

BAY OF PLENTY
REGIONAL COUNCIL
TOI MOANA

Creating fish nursery and rearing habitat on river margins

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Photo 1: Inanga pond creation on the true right hand side of the Whakatāne River; July 2020

Introduction

Conversion of coastal lowland wetlands into dry land throughout New Zealand, through drainage, infilling, and modification of waterways, has led to dramatically altered freshwater habitats for New Zealand's native fish. Ponds, channels, and streams in coastal lowland wetlands where inanga (whitebait, *Galaxias maculatus*) grow to maturity have been drained. Large areas of historical freshwater habitat no longer exist. Diadromous inanga make up the largest proportion of New Zealand's whitebait fishery and are arguably the fish species most affected by this loss of habitat but many other species of freshwater fish use the same habitat.

Photo 2: Te Huauri o Te Kawa, Kaituna River. This photograph was taken just as the tide had turned and new water is being flushed into a pond. Harakeke, exotic grasses and other herbaceous plant species hang over the pond to provide habitat.

Spawning habitat and the salt water wedge

Inanga spawn during spring high tides, amongst flooded vegetation around the upper limit of the salt water wedge. Once the tide recedes, fertilised eggs are left in moist vegetation to develop. Eggs hatch when water covers them during the next month's spring high tide. Larvae then migrate to sea for 21-23 weeks before returning to the rivers to mature. It is this return migration back to freshwater that sustains the iconic whitebait fishing season.

The upstream limit of the salt water wedge in an intertidal waterway, is determined by water flows, tide heights and flood conditions. Inanga prefer to spawn in bank edge vegetation around the top of the wedge, which means that if the wedge can be identified and the spawning site found, the actual site should probably not be interfered with. The fish will have chosen the site that suits them. However, from around there, to as far upriver as inanga can spread (to the limits of too steep/too fast but in the tidal zone) groups of ponds connected to the river can replace some of the lost rearing habitat for inanga and many other species of native fish.

Stopbanks

Stop-banks and their associated drainage schemes have been created to remove water and protect valuable land from flooding. Stopbank maintenance is often required when weak points in the stop-bank structure occur, or when a river footprint and flow patterns change. Riverbanks are often armoured with riprap rock and this also requires similar maintenance.

Nursery and rearing habitat for fish species can be re-created during maintenance, (at minimal cost because equipment is there) on the berm, the area between the between the river and the toe of the stopbank.

Borrow pits and ponds

A borrow pit is a flooded hollow near a river created when soil material has been dug out and used elsewhere; usually to form the stop-bank. Borrow pits have been used as a fisheries habitat enhancement tool. Once the pits are connected to the river, fish are able to populate and use them for rearing.

Similarly fish habitat can be created by constructing, from scratch, a series of connected ponds running parallel to waterways.

Past habitat enhancement projects

Te Huauri o Te Kawa

The original Kaituna borrow pits were excavated on the true right hand side of the lower Kaituna River, Bay of Plenty in the 1950’s. The excavated material was used to build stop-banks as part of the Kaituna River Drainage Scheme. Inanga spawning and estimates of numbers of deposited eggs have been recorded adjacent to the pits over the 1988, 1989 and 1990 spawning period (Mitchell 1990).

In 2007, Maketū Taiapure Trust excavated additional ponds to expand the borrow pits into what is now known as Te Huauri o Te Kawa (the offspring of the Kawa Swamp). This area has also been known as By de Ley Wetland. The ponds were surveyed over the following years with results demonstrating that constructed riverside ponds can create rearing habitat for juvenile and adult stages of inanga and a variety of other fish species (Ellery and Hicks 2009). A further ten small ponds with connections to each other and the river were excavated in 2011.

Ongoing observations have confirmed that the connecting channels between the ponds and the river provide inanga spawning habitat (Ellery *pers. comm* 2020).

Waiau River floodplain

In Southland, in 1999, twenty three artificial rearing ponds were excavated as a trial on the Waiau River floodplain near Te Waewae Lagoon and surveyed for fisheries habitat use over three years (Patterson and Goldsmith 2002). After rapid habitat occupation by inanga and other fish species, twelve additional ponds were excavated nearby at Holly Burn in 2003 (Smith 2004).

Pond construction

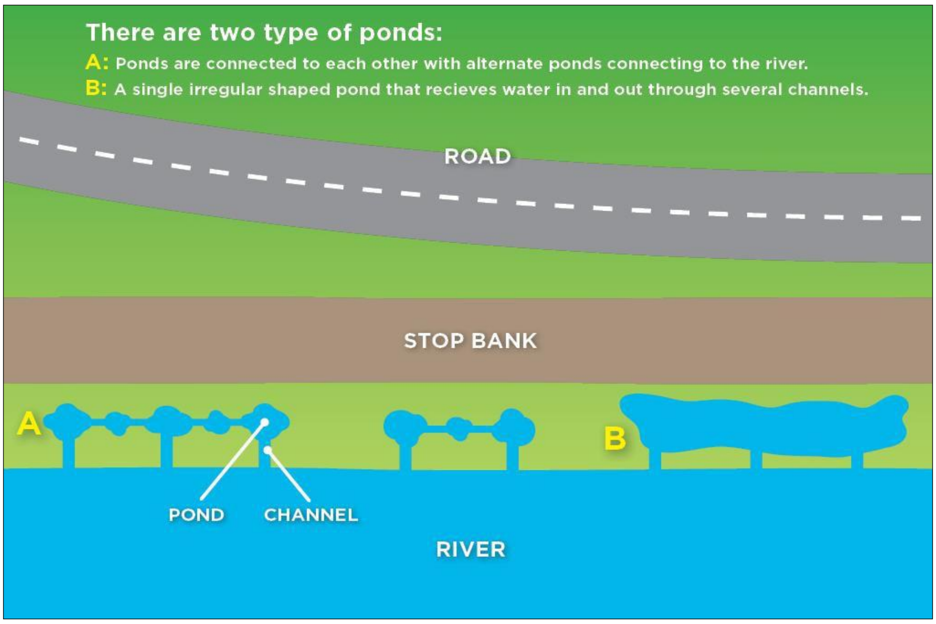
The following provides recommendations for modifying an area between the river margin and the toe of the stopbank to create nursery/rearing habitat for native fish. This methodology can be applied to any stopbank, provided there is sufficient berm width available and work in the berm area isn't going to undermine the stopbank.

Of course this method can be used where there are no stopbanks and the streambank profile is suitable and can be excavated safely; within a wet, boggy paddock adjacent to the river, for example. These ponds can be tidally fed or close to springs that can be connected through the ponds to the river.

Location

If the goal is to enhance a known spawning habitat for inanga, the ponds should be positioned within 0.5-1 km either side of the upper salt water wedge limits. Outside of this area, the primary goal for pond creation is to provide nursery and rearing habitat for inanga and other fish.

On a stopbank berm, it is important to ascertain what size and depth ponds can be excavated without causing water to seep through and undermine the stopbank. A geotech assessment will be required for each area of stopbank berm that is to be modified. An assessment will usually provide a recommended minimum distance to stay away from the toe of the stopbank. Ponds can then be excavated in the available space between there and the riverbank.



Connecting channels

Any configuration of ponds can be created as long as they are linked to each other and the river; the above figure gives a few examples.

Ponds created within the tidal zone of the river will be flushed twice daily with water exchanging to and from the ponds. The key to the success of created fish habitat in this zone, is the interconnectedness of ponds to the river during flows of the top half of the tide and retention of water in the ponds at the lower half. Channels must sit at around the half tide mark so that as the tide rises, the channels fill and water re-enters the ponds.

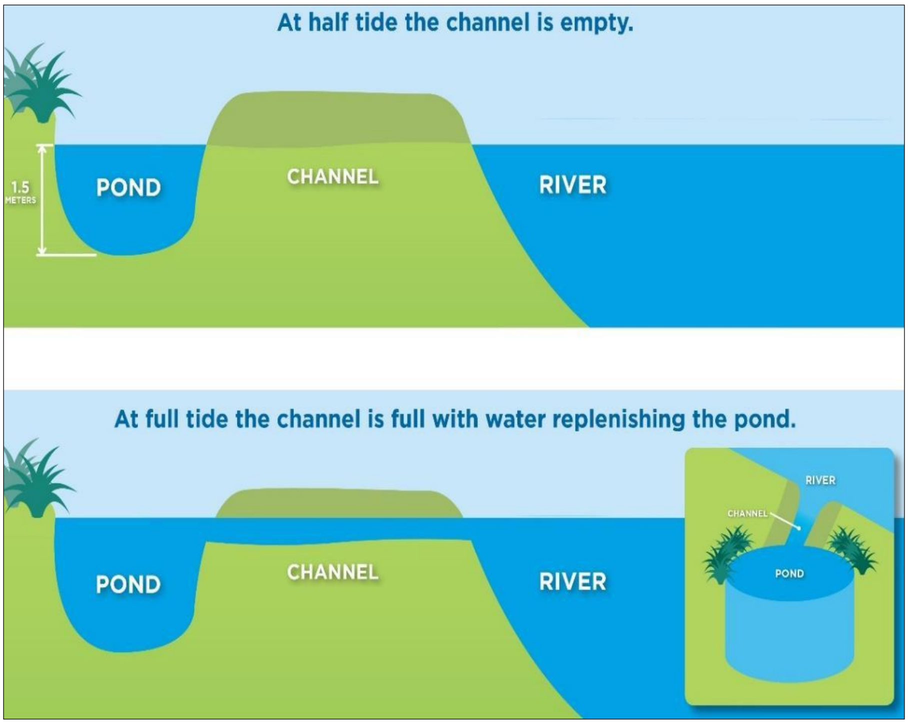
The incoming water source channels need to be 1-2 m wide at the base, with that base at around the half tide level. The sides should angle back at about 45-55 degrees. The floor of these channels and to about half way up the sides should be armoured with rock to prevent erosion and to create another variation in the fish habitat. The inlet at the river may also need to be armoured to prevent scouring. Plants can be added to the sides to create a vegetative cover over the water.

Photo 3: Water flows over the rocks between the river on the right of the photograph and the constructed wetland on the left; plants will be added to create shade. (Reids Canal bifurcation wetland, Thornton).

Design

Pond dimensions will be dictated by the width of available berm. They can be any shape and as small as 5 x 5 m and up to around a 10 m radius. They must be at least 1.0-1.5 m below the depth of the inlet channel, so that they retain sufficient water to accommodate fish during low tide (see the figure and photo below for example). Ponds will stay at the half-tide level while the tide in the river drops, to be replenished as the tide flows in again.

This design ensures a twice-daily flush of river water into the ponds with water that is cooler, oxygenated, and full of food. Flushing also allows fish passage in and out of the ponds.



If the ponds are excavated with near vertical walls rather than angled sides, the surrounding vegetation is able to overhang as it matures, providing cover for native fish. The banks can also be excavated to a 1:4 ratio and planted to create natural succession of bank vegetation but manual maintenance of the ponds as discussed below is a little more difficult.

Photo 4: Newly created pond connected to the Kaituna River (Te Huauri o Te Kawa Wetland.)

Planting

Most of the *Carex* species, *Bolboschoenus fluviatilis* or any other wetland sedge-type species planted on the pond margins after construction are ideal, as they provide shade and overhanging cover. Planting large shrubs, trees, or harakeke (*Phormium tenax*) is not generally recommended as these may interfere with flood flows, stopbank infrastructure or future maintenance work. However, incorporating woody, shade bearing species into pond design may be entirely acceptable where this is not an issue.

The margins of the ponds can just be left in over-hanging exotic grass species, as this provides similar nursery habitat. However, reed sweet grass (*Glyceria maxima*), an exotic grass species common on the margins of Bay of Plenty rivers, is widely acknowledged as a plant capable of disrupting inanga spawning and can completely clog ponds with invasive growth.

Photo 5: Planting around the created ponds (Te Huauri o Te Kawa Wetland, Kaituna)

Ongoing care and maintenance

It is possible that the riverbank itself may require minor maintenance over time. Ponds should be positioned in such a way that vehicles used for maintenance can be driven between the riverbank and the ponds.

Over time, the ponds are likely to become infested with invasive aquatic weeds such as hornwort (*Ceratophyllum demersum)*, *Lagarosiphom major*, *Egeria densa*, willow weed (*Persicaria* spp.) and mercer grass (*Paspalum distichum*). Consequently, ‘weeding’ will be occasionally required to remove these plants as they will reduce the amount of open water available for fish. This can be done simply by tying a rope to a rake, throwing it out, and pulling the weeds out. This weeding technique should be kept in mind during pond construction to ensure that ponds are not built too wide.

Weed species on the margins such as blackberry (*Rubus fruticosus*), pampas (*Cortaderia spp*) and reed sweet grass will also require ongoing control.

Any enhancement or restoration planting on the margins will also require ongoing following up maintenance and releasing to remove weed species.

A local landowner, environmental care group, marae or school, should be set up to provide the ongoing maintenance required to look after the pond site.

Summary

- Identify the area of upper salt water wedge along the river edge and if possible find a current spawning site.
- Undertake geotech assessment to define limits in pond construction.
- Design ponds so that vehicles can access riverbanks for maintenance.
- Excavate the ponds:
  - Create water source channels approximately 1-2 m wide with a rock-armoured base. Channel base should be at a mean half tide level.
  - Create ponds according to available space.
  - Ponds should be at least 1.0 m-1.5 m below the depth of the entry channels so that they will retain sufficient depth of water between the tides.
  - Ensure ponds, channels, and river are all connected when the tide is coming in.
  - Plant margins and surrounding margins with indigenous species including *Carex sp* and *Bolboschoenus fluviatilis* that will cast shade over the pond, improve water quality and reduce weeds.

Continue enhancement planting over the area beyond the pond margins if the site is suitable.

References

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