENT

Tuna have experienced many challenges to their survival over the last 200 years. Early exploration and trade resulted in destruction of many Maaori tuna weirs. Large areas of lowland wetland were progressively drained, and less than 10% of all wetlands that were present when Europeans arrived in Aotearoa now remain. Hydro-electric dams were constructed, along with other barriers such as flood pumps, which block access to upstream habitat and kill tuna that pass through the turbines. Beginning in the 1930s, extermination campaigns were waged against tuna for two decades, during which hundreds of thousands of tuna were deliberately destroyed to protect trout. Then in the 1960s, the commercial eel fishing industry developed, and large quantities of eels have been harvested by commercial fishers ever since.

Unsurprisingly, tuna are now no longer as abundant as they once were, and longfin tuna are currently classified by Te Papa Atawhai (DOC) as **'At risk – Declining'**, which is the same threatened species status as the brown kiwi (*Apteryx mantelli*), a beloved national icon. Shortfin tuna are classified as '**Not Threatened**'.

This decline in tuna populations is of great concern to Maaori, a sentiment expressed by many, including Dr Pita Sharples, former Maaori Party Co-Leader:

'Any threat to the eels are a threat to the identity and mana of the hapuu and iwi who have a responsibility to protect them… It is outrageous that people are still catching them for profit.'[6]

– Dr Pita Sharples (Ngaati Kahungunu, Ngaai Te Kikiri o Rangi, Ngaati Paahauwera)

Our work in this field has highlighted that the decline in tuna populations is driving an urgent exploration of tangible restoration, enhancement, and protection solutions. Some of the potential solutions include making legislative changes to fisheries management (e.g. bylaws that limit catch numbers and weight limits), identifying and implementing fish passage solutions to improve connectivity, selective harvesting (i.e. releasing breeding female tuna), shelving commercial quota, and restoring habitat.

[5] Mead & Grove, 2001: 131
[6] Parliamentary Commissioner for the Environment, 2013

CASE STUDY

DEVELOPING TANGIBLE RESTORATION OPTIONS FOR TUNA

CONSTRUCTED TUNA PONDS FOR HABITAT AND ENHANCEMENT

In the Waikato region, tuna are considered a taonga (culturally important species) by iwi. They are treated as such because they sustain the Waikato way of life, both physically and spiritually. In the physical sense, the fisheries provided a plentiful, reliable, and respected food source essential for the tribe. The Waikato-Tainui Iwi Environmental Management Plan - *Tai Pari Tai Tumu Tai Ao*, highlights the restoration of taonga fish and shellfish species and the ability to provide these taonga as food in reasonable amounts to manuwhiri (visitors) as critical markers of Waikato-Tainui mana and status. The ability to provide these taonga species confirms the tribe's proficiency in manaaki taangata (hospitality of the people) or the practice of generosity and reciprocity. The abundance of food and other resources that were traditionally available to Waikato-Tainui within its tribal rohe (region) are well known throughout the motu (country), as demonstrated by the following quote:

'… the Waikato River, with its tributaries, was the most celebrated in New Zealand for its paa tuna and the quantities of eels found there, right away from the mouth up to the Huka Falls, near Lake Taupoo, above which none are found. The Mangataawhiri, the Maramarua, the Whangamarino, the Mangawara, the Waipaa, the Awaroa, the Opuatia, and the two lakes Waikare and Whangapee, all in middle Waikato, were famed for their eels…'

– Downes[7]

For traditional fishers, the decline in tuna availability has caused concern about the fishery, and also about the intergenerational exchange of fishery information and knowledge among the people the fishery. To start addressing this, we worked in partnership with Waikato-Tainui and Genesis Energy to explore options to create habitat for tuna.

Waiharakeke Stream ford, Utakura River catchment, Northland. The ford is 1.5m high and restricts the ability of elvers to reach habitats upstream. Photo: © NIWA

Scientists have found that small ponds can contain greater biomass (CPUE) of tuna compared with larger water bodies. In addition, tuna favour these habitats if they are able to access them freely, i.e. there are no barriers like dams, flood gates, flood pumps, fords or perched culverts preventing them moving up or down stream.

Based on that information, we thought that building more tuna ponds and creating more habitat within the lower Waikato River system would benefit local tuna populations. In the spirit of action-based research – using the best available knowledge (maatauranga and science) at the time – we created some tuna ponds in Raahui Pookeka (Huntly, Waikato), on private land located between Lake Waahi and the Waikato River (Fig.3).

Before any digging of ponds begins, it is important to check consent and planning requirements for your region.

To construct the tuna habitat pond, we checked consent requirements under the Resource Management Act 1991 (RMA 1991) and District Plans to ensure we had the right planning permissions for managing risk to the environment, and also to ensure appropriate health and safety, particularly during construction. In our case, after discussion with staff at the regional and district councils, our habitat was considered to be within the permitted activity rules for our region. We had selected a site on private land owned by one of the project partners (Genesis Energy), and checked the hydrology to ensure the pond would be viable. The earthworks to create the tuna pond were completed in less than a week.

[7] Downes, 1918: 296–297

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Figure 3. Ponds located near Lake Waahi and the Waikato River, Raahui Pookeka, Waikato.
Source: Manaaki Whenua – Landcare Research

Diggers preparing one of the tuna ponds, Raahui Pookeka. Photo: Erina Watene-Rawiri

Six weeks after the construction phase, we set some fyke nets (type of fish net) to monitor fish numbers. The beginning of winter (June) was not the optimal time for monitoring, but we were still interested in testing the responses of the tuna to the new habitat. We caught more than 106 shortfin eels in the new tuna pond, which was amazing and unexpected.

Three years after construction, with the wetland plants and trees more established, the pond was re-surveyed as part of a wider catchment-scale tuna monitoring programme. Our catch numbers had almost doubled, with 205 shortfin eels captured, spanning a wide range of sizes. This pond provided the largest catch of 34 eels (per net on each night, also referred to as CPUE or catch per unit effort) across the whole monitoring programme, which involved 10 sites across the Waipaa and Waikato River catchment. The early indications highlight that the tuna ponds are indeed beneficial for our taonga, that they have relatively high catch rates, and that they can support small, medium, and large tuna. Based on these observations, we continue to advocate for the creation of tuna ponds and to monitor and evaluate their medium- to long-term success. Our next steps involve looking specifically at growth rates and the length of time tuna stay in the ponds.

Naau i whakatakoto i too hiinaki i te wai taawawarua anei te waituhi ka taha

You set your eel-pot during the main flood, after the first freshet had passed and therefore missed the descending eels[18]

This whakataukii makes clear that effective actions must be carried out at the right time.

A view of the pond 3-years after installation and plantings. Photo: Erina Watene-Rawiri

Constructed tuna habitat in Raahui Pookeka, Waikato. Photo: Erina Watene-Rawiri

The tuna pond was fenced off, and the margins were planted with a mix of indigenous wetland plant species and trees (Table 2).

Table 2. Examples of the indigenous plant species used at the restoration site

Maaori name	Botanical name
Harakeke	*Phormium tenax*
Houhere	*Hoheria sexstylosa*
Karamuu	*Coprosma robusta*
Kuta	*Eleocharis sphacelata*
Maanuka	*Leptospermum scoparium*
Pukatea	*Laurelia novae-zealandiae*
Puurekireki, puurei	*Carex secta, C. virgata*
Tii koouka	*Cordyline australis*
Toetoe	*Austroderia fulvida*

More than just places for tuna

The co-benefits of tuna ponds like these are potentially endless: they are important living classrooms to teach our rangatahi (youth) about tuna; they could be used as potential harvesting locations for tuna (providing tuna outside the ponds increasing opportunities to migrate and spawn); or they could be turned into tuna reserves.

Finally, while the tuna ponds were developed out of a desire to create more tuna habitat, there were other obvious benefits. Bird species like kotare (kingfisher; *Todiramphus sanctus*), swans (*Cygnus atratus*), and ducks (*Anas* spp.) now also utilise the habitat, along with other native fish species, including smelt and bullies. The wetland plants and trees are maturing and can potentially be harvested to support other cultural practices.

[8] Mead & Grove, 2001: 305

Longfin tuna in stream. Photo: Erina Watene-Rawiri

HOW DO WE RESTORE MAATAURANGA OF TUNA?

Key actions we can take to increase our understanding of tuna based on our collective maatauranga follow.

1. **Koorero (speak) with local kaumaatua (elders) and other whaanau (family) members about their memories and current interactions with tuna:**
   - Record where, when, and how tuna were harvested.
   - Identify how those populations and harvesting practices have changed.
   - **What may have caused population decline?** The cause may need to be addressed first, before any new populations can be reintroduced to the area, e.g. restoring bankside vegetation, building tuna ponds, or reducing introduced aquatic weeds and the abundance of pest fish (if present).

2. **Consider the ecology and environmental whakapapa (connection) of the system to understand better:**
   - The best areas to restore tuna. Consider sites that have good water quality, overhanging vegetation, instream woody debris, and stream bed materials suited to the tributary and each species of tuna. Note of caution here – please do not try to change the natural stream bed material to suit the species you want!
   - Examine adjacent land use and how you can mitigate any adverse impacts, e.g. fencing to exclude livestock access – tuna love undercut banks and lots of woody debris.
   - Benefits (if any) for other organisms – (kooura (freshwater crayfish), kookopu (*Galaxias* spp.), matamata (whitebait), porohe (smelt)) and aquatic invertebrates (caddisflies, mayflies, stoneflies, snails, limpets).
   - An aquatic survey (e.g. Stream Health Monitoring and Assessment Kit – SHMAK) of what is there now is a good way to build a baseline to help monitor changes over time.

Two longfin females. Photo: © NIWA

3. **Building a monitoring and restoration framework:**
   - **What are the practices associated with harvest and have these changed?** Also consider whether kaumaatua and whaanau have any thoughts on why practices may have changed (if they have).
   - **What are the local names (if any) for tuna, and what other species are they connected to (whakapapa)?** This is key to building a bigger, more holistic picture of connections and associated health and well-being of the whole system, e.g. insects, birds, other fish, and plants. Depending on what the natural system looks like in your area, this might also include shellfish species and molluscs like snails.
   - **Where to monitor?** Identify your own monitoring areas based on what you have learnt from your people. Think about where the populations of tuna were and where they are now. Note that some whaanau may not wish to share the exact location of their harvesting areas, so consider instead asking if the populations have decreased and disappeared, and if there are any changes to the habitat, or adjacent land use they feel may be affecting tuna populations.
   - **Who to talk to?** Talk to scientists and other communities with additional experience in tuna ecology and restoration, and work with them to help build a restoration framework that best meets the needs of your local community.

WANT TO LEARN MORE?

Note: If you are having problems with the hyperlinks below try copying and pasting the web address into your browser search bar.

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Useful websites

NIWA

Stream Health Monitoring and Assessment Kit (SHMAK)
https://niwa.co.nz/freshwater/management-tools/water-quality-tools/stream-health-monitoring-and-assessment-kit

Taonga species series: Tuna
https://niwa.co.nz/te-kuwaha/tuna

Tuna information resource
https://niwa.co.nz/te-kuwaha/tools-and-resources/tuna-information-resource

Tuna: Barriers to migration
https://niwa.co.nz/te-k%C5%ABwaha/tuna-information-resource/pressures-on-new-zealand-populations/tuna-barriers-to-migration

Tuna: What does science tell us about New Zealand eels?
https://niwa.co.nz/sites/niwa.co.nz/files/Taonga%20Species_Tuna%20LOW%20RES.pdf

Educational Resources

Science Learning Hub – Pokapuu Akoranga Puutaiao

Ngaa ika taketake wai maaori – Tuna
https://www.sciencelearn.org.nz/videos/1808-tuna

Tuna working with glass eels
https://www.sciencelearn.org.nz/resources/423-tuna-working-with-glass-eels

Conservation volunteers NZ
https://conservationvolunteers.co.nz/tamariki-for-tuna-longfin-eel-educational-resources

Waikato-Tainui – Waikato River Fisheries Bylaws
https://gazette.govt.nz/notice/id/2014-go1266

http://www.legislation.govt.nz/regulation/public/2011/0294/latest/DLM3930995.html

Puuraakau

He reo too te kaainga – if our tuna habitat could speak, what would it say?
https://www.bing.com/videos/search?q=he+reo+to+te+kainga+-+if+our+tuna+habitat+could+speak

Tuna restoration in the Waikato
https://waikatoriver.org.nz/wp-content/uploads/2018/12/Restoring-Tuna-a-guide-for-the-Waikato-and-Waipaa-River-Catchment-2016.pdf

Contact details for Erina Watene-Rawiri

Email: erina.watene-rawiri@niwa.co.nz