10 November 2017

TE ARAWA LAKES TRUST

Hon. Stuart Nash
Minister of Fisheries
Parliament House
Wellington 6160

Tena koe Hon. Stuart Nash,

Te Arawa Lakes Trust - Bylaws for Management of taonga kai in the Te Arawa Lakes

Tihei nako nako
Tihei uri uri
Kia rongo te po
Kia rongo te ao
Ka puta ki te whaiao
Ki te Aomarama
Tihei mauri ora

The Te Arawa Lakes Trust through the Te Arawa Lakes Settlement Act 2006, pursuant to sections 74-79 has the ability under the Te Arawa Lakes (Fisheries) Regulations 2006 to develop bylaws to support the management of the taonga species in the Te Arawa Lakes.

The Komiti Whakahaere (Te Arawa Fisheries Committee) has been working with the Te Arawa Lakes Trust and its beneficiaries' to develop the bylaws for the protection and management of these taonga species.

The bylaws are one of the tools available for the sustainable management of these species; and the Mahire Whakahaere (Fisheries Management Plan) outlines a range of management and research approaches that the Te Arawa Lakes Trust will implement over the coming years.

The settlement act and the regulations outline the process for the bylaws to be developed and gazetted by the Minister of Fisheries. The Te Arawa Lakes Trust has, as required approved through resolution of the Trustees, the bylaws for public notification. The next step in the process is the lodging of the bylaws with the Ministry for public notification to formally take place.

It has been a long journey but much has been learnt and the future of the tuna, kākahi,kōaro, kōura, morihana and Īnanga looks positive. The Te Arawa Lakes Trust and Komiti Whakahaere note that public notification will not take place over the coming Christmas holiday period and look forward to seeing the notification take place early in the new Calendar year.

Please find enclosed the full paper outlining the bylaws and the advertisement for public notification.

We congratulate you on your appointment to the Fisheries portfolio and your leadership in supporting our work to sustainably manage our taonga species.

The Te Arawa Lakes Trust also wishes to acknowledge the support of Ministry staff in the development of the Bylaws, in particular Tracey Kingi and Terry Lynch.

We look forward to your positive response.

A kāti. Kia kaha, kia kakama tātau
Kia tatū pai ai te kaupapa

Nga Mihi

Sir Toby Curtis
Chair
Te Arawa Lakes Trust

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TE ARAWA LAKES TRUST

BYLAWS FOR TE ARAWA LAKES FISHERIES

OVERVIEW

As part of the Te Arawa Lakes Settlement Act[1] (the Act), Te Arawa Lakes Trust are responsible for the management of of ngā taongā ika[2] within Te Arawa Lakes.[3] Te Arawa lakes Trust's propose these bylaws under section 77(1) of the Act and regulation 25 of the Te Arawa Lakes (Fisheries) Regulations 2006.

The rationale for proposing these bylaws are to ensure i) sustainability of customary fisheries and to maintain abundance of ngā taongā ika to mānaki future generations; ii) assess stocks, abundance and health of ngā taongā ika; iii) promote customary fishing practices consistent with Te Arawa tikanga and kawa; iv) prevent degradation of the fisheries habitat by supporting restoration of freshwater habitats in te Arawa Lakes; and v) ngā taongā ika are healthy and safe for consumption.

The following ngā taongā ika- fish species are covered by the proposed bylaws and are a traditional and customary food source of Te Arawa, they are;

a. tuna- *anguilla australis and anguilla dieffenbachia (longfin eel and shortfin eel)*
b. īnanga- *galaxias maculatus spp;*
c. kākahi- *hyridella (Echyridella) menziesi;*
d. kōaro-- *galaxias brevipinnis;*
e. kōura- *paranephrops planiforns*; and
f. morihana- *Carassius auratus*

Īnanga specifically for these bylaws refers to the adult species[4] only, īnanga- commonly referred to as whitebait are managed by DOC. Te Arawa refer to them simply as īnanga whether juveniles or adults.

The Objective

These bylaws will ensure cultural and customary practices and sustainable utilisation of ngā taongā ika Te Arawa Lakes. As part of the management plan for ngā taongā ika, the proposed bylaws will assist Te Arawa Lakes Trust in sustaining fisheries resources whilst also protecting those fisheries which are in decline within Te Arawa Lakes. Management practices consistent with kaitakitanga, tikanga and kawa of Te Arawa, will ensure these fisheries for future generations, whilst providing for customary and cultural practices of Te Arawa.

The Bylaws

The following are the proposed bylaws that cover ngā taongā ika.

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[1] *Te Arawa Lakes Settlement Act*
[2] *Treasured fish species*
[3] *Te Arawa Llakes are Rotoehu, Rotomā, Rotorua/ Te Rotorua nui a Kahumatamomoe, Ōkataina/Te Moana i kataina a Te Rangitakaroro, Rotoiti/Te Roto Whaiti I kite ai a Ihenga i Ariki ai a Kahumatamomoe, Ōkareka, Rerewhakaaitu, Tarawera, Rotomahana, Tikitapu (the Blue Lake), Ngāhewa, Tutaeīnanga, Ngāpouri (Opouri) and Ōkaro (Ngakaro)*
[4] *Īnanga-G. maculatus; kōaro-G.brevipinnis; banded kōkopu-G.fasciatus; giant kōkopu-G agrenteus; shortjaw kōkopu-G posvectis*

Bylaw 1: Closure of koaro- *galaxias brevipinnis*.
This bylaw ensures the survival of remaining relic stocks of kōaro through a total closure of this stock. Any kōaro caught accidentally must be returned immediately to the lake.

Bylaw 2: Return of accidentally caught ngā taongā ika.
Ngā taongā ika species that are caught accidentally are to be returned immediately to the lake. This bylaw will ensure when accidental capture of fish species occurs they can be returned to the lake for future generations and support rebuild of any closed fishery.

Bylaw 3: Restrictions on harvesting of tuna, kākahi, kōura, īnanga and mōrihana.
This is to ensure the sustainable utilisation of these fish species and limits access to these fisheries, the amount to be harvested, size and methods to be used for harvesting.

Bylaw 4: Total ban on use of SCUBA when harvesting ngā taongā ika.
The use of Self Contained Underwater Apparatus is not to be used to harvest ngā taongā ika, this will ensure that access to stocks by retaining traditional and customary fishing methods consistent with Kaitiakitanga, tikanga and kawa of Te Arawa.

Bylaw 5: Ko Te Arawa anake e kato nga kai kei nga moana o Te Arawa.
This bylaw will ensure that only Te Arawa iwi will have access to ngā taongā kai (Tuna, īnanga, kākahi, kōaro, kōura, morihana) for customary and cultural purposes, and manage the fishery consistent with Te Arawa tikanga and kawa.

These bylaws have been developed over several years based on hui with Te Arawa iwi members and research undertaken by NIWA and others within Te Arawa Lakes. The research results indicated low stocks of ngā taongā ika, and in some cases rare relic populations survive in small numbers. Current research continues on ngā taongā ika and habitats that impact on the state of the stocks. These bylaws may be reviewed in 5 years, consistent with Te Arawa Lakes Trust's Mahire Whakahaere[5], and should further research and surveys indicate a change to stocks.

A full version of these bylaws setting out limits, sizes and methods can be found at the following locations:

Te Arawa Lakes Trust
1194 Haupapa St
P O Box 128
Rotorua 3040

Rotorua Public Library
1238 Pukuatua St
Rotorua 3010

Ministry for Primary Industries
Te Papa Tipu Innovation Park
99 Sala Street
Rotorua

[5] *Te Arawa Lakes Trust Management plan*

TE ARAWA LAKES TRUST

BYLAWS

FOR TE ARAWA LAKES

1. Contents

2. Background

2.1 Te Arawa Lakes

In 1840 lakes Rotoehu, Rotomā, Rotorua/ Te Rotorua nui a Kahumatamomoe, Ōkataina/Te Moana i kataina a Te Rangitakaroro, Rotoiti/Te Roto Whaiti I kite ai a Ihenga i Ariki ai a Kahumatamomoe, Ōkareka, Rerewhakaaitu, Tarawera, Rotomahana, Tikitapu (the Blue Lake), Ngāhewa, Tutaeīnanga, Ngāpouri (Opouri) and Ōkaro (Ngakaro) provided key resources of food, shelter, the main arterial route for transport and an economy for Te Arawa people. Te Arawa regard the lakes as taonga, treasures that provided all the necessities of life. These treasures ensured that Te Arawa had resources to trade, barter and sustain them that contributed to their mana whenua within this area. By 1880 as part of the growing influx of settlers, tourism became a key focal point as part of the Te Arawa economy. Tourists looking for areas to recreate were attracted to the Rotorua lakes district highlighted by Lake Rotomahana's pink and white terraces, the many ngā wha/thermal springs and guided cultural tours around the different geothermal valleys. Te Arawa played a significant role in developing tourism in the region as part of the Fenton's agreement 1880 and the Thermal Springs District Act 1881.

2.2 Te Arawa mana whenua, mana moana.

Te Arawa has maintained their mana whenua, mana moana since the arrival of their eponymous ancestor Ihenga. Mātauranga o Te Arawa recounts Ihenga establishing his tuahu, Te Pera o Tangaroa proclaiming mana whakahaere, mana moana over the lakes district that would be inherited by many descendants of Te Arawa. To this day hapū and iwi of Te Arawa reside on the shores of the Te Arawa lakes..

Since this time Te Arawa people have maintained their mana whenua and mana moana to ngā roto (the lakes) me ngā taongā ika (treasured fisheries). Te Arawa kaitiakitanga has been maintained and applied to ngā roto me ngā taongā ika; a customary relationship that connects them to their environs, identity, cultural integrity, wairua, tikanga and kawa.

2.3 Te Arawa Lakes Settlement

In 2004 the Te Arawa Maori Trust Board signed a settlement agreement with the Crown, which was legislated and enacted as the Te Arawa Lakes Settlement Act 2006[1] (the settlement). This settlement was to resolve a breach and grievance caused by the Crown that spanned some 136 years. Te Arawa iwi had been involved in many petitions to the Crown, regarding the wrongs committed by crown officials, agencies and departments, within their lakes and takiwa. The 2006 settlement returned ownership of 14 lake beds to be vested back into the Te Arawa Maori Trust Board (now Te Arawa Lakes Trust) on behalf of Te Arawa iwi members. As part of this settlement, management of ngā taongā ika was also returned to Te Arawa.

The settlement included a Crown apology to Te Arawa for past dealings that breached the Crown's obligations under the Fenton Agreement, Thermal Springs Act and lakes related grievances under the Treaty of Waitangi. The settlement also covers matters related to; i) cultural redress- transfer of the lakebeds, statutory acknowledgement and place names; ii) relationships – relationship agreement, strategic management of the lakes, protocols with government agencies and third parties; iii) restoration of access to food sources and traditional materials including indigenous plants and paru; iv) fisheries; v) financial redress; and vi) annuity redress.

[1] http://www.tearawa.iwi.nz/files/te_arawa_iwi/keydocuments/TeArawaLakesSettlementAct2006.pdf

2.4 Te Arawa Lakes Fisheries Regulations 2006.

The Te Arawa Lakes Trust Board is the governing entity responsible for decisions that govern the management and day to day operations of the Te Arawa Lakes Settlement Act 2006, and Te Arawa Lakes Fisheries Regulations 2006.Through the fisheries protocol management of **ngā taongā ika** would also be returned to Te Arawa. This would be implemented through Te Arawa Lakes Fisheries Regulations 2006[2] (the regulations). These regulations provide for the establishment of a fisheries management committee (Te Komiti Whakahaere) to manage **ngā taongā ika** within the 14 lakes, for and on behalf of the beneficiaries of Te Arawa wherever they may reside. They also provide for kaitiakitanga and provision of customary authorisations by Poutiriao through a puka whakamana.

The lakes, its environs, and ngā taongā ika have suffered considerably since the 1870s with the introduction of new species, pollution, habitat degradation, degradation of the lakes water quality, urbanisation of the lakes foreshores, agriculture and development of industrialised areas abutting the lakes foreshores and water systems, and run off from dairy farms, exotic forests, factories, sewage and forestry production. Te Arawa Lakes Trust on behalf of Te Arawa is addressing these issues as part of the Te Arawa Rotorua Lakes Strategy Group. All matters relating to ngā taongā ika will be managed by the Komiti Whakahaere.

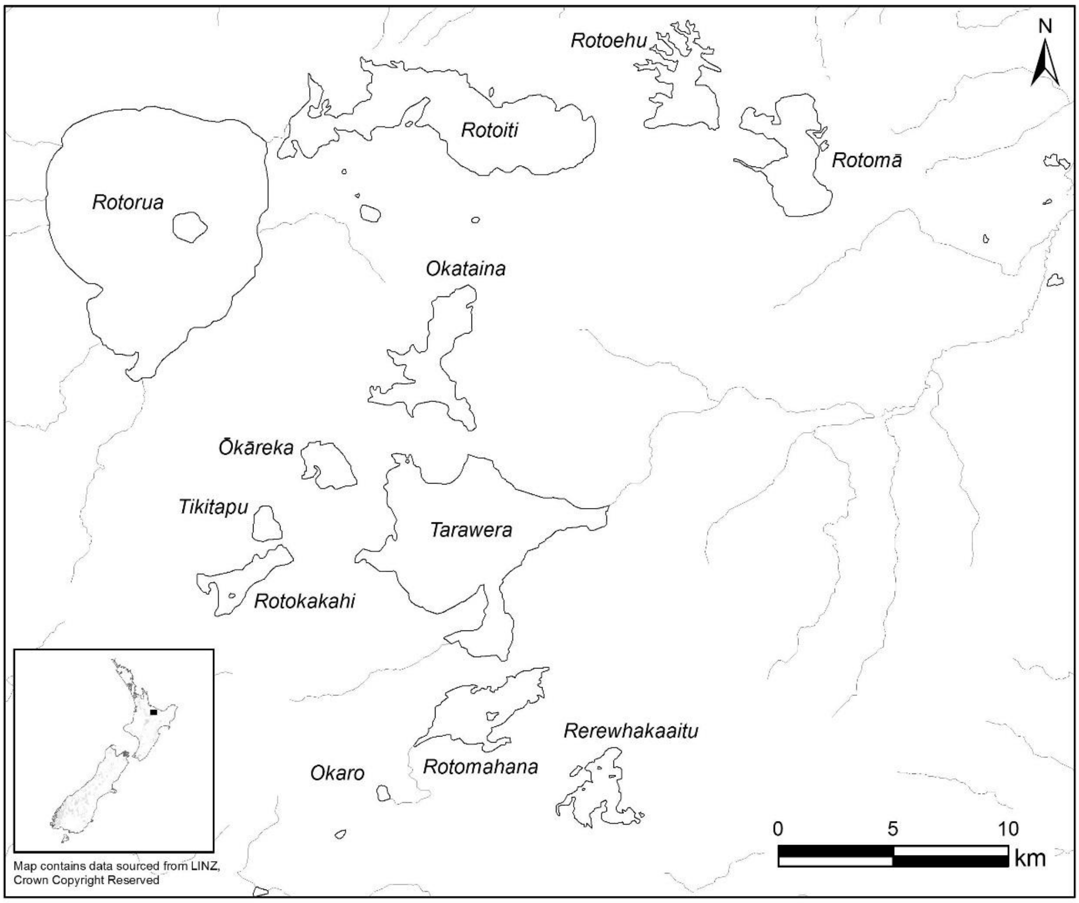
2.5 Te Komiti Whakahaere

The role of Te Komiti Whakahaere is to provide sustainable management decisions for ngā taongā ika within the 14 lakes. Te Komiti Whakahaere are appointed by Trustees under regulation 7 and 9 of the regulations and gazetted by the Minister for Primary Industries. Te Arawa considers that their role as kaitiaki is critical to the survival of the lakes, flora and fauna, environs, fisheries, people and land. Te Komiti Whakahaere propose that Te Arawa Lakes Trust adopt the bylaws proposed to manage sustainably ngā taongā ika within the lakes. These bylaws are made by the Te Arawa Lakes Trust under regulation 25 of the Te Arawa Lakes (Fisheries) Regulations 2006.

[2] http://www.tearawa.iwi.nz/files/te_arawa_iwi/keydocuments/TeArawaLakesFisheries2006.pdf

2.6 Area of application

These bylaws apply generally to the Te Arawa Lakes[3] that includes water, fisheries, and aquatic life in the lakes. They are set out below in the map below, *Te Arawa Lakes Fisheries Area.*



The bylaws do not apply to the islands in those lakes or the land abutting or surrounding those lakes or the streams and rivers flowing into the Te Arawa lakes. Lake Rotokakahi is excluded from these bylaws.

3. Species

The following ngā taongā ika-species are covered by these bylaws:

a. īnanga- galaxias maculatus spp[4];
b. kākahi- hyridella (Echyridella) menziesi;
c. kōaro-- galaxias brevipinnis;
d. kōura- paranephrops planiforns;
e. morihana- Carassius auratus; and
f. tuna- anguilla australis and anguilla dieffenbachia (longfin eel and shortfin eel)

[3] Rotoehu, Rotomā, Rotorua/ Te Rotorua nui a Kahumatamomoe, Ōkataina/Te Moana i kataina a Te Rangitakaroro, Rotoiti/ Te Roto Whaiti I kite ai a Ihenga i Ariki ai a Kahumatamomoe, Ōkareka, Rerewhakaaitu, Tarawera, Rotomahana, Tikitapu (the Blue Lake), Ngāhewa, Tutaeīnanga, Ngāpouri (Opouri) and Ōkaro (Ngakaro).

[4] Adults Īnanga-G. maculatus; kōaro-G.brevipinnis; banded kōkopu-G.fasciatus; giant kōkopu-G agrenteus; shortjaw kōkopu-G posvectis

4. Rationale

These bylaws are made for the following purposes to manage sustainable utilisation of the customary fisheries. Specifically, these bylaws are to support Te Komiti Whakahaere to ensure the following;

i. the sustainability of the customary fisheries in the Te Arawa lakes to maintain the abundance of ngā taongā ika to manāki future generations;
ii. Obtain information on the ngā taongā ika in the Te Arawa lakes and commission research to assess health, abundance and stocks within the lakes;
iii. Promote customary fishing practices consistent with Te Arawa tikanga and kawa;
iv. Prevent the degradation, and support the restoration of fisheries habitats in the Te Arawa lakes; and
v. ngā taongā ika are healthy and safe for consumption

5. Management measures

This section describes the specific fisheries management measures that are to be applied in the Te Arawa Lakes. It is recommended that these are reviewed as, and, when required.

5.1 Management measures applicable to all customary fisheries

The following are the management measures applicable to all customary fishing activities that include;

a) Ngā taonga ika in the Te Arawa Lakes are only to be harvested by Te Arawa iwi and hapū, and are not to be exploited for any non-customary purpose (including commercial and recreational purposes).
b) Puka Whakamana will be issued by Poutiriao for the taking and recording of ngā taongā ika for customary events.
c) The use of Self Contained Underwater Breathing Apparatus (SCUBA) [5]is universally prohibited for gathering of customary fisheries species in the Te Arawa Lakes.

d) The use of registered fish traps, hīnaki, is allowed for gathering of ngā taonga ika (especially kōura) in Te Arawa Lakes.

5.2 Collection for Research and Monitoring Purposes

Any one undertaking research in Te Arawa lakes needs to ensure that TALT and Te Komiti Whakahaere has reviewed the research/monitoring proposal prior to obtaining funding or committing to the work. This is to ensure that the proposed deliverables are not at risk should the TALT decline or suggest revisions to the proposed approach.

5.2.1 Written permission

Any research or monitoring conducted in the Te Arawa Lakes that involves the capture, holding or removal of any of the seven ngā taongā īka , can only be conducted with the written permission from TALT and Te Komiti Whakahaere.

5.2.2 Traditional and other methods

In the first instance, the TALT will direct all research/monitoring proposals to use traditional methods of collection. Alternative sampling or monitoring methods, such as SCUBA, will require written permission from TALT and Te Komiti Whakahaere. Te Arawa Lakes Trust and Te Komiti Whakahaere will require at least two months' notice prior to research proposal submission and/or undertaking field

[5] Does not include snorkels

work that involves the capture of customary fisheries in the Te Arawa lakes. Exceptions will be made in certain circumstances such as the eradication of pest fish or plants.

6. Collection for Non-Customary Purposes (excluding Research and Monitoring)

6.1 Accidental Capture

Customary fisheries species like kōaro are infrequently captured by trout fishermen. It will be prudent to publicise any customary fisheries species accidently captured by members of the public must be returned immediately to the water. In this instance members of the public are encouraged to report the capture and re-release of customary fisheries species to the TALT. Similarly, customary fishers will need to release trout captured accidentally. Customary fishers must have a customary authorisation for customary fish species that exceed the daily customary amount.

6.2 Illegal Harvest

There is anecdotal evidence that rama kōura and hinaki are being used in some lakes by non-Te Arawa fishers to harvest kōura. The bylaws will clearly state that taking of taonga species will be by Te Arawa iwi and hapū.

6.3 Commercial Initiatives

Freshwater crayfish aquaculture industries exist in the southern United States, Australia, Europe and China and small operations exist in New Zealand with both *paranephrops zealandicus* and *paranephrops planifrons*. Commercial exploitation of wild stocks of kōura is prohibited within Te Arawa Lakes under Te Arawa Lakes Fisheries Regulations. Aquaculture activities are generally regarded as for commercial purpose though some can be for non-commercial purposes.

Recent studies have shown that the tau kōura[6] can capture good numbers of harvestable sized kōura (more than 30 mm OCL) in some Te Arawa lakes, e.g., Rotomā, Rotoiti and Rotorua (Kusabs*, et al*). It is feasible that kōura populations in these lakes could sustain increased levels of exploitation because fishing pressure is currently low (mainly due to the low number of eligible fishers that harvest customary fish). Kōura aquaculture, is currently occurring in the South Island, and is an option for Te Arawa Lakes Trust. Rigorous management would be required around the development of brood stock from the lake stocks. Under Te Arawa Lakes fisheries regulations commercial fishing which includes aquaculture can occur. There is a need to research the impact of exploitation of kōura for these types of activities as they have the potential to adversely affect kōura populations. Hence these bylaws prohibit such activities until a managed approach and research can provide information to make an informed decision on kōura populations.

6.3.1 Enhancement Initiatives

Over the years, there have been a number of proposals to release artificially-raised kōura to both enhance and arrest the perceived decline in kōura populations in Te Arawa lakes. However, Kusabs et al, (in press) found that relative kōura abundance is heavily influenced by abiotic factors, especially the composition of lake-bed sediment; with no evidence to suggest that kōura populations are limited by juvenile recruitment. The release of juvenile artificially-raised kōura is not only questionable but evaluating the survival of hatchery-reared juveniles would also be problematic. Increasing useable habitat for kōura by improving lake water quality and removing invasive macrophyte beds, and preventing the establishment of pest fish (and exotic crayfish) populations would reduce the decline in native kōura populations. As a consequence, this plan does not address the prospect of hatchery rearing and seeding at present and further information is required.

[6] Is a traditional form of harvesting.

7: Barriers and passages

The number of tuna (if any) that are able to reach Te Arawa Lakes is naturally low because of the presence of barriers such as waterfalls below their outlets. The small numbers of eels present in the lakes are almost entirely as a result of accidental or deliberate liberations. On the Waikato River close to two million elvers are caught below the Karāpiro Dam annually. These are currently transferred into the hydro-lake reservoirs upstream. A similar trap and transfer programme could, in theory, be made into one or more of Te Arawa Lakes, although sourcing sufficient elvers for stocking could prove difficult. Farm impoundments that are in the Waikato River catchment but still within Te Arawa Lakes may also be potentially suitable. Provision for downstream passage of tuna heke (mature migrant eels), the effects of eels on existing biota (e.g., kōura), and the risk of introducing new diseases and/or foreign organisms (including pest fish) should be carefully considered before any artificial eel seeding program is implemented.

8. Species specific management measures and relevant bylaws

8.1 Kākahi-Hyridella (Echyridella) menziesii – Bylaw 2,3,4,5

Te Arawa Lakes Trust proposes the following bylaws to be applied to the taking of kākahi found in Te Arawa lakes.

8.1.1 Outcome:

To maintain the sustainability of the customary kākahi fishery in the Te Arawa fisheries area.

8.1.2 Size and limits;

a. Minimum size be set at 30mm from the greatest length of the shell in a straight line (not over the curve of the shell).

b. Whanau take limit of 50 kākahi per person per day

c. Customary non-commercial harvest for customary purposes. Puka whakamana to be issued for customary purposes for a maximum amount of 500 kākahi.

Measure the greatest length of the shell in a straight line (not over the curve of the shell)

8.1.3 Methods to be used for taking or harvesting;

a. Kohi (hand gathering);

b. Te Kapu (Rake); and

c. Ruku (Free diving).

8.1.4 Restrictions and Closures;

a. There will be no harvesting of kākahi for commercial or recreational purposes.

8.1.5 Matters for which bylaws are required

Te Arawa Lakes Trust consider that the permitted traditional methods for harvesting kākahi are sufficient to ensure the sustainability of the customary kākahi fishery in the Te Arawa fisheries area. Anecdotal evidence suggests that the customary kākahi fishery is fished only by Te Arawa iwi.

8.2 Kōaro- galaxias brevipinnis. This fishery will be closed - Bylaw 1,2,3,4,5

Te Arawa Lakes Trust proposes that the kōaro fishery be closed until further notice. Kōaro has been a traditional staple diet of Te Arawa people. Recent research undertaken in the lakes indicated small numbers of kōaro present in only some of the lakes with predation a contributing factor. This approach to close the fishery is consistent with Te Arawa Lakes Trust Mahire Whakahaere to ensure survival of taonga (included) species within the lakes. Further it is proposed that any kōaro caught accidentally or as by catch is to be returned immediately to the lake(s).

8.2.1 Outcome

Ensure the survival of kōaro populations in the Te Arawa Lakes by prohibiting harvest.

8.2.2 Methods, quantity, size and limits

No capture of kōaro for customary non-commercial, commercial or recreational purposes is permitted and no kōaro may be taken. Any kōaro captured accidently must be returned immediately to the lake (dead or alive).

8.2.3 Matters for which by laws are required

Kōaro populations in the Te Arawa lakes have been decimated by the introduction of trout and smelt. The following proposed bylaw is aimed to protect the relic kōaro populations in the Te Arawa fisheries area.

8.3 Kōura-paranephrops planifrons – Bylaw 2,3,4,5

Te Arawa Lakes Trust proposes that the above bylaws for koura will provide for sustainable management of koura that is consistent with tikanga, kawa, and traditional practices of Te Arawa.

8.3.1 Outcome

To ensure the sustainability of the customary kōura fisheries in the Te Arawa fisheries area.

8.3.2 Size and Limits

a. A minimum size of 30mm from OCL[7];
b. Customary non-commercial harvest for customary purposes- puka whakamana to be issued maximum 1000 koura; and
c. Whanau take daily limit of 50 per person.

8.3.3 Methods to be used for taking or harvesting kōura;

a. Tau kōura - a traditional Te Arawa waka harvest method;
b. Rama kōura;
c. Paepae/Hao (dredge net)
d. Ruku kōura (free diving)
e. Rapu kōura (hand gathering)
f. Hīnaki

[7] OCL is the orbit –carapace length – from behind the eye socket to the back of the carapace.

8.3.4 Restrictions and Closures

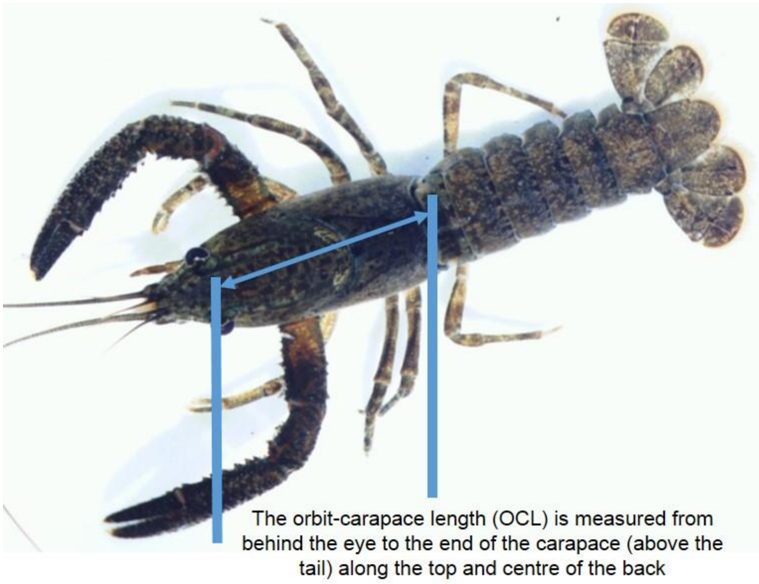
a) Females carrying eggs and hatching to be returned live to the lake;
d. Kōura that are molting are to be returned live to the lake; and
e. There will be no harvesting of kōura for commercial or recreational purposes.

8.3.5 Registration of tau kōura

The use of tau kōura will need to be registered with Te Arawa Lakes Trust, through their office administrator. The use of SCUBA equipment is prohibited.

8.3.6 Matters related to bylaw for female kōura

The bylaw measures aim to protect breeding females if they are captured. A period when the season is closed (similar to the traditional harvesting season is proposed to provide the majority of females with time to breed and release their young prior to key periods of harvest activity (Kusabs*, et al.* submitted-a). Females carrying eggs (berried kōura) must be returned immediately, dead or alive, to the lake. It is recommended that the minimum legal length (MLL) is 30mm OCL, which is greater than the SOB of 27.5mm OCL recorded by Kusabs*, et al.* (submitted-a) (see section 2.5.2). The release of large female kōura (> 40 mm OCL) is advisable as fecundity analysis indicates that egg numbers increase markedly with female kōura size.



Measurement of the orbit carapace length (OCL) of kōura (Photo S. Parkyn).

8.4 Morihana- Carassius auratus – Bylaw 2,3,4,5

Morihana were first introduced in Te Arawa Lakes around 1870 by a Mr Morrision. Morihana became a taonga species due to the decimation of kōaro and the limited ika available to sustain hapū and iwi of Te Arawa. Although, morihana are widely distributed throughout Te Arawa fisheries area they are only abundant in localised areas.

8.4.1 Outcome

Maintain the customary morihana fishery in Te Arawa fisheries area.

8.4.2 Size and limits

a. Whanau take a daily limit of 6 morihana per person

b. Puka whakamana issued for customary purposes to a maximum amount of 50 morihana.
c. Minimum size set at 125mm

8.4.3 Methods to be used of taking or harvesting

a. Kohi (hand gathered)
b. Panekoti (traditional method)
c. Aho hi ika (set line)

8.4.4 Restrictions and Closures

There will be no harvesting of morihana for commercial or recreational purposes.

8.4.5 Matters for which by laws are required

Given the status and the low level of exploitation of this species, we consider that the permitted traditional methods for harvesting morihana are sufficient to ensure the sustainability of the morihana fishery within Te Arawa fisheries area at this time.

8.5 Īnanga- Galaxias maculatus spp (adults only) – Bylaw 2,3,4,5

In Te Arawa īnanga are of various galaxids species in their adult phase are managed under the Fisheries Act by MPI . Whitebait are juvenile Īnanga that are managed by DOC. They are found more commonly in the Ohau Channel. Adult Īnanga are not in great quantities within Te Arawa Lakes. The Ohau Channel is excluded from these bylaws.

8.5.1 Outcome

Maintain the customary īnanga fishery within Te Arawa fisheries area.

8.5.2 Size and limits

a. Whanau take no limit on the quantity to be taken;
b. Puka whakamana used for customary purposes maximum amount of 10 litres.

8.5.3 Methods to be used of taking or harvesting

a. Drag/Scrim nets up to a maximum of 10m in length by 1.5m wide by 1m height.

Whitebait traps, and seine nets (known locally as drag or scrim nets) are the only methods approved for the customary harvest of īnanga. Seine nets are up to a maximum size of 10 m in length by 1.5 m in width by 1m in height are considered appropriate as they are consistent with the methods for white baiting set by DOC.

8.5.4 Restrictions and Closures

a. There will be no harvesting of īnanga for commercial or recreational purposes.

8.5.5 Matters for which by laws are required

The predominant customary fishery is located in the Ohau Channel between Lake Rotoiti to Rotorua. Traditionally the season to harvest adult īnanga went from about October to February and juveniles-īnanga from December to April. Anecdotal evidence suggests that īnanga may be under-utilised. We consider that the fishing season and the permitted traditional methods currently utilised to harvest īnanga are sufficient to ensure the sustainability of the customary īnanga fishery within Te Arawa fisheries area at this time.

8.6 Tuna- anguilla dieffenbachia (Tuna long fin TLF) and anguilla australis (Tuna Short fin TSF) within Te Arawa Lakes Settlement Area – Bylaw 2,3,4,5

Tuna are regarded as a tino taonga of Te Arawa. Historically, tuna have not been plentiful within Te Arawa Lakes though they are found above falls and in rivers and streams within Te Arawa rohe. Te Arawa Lakes Trust proposes these bylaws to address sustainable management of our tuna fishery. This is consistent with the mana whenua and mana moana of Te Arawa tikanga and kawa.

8.6.1 Outcome

Ensure that tuna (both longfin and shortfin) are not over-harvested within Te Arawa fisheries area.

8.6.2 Size and limits

a. A minimum size set to take or harvest TLF be set at 500mm
b. A minimum size set to take or harvest TSF be set at 380mm
c. Customary non-commercial harvest for customary purposes. Puka whakamana to be issued for customary purposes for a maximum amount of 2 tuna per vehicle or waka.
d. Whanau take set at a limit of 2 tuna per vehicle or waka per day

8.6.3 Methods to be used for taking or harvesting;

a. Hïnaki;
b. Rama;
c. Matarau (Spear and Gaff);
d. Aho hi ika (set line); and
e. Ruku (Free diving)

8.6.4 Restrictions and Closures

There will be no harvesting of tuna for commercial or recreational purposes.

8.6.5 Matters for bylaws for tuna

Tuna are rarely harvested because they are present in such low numbers. Given the low numbers it is important that rigid management controls be implemented to ensure the sustainability of the customary tuna fishery in Te Arawa lakes.

Te Arawa Lakes Trust submits these bylaws for consideration to the Minister for Primary Industries. In considering these bylaws, we note to the Minister that consultation was undertaken in the following years of 2011, 2013, 2015 and early 2016 with hapu and iwi of Te Arawa who endorsed the above proposed bylaws.

9 Summary Table of Bylaws

Species	Seasons and restricted areas	Approved fishing methods	Minimum size	Daily limit for personal use	Max limit for customary event
Kākahi- endangered species	Limits	Kohi (gather by hand) Te Kapu (rake), Ruku (free diving)	30mm from the greatest length of the shell in a straight line (not over the curve of the shell)	50 per person	500
Kōaro- collapsed fishery in the lakes	Prohibit any take indefinitely	Prohibit any take indefinitely	Prohibit any take indefinitely	Prohibit any take indefinitely	Prohibit any take indefinitely
Kōura	(1) Tau kōura restricted between 1 December to 31 March. (2) Berried females must be returned to the water alive immediately. (3) Females with hatchlings to be returned to the water immediately alive.	Tau kōura, rama kōura, paepae/hao (dredge net), ruku (free diving), rapu kōura (gather by hand), hi kōura (line fishing), and hinaki	30 mm (OCL) minimum	50	1000
Morihana	Limits	Kohi (hand gathering), aho hi ika (set line), panekoti (traditional method)	125mm minimum	6 per person	50
Īnanga- (adults only)	No restrictions	Whitebait drag / scrim nets (< 10 m in length, by 1.5m wide, by 1m high)	No restriction	No restriction	10 litres
Tuna- TLF tuna long fin; TSF tuna short fin	Limits	Hinaki, ruku (free diving) matarau (spear and gaff), aho hi ika (set line)	TLF 500mm TSF 380mm	2 per vehicle or waka	2 Per vehicle or waka

10 APPENDIX 1: RESEARCH ON TAONGĀ SPECIES[8]

10.1 Te Arawa Customary Fisheries

Most native New Zealand fish species are diadromous moving between freshwater and marine environments. This movement is often, but not always, obligatory and is required for the completion of their lifecycle. Native fish diversity, distribution and abundance in any freshwater environment, is therefore dependent on the ability of each species to negotiate obstacles to upstream migration. The Te Arawa lakes are essentially 'landlocked' with few surface outflows. The two lakes with surface outflows to the sea, lakes Rotoiti and Tarawera, both have significant natural barriers (waterfalls) which impede upstream fish migration. Therefore, fish diversity in the Te Arawa lakes is relatively low with five native and five introduced fish species (Table 1).

Native fish species include kōaro (*Galaxias brevipinnis*), tuna (both shortfin (*Anguilla australis*) and longfin eel (*A. dieffenbachii*) īnanga and toitoi or common bully (*Gobiomorphus cotidianus*). The freshwater crayfish more commonly known as kōura (*Paranephrops planifrons*) and the freshwater mussel, known locally as kākahi (*Echyridella menziesi*) are also important customary species for Te Arawa. Introduced fish species in the lakes include rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), brook char (*Salvelinus fontinalis*), morihana (*Carassius auratus*) and gambusia (*Gambusia affinis*) (Table 1).

Sections 3.2 and 3.3 draw upon the knowledge collated during the MBIE-funded Sustainable Management Framework for Te Arawa Lakes Customary Fishing programme (C01X0512) that was active between 2006 and 2011 (Martin et al. 2007; Parkyn and Kusabs 2007; Phiilips et al. 2007; Rowe and Kusabs 2007a and b).

Table 1: The common, scientific and Te Arawa names for freshwater fisheries in the Te Arawa lakes.

Fishery	Te Arawa Name	Common Name	Scientific Name
NATIVE FISH	Tuna	Longfin eel	*Anguilla dieffenbachii*
	Tuna	Shortfin eel	*Anguilla australis*
	Toitoi	Common bully	*Gobiomorphus cotidianus*
	Īnanga	Īnanga	*galaxias maculatus spp*
	Kōaro	Kōaro	*Galaxias brevipinnis*
INTRODUCED FISH	Taraute	Rainbow trout	*Oncorhynchus mykiss*
	Taraute	Brown trout	*Salmo trutta*
		Brook char	*Salvelinus fontinalis*
		Gambusia	*Gambusia affinis*
	Morihana	Goldfish	*Carassius auratus*
NATIVE CRUSTACEA	Kōura	Freshwater crayfish	*Paranephrops planifrons*
NATIVE MOLLUSC	Kākahi	Freshwater mussel	*Echyridella menziesi*

[8] Source 'Mahire Whakahaere: Ngā Roto O Te Arawa Mahire Whakahaere Mo Ngā Taonga Ika. Te Arawa Lakes Fisheries Plan July 2014'.

10.2 Kākahi (Echyridella menziesi)

10.2.1 Customary Fishery

The kākahi was once a valuable food source for Te Arawa (Hiroa 1921) (Figure 4). Despite it being considered the least appetising of the fisheries resources in the Te Arawa lakes it was the most important in story, song and proverb. Kākahi were collected from all the lakes but were most plentiful and easily harvested in the shallower lakes such as Rotorua, Rotoehu and Rotokākahi. Kākahi were collected throughout the year, but were best in winter. Kākahi were eaten raw, lightly boiled or dried in the sun for use in stews. They were also used in the feeding of motherless infants and as a food for the sick (a rongoā or medicine) (Hiroa 1921).

Figure 1: The kākahi or freshwater mussel (E. menziesi) (Photos: Ian Kusabs and NIWA).

10.2.2 Biology

The hyriid mussel (previously known as *Hyridella menziesii*) is one of four, possibly five species (including two subspecies) of freshwater mussels native to New Zealand (Fenwick and Marshall 2006). Of these *E. menziesii* is thought to be the most widely distributed and abundant species, found throughout New Zealand in rivers and lakes (Forsyth 1978; Grimmond 1968; Roper and Hickey 1994). Kākahi are typically found at depths of 3 m to 5 m in areas of low slope and sandy-muddy substrates, but not in very soft substrates where they sink below the surface. In New Zealand, kākahi can reach sizes over 100 mm in length, with maximum ages generally ranging from 13 to 33 years (Walker et al. 2001), although Grimmond (1968) reported kākahi ages over 50+ years in Lake Waipori (South Island). The primary food source for kākahi is material suspended in the water, and dense aggregations may modify algal composition and microbial activity.

Like other freshwater mussels the kākahi has a complex and unique lifecycle that includes a larval stage called a glochidia released from the female mussel to parasitize on fish (e.g., Walker et al. 2001). In New Zealand glochidia have been found on longfin and shortfin eels, giant bullies (*Gobiomorphus gobioides*) and kōaro (Hine 1978; Percival 1931). There have been several New Zealand-based studies of the ecology (Butterworth 2008; James 1985 and 1987; Roper and Hickey 1994), reproduction (Clearwater et al. submitted), growth and energetics (Grimmond 1968; Nobes 1980), contaminant accumulation (Burggraaf et al. 1996; Hickey et al. 1997; Hickey et al. 1995) and potential use as biomonitors (Ellis 1997; Ogilvie and Mitchell 1995; White 2000).

Butterworth (2008) found that the highest densities of kākahi in Lake Rotokākahi consistently occurred at intermediate depths (5 and 10 m) compared with shallower (1 m) and deeper (15 m) sites encompassed by each transect. Dissolved oxygen, temperature and algal fluorescence were most important by correlation with *E. menziesii* density and biomass in the lake. These results have important implications for other deep Te Arawa lakes and in New Zealand where eutrophication has resulted in a trend of declining dissolved oxygen in deeper waters when these lakes undergo seasonal thermal stratification.

10.2.3 Threats

Globally, freshwater mussels are in serious decline as a result primarily of habitat modification and eutrophication (e.g., Williams et al. 1993; Bryne 1998). Part of this decline may also relate to their early life history as they have a brief, parasitic larval stage known as a glochidium, which attaches to a fish host and subsequently is dispersed when it falls off the host, to grow into a more sedentary adult form (Atkins 1979; Walker et al. 2001). Glochidia appear to be somewhat selective as to which fish host they attach to and there is anecdotal evidence that declining availability of native fish species hosts such as kōaro, giant bully (*Gobiomorphus gobioides*) and the common bully can affect recruitment into the adult stage (McDowall 2002).

While kākahi are generally present across the fourteen Te Arawa lakes (Phillips et al. 2007) (Table 2) they are considered a threatened species in New Zealand (Collier and Hogg 2010). Recognition of the potential threats to kākahi populations is reflected in the conservation classification status as of being in “gradual decline” (Hitchmough 2007). In New Zealand this decline has been attributed to the loss of habitat associated with river regulation, eutrophication, and other types of pollution, and possibly through loss of the host fish on which completion of the life cycle depends.

Table 2: Kākahi presence in the Te Arawa lakes (LakeSPI = Lake Submerged Plant Indicator).

Te Arawa Lake	Kākahi Recorded	Information Source
Ōkareka	No	LakeSPI surveys 1981-2004; Happy (2006)
Ōkaro	No	LakeSPI surveys 1981-2004
Ōkataina	No	LakeSPI surveys 1981-2004
Rerewhakaaitu	Yes	LakeSPI surveys 1981-2004
Rotoehu	Yes	LakeSPI surveys 1981-2004
Rotoiti	Yes	LakeSPI surveys 1981-2004; Happy (2006)
Rotokākahi	Yes	LakeSPI surveys 1981-2004; Butterworth (2008)
Rotomā	Yes	LakeSPI surveys 1981-2004; Happy (2006)
Rotomāhana	No	LakeSPI surveys 1981-2004
Rotorua	Yes	LakeSPI surveys 1981-2004; Happy (2006)
Tarawera	Yes	LakeSPI surveys 1981-2004; Happy (2006)
Tikitapu[9]	No	LakeSPI surveys 1981-2004; Happy (2006)
Ngāhewa	Yes	Pers. Obs. Ian Kusabs (2006)
Ngāpouri	Yes	LakeSPI surveys 1981-2004
Tutaeīnanga	Yes	LakeSPI surveys 1981-2004

[9] No mussels are present in Lake Tikitapu, where calcium concentrations are as low as 0.7 mg l^{-1} (Forsyth 1978). A minimum calcium requirement of at least 1 mg l^{-1} is suggested by their presence in Lake Rotokākahi, which has a calcium level of 1.9 mg l^{-1} and supports *H. menziesi* and other molluscs (Forsyth 1978; Timperley 1987). Environmental calcium has also been implicated in reducing bioavailability and metal toxicity in freshwater mussels (Jeffree et al. 1993) (Phillips et al. 2007).

While kākahi are still consumed today they are not as popular or as important as they were in the past (Tipa et al. 2010). This may be mainly due to the taste of the kākahi rather than a decline in harvestable quantities. However, their propensity to accumulate pollutants may prejudice the health of consumers (pers comm., Ngāti Pikiao hui 2006; Walker et al. 2001; Tipa et al. 2010) and this may be one of the reasons why kākahi are no longer exploited on a large scale by Te Arawa iwi and hapū.

10.3 Kōaro (Galaxias brevipinnis)

10.3.1 Customary Fishery

Land-locked kōaro were once the dominant fish species in most of the large, inland lakes of the central North Island and up until about 1900, kōaro supported important Māori fisheries (Figure 5). In pre-European times, the main fish harvested by iwi and hapū in the Te Arawa lakes included the juvenile and adult stages of the kōaro termed 'īnanga' and 'kōkopu' respectively. These customary fisheries were widespread in many of the Te Arawa lakes up to the mid-1890s, and fishing grounds were clearly delineated and managed. Hiroa (1921) provides an account of the fisheries for kōaro, primarily in Lake Rotorua, and fishing grounds were documented for kōaro in Rotorua, Rotoiti, Rotoehu and Rotomā (Stafford 1994 and 1996). Some years after the introduction of trout to Lake Rotorua, Gilbert Mair, in a letter to his friend Arthur Iles (dated 14th March 1922), described the fishery situation as follows:

'Re native trout or kōkopu. These used to be caught by baiting small circular nets with crushed "kōura" in deep water in Rotoiti in very large numbers. They were very fat and delicious eating. A rare species was taken on certain nights coming up out of the Awahou and Hamurana springs. It is entirely a lake fish in these parts, but elsewhere are found in small streams – I mean the kōkopu, not the one found at Hamurana. In Taupō, the kōkopu used to abound in large quantities and grow to a foot or more. They were affected by a thin red worm which coiled up under the skin and eventually caused its death, or at least caused them to rise to the surface when the wind eventually drifted them onshore. After two or three days strong westerly winds they used to pile up on the east coast of Taupō in cart loads and were eagerly collected for food by the natives....The only fish in our lake are the kōkopu, īnanga or whitebait, toitoi and the rare fish which used to come out of the Waititi, Awahou and Hamurana Springs called "kōaro".'

'Re Shags. There have always been a fair number in all these lakes since I knew them in 1865.....I believe that the introduction of trout has had the effect of increasing the shags at least fourfold. Formerly it was a great rarity to find a shag away from the lake, but now they are to be seen in the very small streams – in fact wherever trout are found. I think that the largely increased number of shags has had an appreciable effect on the diminished kōura supply.'

Mair (1923) later described the capture of adult 'kōaro' coming out of the Hamurana Stream in Lake Rotorua in the 1860s in more detail:

'a long funnel-shaped net with a pocket was stretched across the river ....the net was lowered into position and pegged to the bottom with forked sticks at about 8 pm; then a 50 ft canoe was moored to a stake at the lower end. Two hours then elapsed, when the pocket was lifted, the end untied and several hundredweight of the fat little fish were emptied into the canoe. This process was repeated several times during the night till quite a ton of weight had been obtained....Of course the introduction of trout was the death-knell of the kōaro and I very much fear they will be destroyed utterly in Rotoaira Lake in like manner.'

This method of capture is now known as 'fyke netting', and was also used to catch kōaro in Lake Rotoaira when they exited and entered the lake from subterranean springs at night from November to January (Phillipps 1924).

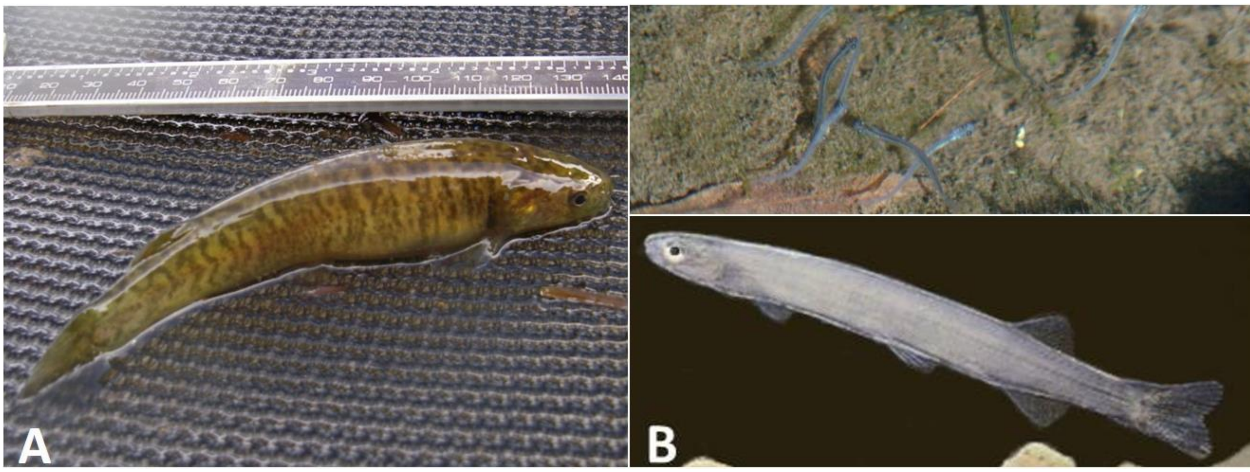


Figure 2: Kōaro (Galaxias brevipinnis). Left (A) Adult kōaro captured from Lake Ōkāreka showing typical body-form and camouflage colouration pattern (Photo: Ian Kusabs); Right (B) Juvenile kōaro (Photos: B McDowall).

Large seine nets were also used to catch kōaro along the shores of the lakes. These nets would have needed relatively fine mesh (less than 5 mm mesh width) to catch the juvenile kōaro. The 'pouraka' trap was used to capture the larger kōkopu present close to the lake bottom in deeper (20 to 80 m) waters. Another method of harvest recorded in Lakes Taupō and Rotoaira was to collect the kōaro when they were washed ashore onto beaches by strong onshore winds and wave action. The tau method was also used to catch large kōaro in some lakes, particularly in Lake Taupō (Fletcher 1919). Adult kōaro are still caught in tau kōura set in the Te Arawa lakes (pers. comm., Ian Kusabs).

10.3.2 Biology

The kōaro is elongate, slender and covered in a variable pattern of golden blotches and bands. This species is long-lived, with a koaro of 288 mm (in length) estimated to be greater than 15years of age (McDowall 2000).

Kōaro also have the ability to penetrate well inland in many river systems, and have a more widespread distribution than the other whitebait species. Although kōaro comprise part of the whitebait catch, they also form land-locked populations in lakes and have adapted their lifecycle for spawning to occur in lake tributaries. Kōaro typically spawn in autumn/winter when thousands of eggs (about 2 mm) are laid amongst marginal gravel and stream litter during high flows. The eggs hatch after 3 to 4 weeks when the flow re-inundates the eggs.

10.3.3 Threats

Kōaro populations in the Te Arawa fisheries area were decimated by the introduction of rainbow trout and brown trout in the late 1800's to the point where the customary fishery collapsed (Mair 1923; Phillipps 1924) The introduction of smelt to Lake Rotorua in the 1920's, and to the other Te Arawa Lakes in the 1930's, caused a further decline in kōaro. Competition between juvenile smelt and kōaro for food and space, coupled with predation of kōaro larvae by large smelt, is likely to have resulted in the decline of the kōaro population to the point where they are now rare in these lakes. In addition, forest clearance has led to the disappearance of kōaro from many streams in the lakes' catchments. Today, the kōaro is regarded as a former taonga species with high heritage values. Despite this reduction, the current status of kōaro is still largely unknown and there are very few management initiatives currently in place to secure relict populations or to restore lost populations in streams, even though this is technically feasible.

Relict populations of kōaro exist in lakes Ōkataina, Rotoiti, Tarawera, Ōkāreka and Rotorua (tributaries) however, they are probably extinct in ten of the Te Arawa Lakes (i.e., in lakes Rotoehu, Rotomā, Rotokawau, Rotokākahi, Rotomāhana, Rerewhakaaitu, Ōkaro, Ngāhewa, Ngāpouri and Tutaeīnanga) (Rowe and Kusabs 2007). This species is only secure in Lake Ōkataina where it is still common in all six inlet streams. It is apparent that management will be required to prevent the known relict stream populations from declining further and to restore kōaro in streams where they are now absent, but where removal of trout and/or the creation of riparian buffers could help restore them.

Restoration of kōaro populations in the Te Arawa lakes has been proposed by Young and Smale (2003). However, this would necessitate the eradication of trout and smelt which is logistically impossible in medium and large sized lakes. A more realistic goal would be to restore kōaro in some of the tributary streams of the large lakes and to restore lake-dwelling stocks to small lakes, especially those that are of limited value for trout fishing and where trout and smelt removal would be feasible. Such lakes could include Rotokawau and Ngāhewa. Rotokawau formerly contained large numbers of kōaro, its water quality is high, no trout are present, and removal of smelt is the main management action required. This could theoretically be accomplished using a piscicide. However, the depth of this lake (80 m) provides a technical challenge. The piscicide would not be easily mixed to all depths and some smelt may remain in deep water and so evade its effects. However, smelt egg survival might be drastically reduced by shoreline application of a suitable piscicide, and this option may be more viable. Lakes Ōkaro, Ngāpouri, and Tikitapu are also potential sites for kōaro restoration, but the trout fisheries here have some value and the poor water quality in the former two lakes, and a lack of adequate kōaro spawning grounds (i.e., damp forested streams) in the latter, may prove to be insurmountable barriers.

10.4 Kōura (Paranephrops planifrons)

10.4.1 Customary Fishery

Kōura (Figure 6) are a valued mahinga kai species and considered a delicacy by Te Arawa. In the past they were a staple food item, and prized for their use as a bartering item with Māori from outlying districts (Kusabs and Quinn 2009). Although, found in many other freshwater streams and waterways, the Te Arawa and Taupō lakes were considered the most productive kōura fisheries in New Zealand (Best 1929; Hiroa 1921; Mair 1918). An example of this productivity was at the opening of Tamatekapua at Ohinemutu in 1873, where a reputed 500 rohe (where a rohe was roughly the equivalent of a modern sack) of dried kōura and īnanga were consumed (Hiroa 1921).

Figure 3: Kōura (Paranephrops planifrons). (Left) Adult kōura captured from Lake Ōkāreka (Photo: Ian Kusabs); (Right) Female kōura with eggs (Photo: Steph Parkyn).

A number of methods were, and are still used to capture kōura in the Te Arawa lakes. These are: the tau kōura, the paepae or hao (a dredge net), collecting kōura by hand and rama kōura (night-time spotlighting using small dip nets) and hi kōura. Tau kōura was the favourite traditional fishing method for harvesting kōura in Te Arawa lakes (Hiroa 1921). This method involves the placement of bracken fern bundles (known as whakaweku) on the lake bed for kōura to take refuge in and then retrieving the bundles into a canoe to harvest the kōura. The figure below shows a traditional tau kōura, comprising the surface line (tāuhu) attached at one end, to a surface reaching pole (tumu) and a float (pōito) at the other end held in place by an anchor (punga), from which drop lines (pekapeka) that reached to the bottom with fern bundles (whakaweku) attached. To harvest the kōura the fern bundles were lifted onto a net of woven flax or kōrapa, which prevented the tau kōura from escaping as they were lifted out of the water. Tumu were made out of rewarewa and ponga ferns (*Cyathea dealbata*). Not only did they mark the fishing ground but they were also a mark of ownership and helped to delineate the boundaries of the various hapū and whānau (Hiroa 1921).

Until recently, there was a lack of quantitative information on kōura abundance and ecology which made it difficult for Te Arawa and government agencies to manage kōura populations in the Te Arawa lakes. However, the recent adaption and use of the tau kōura, the traditional Māori harvesting method, for monitoring (Kusabs 2006; Kusabs and Butterworth 2013; Kusabs and Quinn 2009) and research purposes (Clearwater et al. 2012; Kusabs et al. in press; Wood et al. 2012) has greatly increased our understanding of kōura populations in the Te Arawa lakes. Kusabs et al. (in press) found that kōura abundance and distribution in seven Te Arawa lakes was influenced by the combined effects of lake-bed sediments, lake morphology, and hypolimnetic conditions related to trophic state. Sediment particle size was identified as the strongest driver of kōura abundance and biomass, with kōura populations increasing with increasing sediment particle size. Kōura abundance was highest in lakes Rotomā, Rotorua and Rotoiti which had a high proportion of coarse lake bed substrates and low in lakes Ōkāreka, Rotokākahi, Tarawera and Ōkaro where lake bed substrates were comprised mainly of mud.

10.4.2 Biology

Kōura or freshwater crayfish are a distinctive part of the fauna of New Zealand streams and lakes. There are two species of kōura in New Zealand, *P. planifrons* and *P. zealandicus* belonging to the family Parastacidae. *P. planifrons* is found in the North Island and in the northwest of the South Island, and is separated from *P. zealandicus* by the Southern Alps. Therefore, the species present in the Te Arawa Lakes is *P. planifrons*. Kōura have a very ancient lineage in New Zealand, perhaps dating back before the breakup of the southern continent of Gondwanaland about 82 million years ago (Cooper and Millener 1993).

Kōura are detritivores or scavengers that eat all sorts of organic matter in their habitat, from live fish to carrion and vegetable detritus. In streams and rivers, kōura seek cover during the day. Natural habitat for kōura in streams and rivers consists largely of fallen logs, undercut banks, tree roots, boulders, etc. Tuna, trout, catfish and perch are major predators of kōura when also present in the same waterways. Of these species only trout are found in significant numbers in the Te Arawa lakes. Terrestrial predators include shags, kingfishers and rats.

10.4.3 Threats

Kusabs et al. (in press) examined the biological traits of Te Arawa kōura and discussed the implications of this data in relation to the current fishing regulations and sustainable management of kōura in seven lakes and a lake outlet. They found that the study lakes varied in their capacity to support customary tau kōura fisheries. Lakes Rotorua, Rotoiti and Rotomā had high numbers of kōura of harvestable size whereas in lakes Ōkāreka, Ōkaro, Rotoehu, Rotokākahi, Tarawera and the Okere Arm, kōura abundance was too low or kōura were too small to make tau kōura harvesting worthwhile.

In New Zealand, kōura are considered a threatened species (Hitchmough 2013). Although objective information is sparse, it seems likely that kōura populations have been exposed to a series of impacts, including deforestation, wetland drainage, eutrophication (particularly in lakes) and the introduction of trout into many New Zealand waterways.

Kōura fisheries management measures that aim to protect breeding females if they are captured and limit the season to allow for the majority of females to breed are suggested by Kusabs et al (in press). As fecundity analysis shows that egg numbers increase exponentially with female kōura size, the release of large female kōura should also be considered as a management measure Kusabs et al (in press) (see Section 5.4).

Improving water quality and preventing the introduction of benthic piscine predatory fish species are also extremely important considerations to ensure the sustainability of kōura populations in the Te Arawa lakes.

10.5 Morihana (Carassius auratus)

10.5.1 Customary Fishery

In the past, morihana (Figure 7) were valued by Māori as a source of food and as a rongoā. Whānau contributing a research project investigating the past and present “wild” kai consumption patterns of members from within the Te Arawa rohe identified that morihana were/are collected from the Ohau Channel and Lakes Rotorua, Rotoiti, Rotomā, Tarawera, Rotokākahi and Rotoehu (Tipa et al. 2010).

Figure 4: Morihana or goldfish (Carassius auratus) captured from the Ohau Channel. (Photo: B. Hicks).

10.5.2 Biology

Morihana is the common, aquarium goldfish, sometimes known as carp. The name morihana was derived from the name of Sub-Inspector H. Morrison of the Armed Constabulary who introduced them into Lake Taupō in 1872.

Populations of morihana occur throughout the Te Arawa lakes but are most commonly found near geothermal inflows. In the Te Arawa Lakes, morihana commonly grow to 250 mm in length and vary in colour from bright orange to bronze-olive. Morihana feed on aquatic macrophytes and organic detritus, and use macrophytes for cover. These omnivorous fish do not appear to have any adverse effect on native fauna and flora in any of the habitats within the catchment, although this has not been well studied.

10.5.3 Threats

It is thought that the abundance of morihana has declined owing to drainage of wetlands for development around many lakes shores (McDowall 2011).

High density populations of goldfish are thought to increase turbidity and contribute to reduced water clarity in shallow lakes and ponds (Champion et al. 2012). The Waikato Regional Council Regional Pest Management Strategy[10] currently lists goldfish as a pest fish species to "Contain, and where practicable, reduce or eradicate…" A categorisation like this in the Te Arawa lakes region may threatened customary harvest activities in the future.

10.6 Īnanga (Galaxias maculatus spp)

10.6.1 Customary Fishery

Īnanga (galaxias muculatus sp), are a taong ā species of Te Arawa and were traditionally abundant in Te Arawa lakes. At hui held during 2012 to 2014, Te Arawa people noted when the lake would be teeming with īnanga. Historically, in Habib (1991), he recall that Mika Aporo recalled the īnanga fishery wihin Lake Rotomahana. A Lietuenat Bates in 1869 observed a chief Te Mani on Lake Tarawera, '*they had come here to fish and their*

[10] http://www.waikatoregion.govt.nz/Council/Policy-and-plans/Regional-Pest-Management-Strategy/Regional-Pest-Management-Strategy-2008-2013/Part-2/6-Animals/615-Brown-bullhead-catfish-A-nebulous/

net was now drying in the sun while an immense heap of ruangas [īnanga] or whitebait shewed that they had been very successful.... and having purchased a kit of ruangas we rembarked...'

The fishery was abundant with the various species of īnanga, dwarf galaxias, kaoro and banded kōkopu, they were found throughout Te Arawa Lakes (Habib, pg IX, 1991). .

Īnanga were and are an important fishery for Te Arawa, and remain still today though relic popultions are rare. The introduction of smelt and trout saw a decline of īnanga throughout Te Arawa Lakes. Īnanga populations whilst scarce remian a taonga species for Te Arawa and where they are found, Te Arawa people continue to harvest them using whitebait nets.

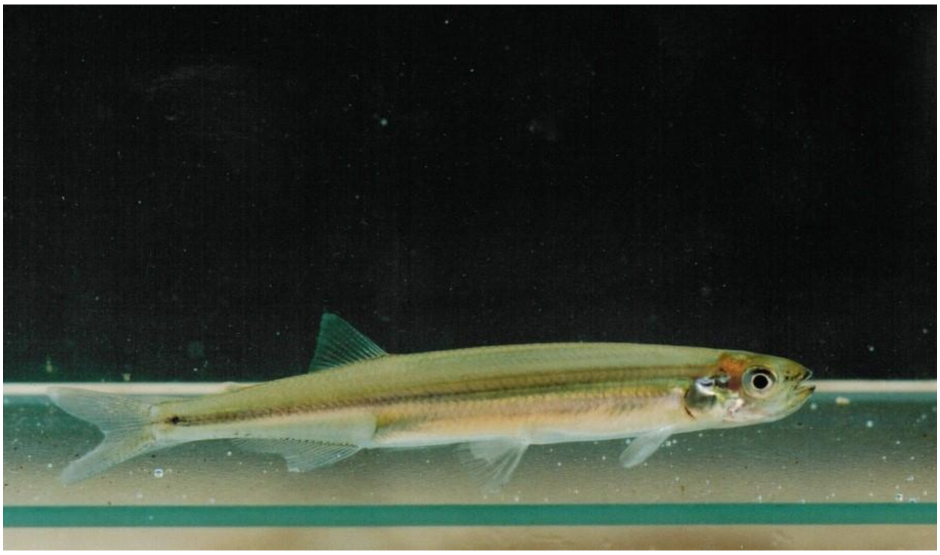


Figure 5: 'Īnanga'. (Photo: Ian Kusabs)

In the Ohau Channel between lakes Rotoiti and Rotorua, the large runs of kōaro that would once have occurred were replaced by large runs of migrant. These formed the basis for a new Te Arawa customary fishery in the channel to replace that provided by juvenile kōaro. Today, schools of Īnanga (of all size classes) are periodically harvested by members of Te hapū o Ngāti Pikiao as they move up the Ohau Channel from Lake Rotoiti to Rotorua (Kusabs 1989). Large quantities of Īnanga were harvested from this fishery prior to the installation of the control weir in the early 1990's. Up to 30 whānau would use whitebait traps (elongated cylindrical nets) to harvest Īnanga from about October to February and juvenile smelt from December to April (Rowe and Kusabs 2007). nets). Īnanga were targeted in the spring when they were congregating to spawn. This method was used up until the 1970's but was discouraged by the Department of Internal Affairs - the fishery managers at the time. This harvesting method is no longer practiced but there is some interest in reviving the method given the decline in catches from the Ohau Channel (pers. comm., Ngāti Pikiao hui 2006).

10.6.2 Biology

There are two New Zealand species in the Retropinnidae family, the common smelt and Stokells smelt. This family of fishes is also found in Australia, but the two species found in New Zealand are unique to Aotearoa. While the common smelt is usually a diadromous species it can also form land-locked lacustrine (lake) populations. Larval and juvenile smelt can be confused with īnanga and kōaro, but smelt have easily dislodged scales, an adipose fin (a small fleshy lobe on their back between the dorsal fin and the tail), a distinctly forked tail and a peculiar, strong cucumber smell.

Smelt are pelagic, which means they swim in mid-water rather than resting or hiding on the substrate. They are often seen out in the open in streams and lakes as they feed on drifting food organisms. They live in flowing and still water, and form sea-going and land-locked populations, although humans have established many of the land-locked ones (e.g., as food for trout).

Common smelt typically mature at one year (a few two years). They spawn in the lower reaches of rivers in summer and autumn laying thousands of small eggs (c. 1 mm) over sandy shoals, the larvae (about 5 mm to 6 mm long) hatch and go out to sea if from riverine populations. The adults then die after spawning. Some smelt return in spring as transparent, whitebait-like juveniles (about 45 mm to 50 mm long), but most return as adults in spring/summer, therefore spending most of their lives at sea (McDowall 2000).

10.6.3 Threats

The relative abundance of smelt varies within the Te Arawa lakes, with smelt being more abundant in the clearer lakes than in the more productive, turbid ones (Rowe 2004). Smelt recruitment has been shown to be reduced in the more productive, turbid lakes in the Rotorua district compared with the clear, less productive lakes (Rowe and Taumoepeau 2004). This decline in smelt recruitment contrasts with the increased recruitment of common bullies in such lakes.

The smelt fishery has reputedly been affected by the construction of the Ohau Channel which is used to maintain the level of Lake Rotorua. However, the decline in smelt numbers in Lake Rotoiti related to its increased trophic status (Rowe et al. 2006) may also have contributed to the decline of this fishery. The proposed diversion wall may also reduce this fishery further and monitoring is currently being undertaken to determine the pattern and extent of smelt movements in this channel.

Smelt are one of the most sensitive New Zealand freshwater fish to pollutants like high water temperature or ammonia. The presence of smelt usually indicates that the water quality is suitable for most other fish. Increasing lake productivity results in a decline in smelt abundance (Rowe and Taumoepeau 2004). Improving water quality should result in an increase in smelt abundance in the Te Arawa fisheries area.

10.7 Tuna, Shortfin and Longfin Eels (*Anguilla sp.)*

10.7.1 Customary Fishery

Prior to European settlement, tuna were the most important freshwater fish resource for Māori exploitation because they were widespread, abundant, of large size, easily caught, of high nutritional value and capable of being preserved (McDowall 2011). Strickland (1985) lists 185 Māori names for eels, signifying their high importance in Māori diet and tradition. In pre-European times, the transfer of elvers and juvenile eels above barriers was a recognised means of maintaining populations where access was restricted or not possible (Best 1929).

Although, the Te Arawa fisheries area provided a bountiful supply of fisheries resources, such as kōaro, toi toi, kōura and kākahi, the freshwater eel or tuna were, and remain, very rare. In contrast, tuna was abundant in many other waterways in the rohe, such as, the Kaituna River, where they provided a valuable food source. Soon after the discovery of the lakes, the absence of tuna was promptly recognised and liberations began. Hatupatu is credited with the first introduction of tuna into Lake Rotorua (Stafford 1986).

Of all the Te Arawa Lakes, tuna was and are, most common in Lake Tarawera. Tuna are still harvested using hīnaki (eel nets), hi-tuna (set lines), and rama tuna (spearing tuna at night using matarau or spears/gaffs) (pers comm., Ngāti Pikiao and Ngāti Tuhourangi hui, 2006), free diving, spear, gaff and bobbing. Traditionally there were also rauweri or pā tuna, where tuna would be held in a live state in large pools, and harvested when required. The fishery is comprised of low numbers of very large eels, which are female. The largest recorded in recent times was a 20 kg female longfin eel caught in Te Wairoa Bay in 1995 by John Waaka (this eel was weighed and recorded by Eastern Region Fish and Game Council staff at the Te Wairoa fish trap). The eel was aged at approximately 50 years old by Ben Chisnall (ex-NIWA scientist). Large tuna are a highly prized delicacy and are the subject of modern day legend. Many regular lake users have stories regarding large eels, from seeing eels as big as taniwha, to pet dogs disappearing. Others consider large tuna to be tūpuna (or ancestors) (pers. comm., Peter Paul).

Tuna have also been recorded in the following Te Arawa Lakes: Rotorua (Wildlife Service, Te Ure o Uenukukopako hapū hui, 2006), Ōkareka (pers. obs., I Kusabs 2001), Rotokākahi (pers. obs., I Kusabs 1994), Rotoiti (Joe Malcolm in Habib 2001), Rotoehu and Rotomā (pers. comm., Ngāti Pikiao hui 2006). The presence of tuna in these lakes is almost certainly due to deliberate or accidental liberations. For example, in the 1980's tuna was common in Lake Rotorua around Hinemoa Point, following the escape of tuna from cages belonging to two commercial eel fisherman which were situated in the Waingaehe Stream (Wildlife Service, Te Ure o Uenukukopako hapū hui 2006).

10.7.2 Biology

Three eel species are found in New Zealand; the endemic longfin (*Anguilla dieffenbachii*); the shortfin[11] (*A. australis*), which also occurs in eastern Australia; and the Australian speckled longfin[12] (*A. reinhardtii*), which has recently been confirmed as present in New Zealand, and is also found in Australia and New Caledonia. Longfins are distinguished from shortfins by the length of the dorsal fin (on the top); when viewed side on, the dorsal fin is longer that the anal fin (on the bottom), and extends well forward past the end of the anal fin (Figure 9). In shortfins, the dorsal and anal fin ends are almost the same length (Figure 9). The Australian speckled longfins resemble our longfins but have black blotches all over their body, with the exception of their belly (Figure 9).

[11] The term shortfin applies to four other Indo-Pacific species; all other species are longfin. In New Zealand, the only shortfin is *A. australis*, and longfin refers to *A. dieffenbachii.*

[12] Confirmed in 1997, from 19 eels caught in the Waikato River. The method of arrival in New Zealand is unknown but may be due to changes in oceanic currents that transport the passive larvae from the spawning grounds in the South Pacific. Although this confirmation is recent, anecdotal evidence suggests "*reinhardtii*" may have been in New Zealand for at least 25 years.

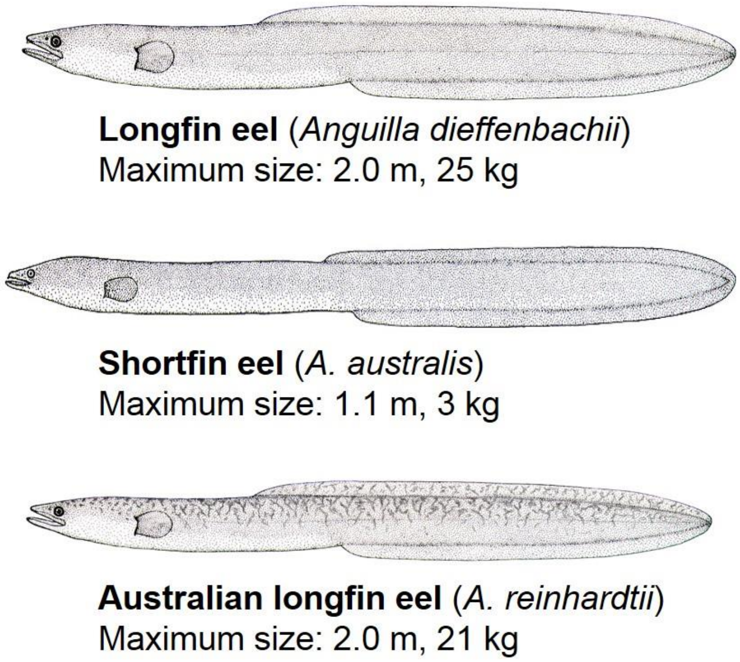


Figure 6: Tuna or freshwater eel species present in New Zealand. (Top) The longfin eel (A. dieffenbachii); (Middle) The shortfin eel (A. australis); and (Bottom) the Australian longfin eel (A. reinhardtii). (Drawings courtesy of B. McDowall).

In New Zealand the shortfin eel is widely distributed in rivers, streams, lakes, swamps and estuaries. It is usually the most common species where eel populations are very dense, and generally does not penetrate as far upstream as longfin (McDowall 1990). The longfin is found throughout New Zealand, including the Chatham Islands, from the coast to any upstream habitat it can reach.

In order to complete their lifecycle, freshwater eels must move between freshwater and the sea (known as a diadromy), spending extended periods in marine, estuarine, and freshwater habitats. The eel has a unique larval stage, known as a leptocephalus, which is only found in the sea. Breeding occurs in the marine environment, following recruitment into freshwaters (glass eels and elvers) an extended adult growth stage in freshwater (sub-adult eels), and a long migration (migrant eels or tuna heke) from their freshwater habitat. The migration to oceanic spawning grounds takes many months.

Glass eels (typically 55–70 mm long) aggregate in large numbers in estuaries, generally arriving in New Zealand waters from August to December. As the eels grow larger and move upstream, or further inland, they hide beneath overhanging banks and logs, where they move and feed during most of the year. Eels occupy a wide variety of freshwater habitats, including, coastal estuaries, lakes, wetlands, rivers, mountain streams and even alpine tarns. Larger eels (larger than 300 mm) of both species are commonly associated with cover, such as macrophyte beds, overhanging banks, in-stream debris and shade, but longfins may utilise a greater variety than shortfins (Glova et al. 1998). After reaching suitable habitat, the eels grow, often for several decades, before maturing and beginning the return trip to the sea.

The longfin is New Zealand's largest and most long-lived freshwater fish and is often the top predator in freshwater ecosystems. Eels are opportunistic feeders and eat a diverse range of food, including stream insects, terrestrial insects, snails, kōura, fish, even small birds. In floods, eels may consume large quantities of terrestrial insects such as earthworms.

New Zealand longfins are one of the largest eel species in the world (Tesch 2003) and can attain a size of almost 2,000 mm and more than 50 kg (Potts 1882; Cairns 1941). Shortfin eels do not grow as large as longfins. Eel growth rates are highly variable due to species, sex, location, water temperature, season, population density, food supply and the types of habitats (e.g., Chisnall and Hicks 1993; Domingos et al. 2006). Female eels from the same species grow larger and are older than males at maturity. For longfins, the maximum size can be approximately 2 m long and 20 kg. Females mature from 20 years to well over 40 years, and they grow 15–25 mm/year. Male longfins mature at a younger age (12–45 years). Female shortfins can grow to approximately 1 m and 3.5 kg, and usually mature at 20 years of age (Burnet 1968a and 1968b, Chisnall and Hicks 1993). High growth rates may occur where food is abundant (e.g., 41 mm/year, recorded for eel transplanted into virgin habitats by Beentjes and Jellyman (2003)), but can be very poor in highly modified habitats with high recruitment (e.g., Lake Waikare in the Waikato, Mike Holmes, eel fisher, pers. comm.)

Eels are not born a particular sex, this is determined as they get older by the environment they are living in. Large eels, particularly longfins, play an important role in determining the population structure of eels, including species composition, sex ratios and size distribution. The environment and the number of individual eels who share that same environment contribute to determining the sex of an eel, with females tending to be more common at lower eel population densities.

The precise trigger that causes eels to develop into migrants (i.e., the tuna heke/tuna whakaheke) is not well known, but high fat content that provides sufficient energy to develop gonads (reproductive organs) and cover the long distance to spawning grounds appears to be essential (Larsson et al. 1990). Once eels become migrants they stop feeding, and progressively develop the external features that clearly distinguish them from 'feeders', which include: the head becomes flatter and slender, lips become thinner, the head and back may darken, and the belly lightens to a grey or silver colour. In addition, the pectoral fins and eyes enlarge and become surrounded by a narrow ring (Figures 10 and 11) (see also Todd 1981a and 1981b). In New Zealand, sexually maturing adults migrate downstream from lakes, streams and rivers mostly in autumn. A small migration can also occur in spring, especially where eels are delayed by dams (Watene and Boubée 2005). Migration usually occurs at night and may be triggered by changes in water temperature, and increases in rainfall and flow (Best 1929, Boubée et al. 2001, Watene et al. 2003). Low barometric pressure has also been found to trigger migrations (Boubée and Williams 2006). Shortfin males tend to migrate in February and March, followed soon after by the shortfin females. Longfin males migrate during April, and longfin females during late April and May (Boubée et al. 2001, Burnett 1969b, Cairns 1941, Hobbs 1947, Todd 1981b).

Figure 7: Migrant shortfin male (top) and female (bottom). Note the enlarged eye, dark fins, silver belly, and pointed heads (Photo: J. Boubée).

The age and size of the migrating adults varies depending on the species, sex, and location. Shortfins generally migrate at a younger age than longfins, and are smaller than longfins when they migrate. Males are smaller and migrate at an earlier age than females. The size difference between males and females is strategically important. Fecundity has been estimated at between 1.5 and 3 million eggs in migrant shortfin females 500–800 mm in length while large migrant longfin females (1,400–1,600 mm length) may contain over 20 million eggs (Todd 1981a). An example what the female gonad looks like is shown in Figure 11. Males, on the other hand, do not need to be large to produce a large quantity of sperm, so they grow rapidly to a size that enables them to migrate to the spawning ground (McDowall 1990).

Larger female eels are much more fecund (i.e., contain more eggs) than smaller female eels. Larger female eels potentially make a greater reproductive contribution by producing a higher proportion of eggs for potential recruitment to New Zealand fisheries waters. In addition, female longfin eels are long-lived and take several decades to reach reproductive maturity. Until they reach maturity and migrate to sea, these eels (therefore particularly the females) are susceptible for a long period of time to fishing activities, as well as mortality caused by non-fishing activities (e.g., drainage clearance, pollution events).

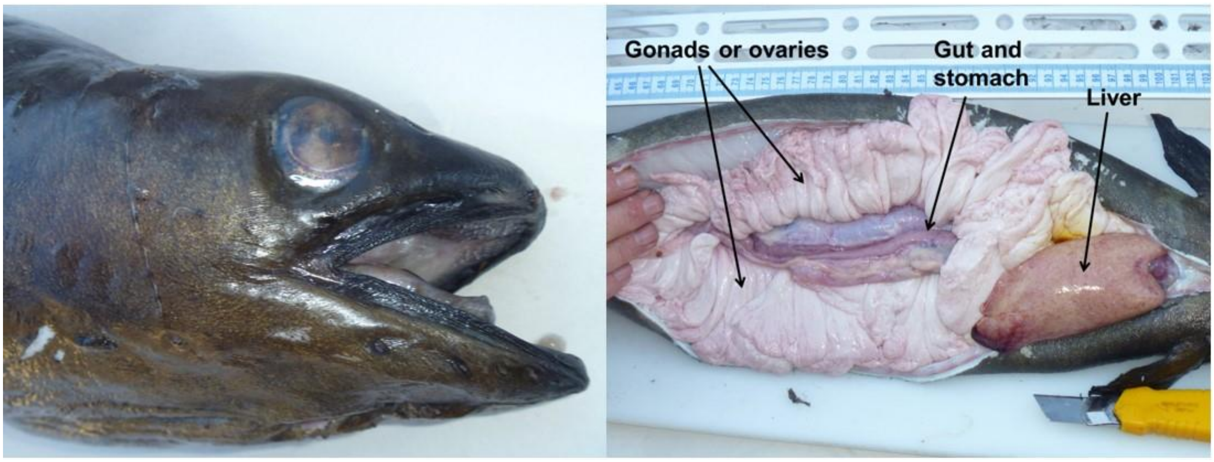


Figure 8: Migrant longfin female (7.08 kg and 1,340 mm in length) caught at the outlet of Lake Otamangakau.

The level of egg production to ensure sufficient recruitment of eels is unknown. However, there are concerns about a decline in the number of large longfin female eels in New Zealand's fishery and what impact this might have on spawning escapement. An assessment of the size and age structure of eel populations in the 1990s emphasises that the number of large (larger than 700 mm) female longfins has significantly reduced in comparison to observations made prior to, or during, the 1970s. The length frequency distributions of eels caught by commercial fishers in recent years throughout the country shows that fewer large eels are being caught. There is a low level of escapement of longfins from fished areas. It is likely that eel populations in unfished areas contribute a greater proportion of large migrant females to the spawning population. The exact proportion of eels escaping to spawn from fished and unfished areas is unknown.

10.7.3 Threats

International studies conducted in countries where glass eel commercial fisheries exist suggests that there has been a worldwide decline in recruitment of glass eels (Dekker 2002 and 2004). Factors contributing to this decline are likely to include climatic change, loss of habitat, parasite infestation, pollutants, over-fishing, and obstacles to migration (Feunteun 2002). In New Zealand, it is not known how present recruitment relates to historical runs, but since 1995 the Ministry of Primary Industries (MPI) has been using trap and transfer operations at key sites to establish trends in elver recruitment (e.g., Martin et al. 2010). There are indications that the huge elver runs that were both witnessed (e.g., Best 1929) and filmed (Hayward and Hayward 1992) prior to the 1960s are no longer seen, and that current runs are considerably less than historical runs.

In New Zealand, although longfins are still one of the most common freshwater fish, there are concerns about the scarcity of very large specimens. In New Zealand, fisheries regulations, including the Quota Management System (size limit of > 220 g eels) and a ban on commercial harvest in some rivers and lakes, have recently been put in place in anticipation of controlling harvest. Significant reductions in catch have been achieved. However, wetlands are still being drained, new flood banks, flood gates and pumping stations continue to be installed, water way channelisation and bankside vegetation removal is on-going, all with little concern for the resulting loss of eel habitat.

Natural barriers (e.g., waterfalls and rapids on the Kaituna River) are the primary reason why eels are very rare in the Te Arawa lakes. One of the greatest threats to indigenous fish populations that follow a diadromous lifecycle are barriers that prevent or delay migrations (both upstream and downstream) between freshwater and marine environments.

Longfin and shortfin eels have been heavily exploited by commercial fishing, and numbers are now much reduced. Although, longfin and shortfin eel remain widespread and common, the longfin eel is considered to be at risk and declining under the threat classification rankings for New Zealand freshwater fish (Hitchmough 2013). This ranking was based on the vulnerability of longfins to overexploitation (Jellyman and Graynoth 2005) and the fact that these very long-lived (up to 100 years) fish only breed once before dying.

11 Contemporary Practices of Te Arawa Whānau and Hapū

In 2009 Te Arawa were part of a research project investigating the past and present "wild" kai consumption patterns of members from within the Te Arawa rohe (including marine and freshwater species) (Tipa et al. 2010). The levels of bioaccumulative contaminants were also characterised in a number of commonly gathered kai species, in associated aquatic sediments, from up to 23 sites throughout the Te Arawa rohe (Phillips et al. 2011). Local average consumption rates of wild fish and invertebrate species ranged from 0.33 g/day for kākahi to 10.9 g/day for trout, whereas for watercress the calculated consumption rate was 15.8 g/day. The total average wild fish consumption rate was 12.4 g/day (Tipa et al. 2010).

The Kai Consumption Survey showed that a large variety of wild kai continues to be regularly collected, gifted, purchased and/or consumed by Te Arawa. While whānau made use of many species, the centrality of kōura and īnanga as a critical food source in the Te Arawa lakes is well known and is reflected in the initiatives to restore populations of taonga species. Although some resources were gathered seasonally, historically whānau relied on freshwater resources during the year. In addition to identifying the species gathered, the sites from which kai was sourced were identified (Figure 3). The most highly used area for the participants in this project was the coast as 52.4% said they gathered from Maketū, followed by lakes Rotoiti (17.5%) and Tarawera (12%). There was no gathering by participants from Lakes Rerewhakaaitu, Ōkāreka, and Tikitapu (Tipa et al. 2010).

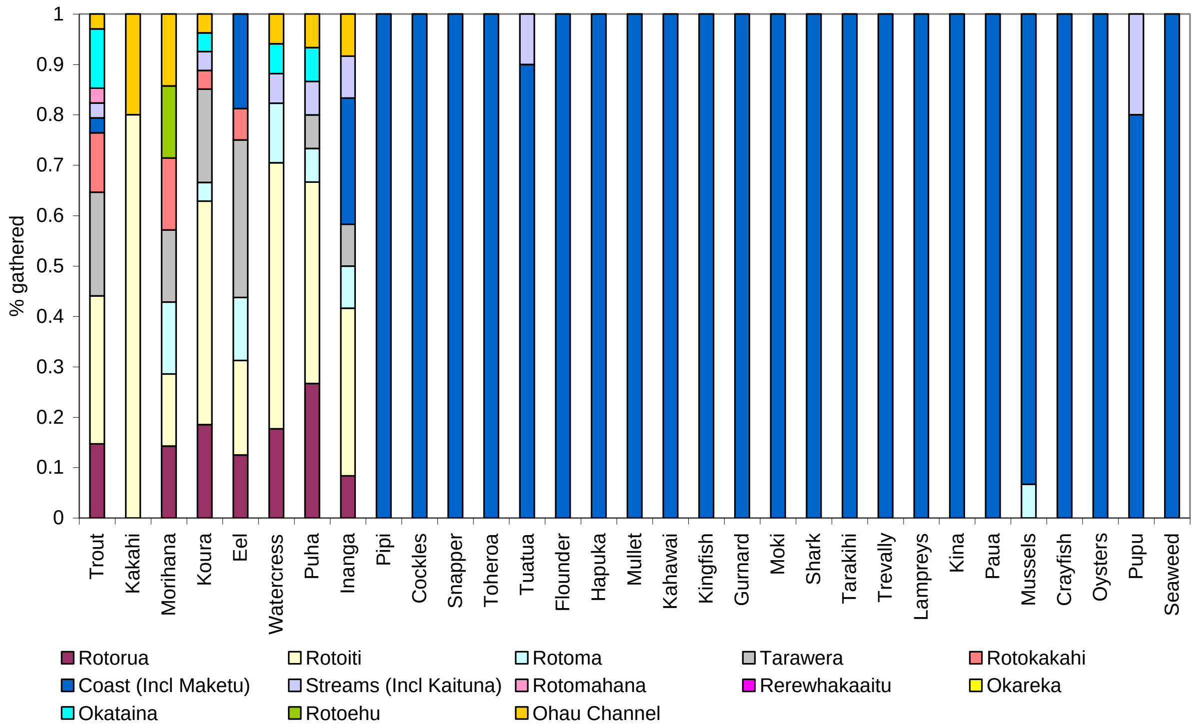


Figure 9: Relative proportions of sites within the Te Arawa rohe from where different species of kai (freshwater and marine) were gathered (from Tipa et al. 2010). In this figure 'Īnanga' refers to both common smelt (Retropinna retropinna) (in the lakes and Ohau Channel) and īnanga (Galaxias maculatus) (on the coast and in the tributaries of the Kaituna River).

In comparison to historic levels of customary fisheries harvest, the following conclusions can be drawn:

- The quantities available are substantially lower than historic levels and the levels desired by whānau who wish to engage in mahinga kai practices. The species that possibly approach adequate abundance are mussels, which respondents confirmed were available and often sourced from the supermarket or takeaway.

- For almost every species, the majority of respondents believed that the abundance of populations was declining.
- The majority of kai species are now only consumed on special occasions.
- The quantities of kai consumed have steadily decreased: from approximately 241g historically; to about 94.1g in the mid-twentieth century; to approximately 36.2g today (which is similar to the average New Zealand consumption rate).

Part of the reduction in quantities consumed can be attributed to environmental degradation. A species will show signs of dwindling for a while and then suddenly decline because its population is no longer self-sustaining. In the 1930s, a number of factors were blamed for the decline in īnanga catches including: excessive take by whitebaiters; predation by sea birds, herrings, eels, trout; draining of swamps, backwaters, and creeks; or damage to estuarine spawning grounds by stock. By the 1990s a number of native fish species had disappeared from waterways or were in decline. A combination of factors was attributed to these losses including: afforestation, sedimentation and flooding, wetland drainage, river modifications, sewage, water abstraction (irrigation), and pollution arising from adjacent land uses.

Changes to the health of the lakes and consequently the relationship of Te Arawa with the lakes have resulted in a range of health and wellbeing implications for Te Arawa whānui. All of these changes directly and indirectly impact cultural practices, principles and tikanga associated with food gathering (Tipa et al. 2010), including:

- Young people are growing up not learning the basic knowledge associated with kai species, fishing, boating and gathering.
- Whānau are “losing the taste” of kai.
- Kai generally was known to be good for health. There is a feeling that the younger generation don’t know this, or if they do, they don’t practice it.
- Water quality is a concern for parents and therefore they are reluctant to let kids explore/play in aquatic environments unattended.
- Parents feel their children have missed something not growing up in an active hapū gathering environment.
- The context within which fundamental cultural practices such as whānaungatanga are learned has been impacted.
- The result of these environmental perceptions is uncertainty as to whether or not kai is contaminated from within the urban environment.

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