Restoration of Inanga Rearing Habitat in the Kaituna River Margin

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Abstract.

During 2007-2008, four ponds were excavated at the Borrow Pits on the Kaituna River as a project to enhance the amount of available off-river habitat for native fish. This project, instigated by the Maketu Taiapure Trust and utilizing a range of environmental funding sources, is focused on improving the whitebait run and therefore on improving the habitat for growing and maturing inanga. The Borrow Pits ponds are not only a reported spawning site but they also contain a permanent, year-round population of inanga.

This report describes the development of the site and tracks the utilization of the new ponds by native fish, both freshwater and marine. Since the new ponds were excavated, trapping for inanga has been carried out to determine the presence, in the new ponds, old ponds and river, of inanga and associated species.

Through the trapping process, a short bait comparison trial and a comparison of catch rate between Gee Minnow and a Collapsible trap has been included in the data.

This initial assessment establishes a small beginning of a database on the diversity of fish species, both freshwater and marine, that utilize connected, off-river, pond habitat. The traps used in this survey have limitations as to species caught. The results should not be considered any sort of population assessment, they are merely a confirmation of presence. The traps collected inanga, smelt, bullies and eels. Observed but not trapped, species include; kahawai, yellow eyed mullet, parore, stargazer, juvenile and adult flounder. Other methods of surveying need to be applied to fully determine just how many species use these off-river ponds for whatever part of their life-cycle.

All of these species have readily colonized the new ponds, in fact, inanga were caught in greater numbers in the new ponds than in the established old ponds. The newly arriving shoals of whitebait and smelt flooded into the new ponds and stayed there. They are easily observed at any time but especially around dusk.

No inanga were caught in the river, highlighting the absolute importance of off-river habitat for these fish. If we want to improve the numbers of our native fish we must build more riverine ponds. If we do, the fish will move in and occupy them and thereby increase in numbers enough to make a difference to our coastal fisheries. At the same time, those ponds will be doing all those jobs that wetland ponds do, in improving water quality, flood control and the plant, bird, fish and invertebrate productivity that comes from retaining and utilizing excess nutrients and pollutants. Ongoing management of such sites, to retain their best productivity, will be as important as constructing them in the first place.

Acknowledgements:

Firstly I must thank Kim Young, who first started me on trapping inanga to establish that they were still using the Borrow Pits as a spawning site for the Kaituna River, as described by Charles Mitchell in 1990. Then a freshwater biologist with the Department of Conservation (DoC) in Rotorua, specializing in freshwater native fish, Kim is now working in marine ecology and studying elephants in Africa. Kim was very supportive of the enhancement of the Borrow Pits by the Maketu Taiapure subcommittee, gave us plenty of time and assistance, readily shared her knowledge and loaned us traps and in particular, encouraged me to undertake a course of study at Waikato University, to ensure that we had the right survey and data gathering that we needed, to prove the outcomes of any enhancement.

Secondly, Professor Brendan Hicks, supervisor for this study, has been, still is, a mentor. His deep knowledge of our freshwater fisheries, his years of trapping experience and his communicative ease in cutting to the chase of, what to do, how to do it, how often, when, where, made setting up the study easy, with the surety of scientifically acceptable results.

To the other tutors of the papers I have taken for the Graduate Diploma in Applied Science, thank you for your patience as I felt my way into the academic process. To all the students with whom I shared classes, thanx for the total acceptance.

None of this would have been possible without the support of my family. Taking a two year part time university course, out of a busy family business, driving from Rotorua to Hamilton three times per week, at 57 years old, was no minor undertaking. Total support and encouragement from my wife Carys and son Darren has been unflagging. Mum, who always insisted that we spoke and wrote “good English”, has also been a constant source of encouragement. Although Dad is dead now, he was into wildlife management for much of his life so I’m sure he’ll approve. I think my brothers and sisters think I’m nuts but they’re polite enough to not say so.

To Willie and Elaine and the rest of the Maketu Taiapure Trust, kia ora tatou. This group provided the platform and impetus for enhancing this piece of the coastal habitat. Kia ora for accepting a pakeha into your fisheries management group. Caring for and enhancing the spawning area of an important native fish, when that spawning area is at the very interface of where land meets water and freshwater meets the moana is at the very basis of the coastal mauri. It’s my belief, that the caring for and nurturing of, this habitat, is the same whether we call it, the kawa of the rohemoana, that has been handed down through the generations as the kaitiakitanga of tikanga maori, or, enhancement of the sustainable management and utilization of our harvestable natural resources, it’s just a matter of, choose your reo.

Special thanks to Henry By de Ley, owner of most of the land that contains the Borrow Pits ponds. Without his co-operation and preparedness to work with the Maketu Taiapure Trust, this project could not have gone ahead.

A BIG thank you to Bruce Read of Reads Transport Ltd who saw the worth of the project and went above and beyond in donating extra digger time to complete the project and in particular Dion Henderson who drove the digger with such skill that he made it look easy but knowing the softness of his working ground and the minimal footprint he left behind in creating the ponds and sills, I applaud his experience and dexterity. Impressive to see a big butch digger doing such environmentally sensitive work.

To Charles Mitchell, thank you. I have often queried Charles about aspects of the biology and habits of these interesting and often perplexing fish and he has always been there with a mine of information. Thank you Jan, for food and bed the night I came to watch the mass hatching of inanga eggs into the seething mass of larvae and the opening of the sluice gates to release squillions of larvae off on the outgoing tide to their destiny in the coastal planktonic soup. Amazing!

Thank you to Red Barker of Maketu, who took aerial photos for me.

Thanks to Jaques Boubee for the info on both the Collapsible trap and the pantyhose idea.

Last but most definitely not least, driving into the Borrow Pits for that part of the trapping sessions that was during the whitebait season meant passing Ray Bushell's stand, he was nearly always there and stopping for cuppa, checkout the run, general korero, was pretty much obligatory. We are both on the Kaituna River and Maketu Estuary Strategy working group and he's a keen whitebaiter and duck shooter. He has also been a regular predator trapper and general kaitiaki for the Kaituna Wetland Reserve for many years. He's a practical deep thinker who can be a grumpy old bugger but I value highly, those chats on the ins and outs and roundabouts of trying to improve the management of our natural resources.

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CHAPTER 1: GENERAL INTRODUCTION

Introduction to the site:

The Kaituna River is ~50km long and drains Lakes Rotorua and Rotoiti. The entire catchment covers 124,000ha with ~48% of this below the lakes outlet at Okere Falls. After falling ~260m through a steep narrow gorge, the lower river watershed of the Te Puke Lowlands includes the Mangorewa River, Waiari and Ohineangaanga Streams and Raparahoe and Kopuroa canals. Mean annual discharge of the river is ~39 m^3s^{-1} with peak flows reaching ~150 m^3s^{-1}. (Goodhue 2007)

When the first European, Philip Tapsell, arrived in 1829, the whole of the Te Puke Lowlands was thousands of acres of flax swamp and he set up a trading post at Maketu that exported flax via small ships that entered the estuary. Which was essentially the beginning of the end for the river's wetlands. Te Puke was opened for settlement in 1880 and the Kaituna Swamp to the west, the Waihi Swamp to the east and the Kaawa Swamp to the south all soon dwindled away to the 248 ha, or less than 1%, left in wetland today. (Ministry for the Environment 1997)

Photo 1. Mouth of the Kaituna River today, showing the last remnant of wetland and the Borrow Pits (arrowed) Photo by Google Earth.

Various flood control measures over time have resulted in the Cut at Te Tumu, 67k of stopbank, 88k of canals and drains, 7 pump stations and 5 flood gate structures. (Goodhue 2007) The Kaituna River now travels its much-straightened way through intensive dairy and horticulture lands with the associated nutrient overloadings, combined with the impact from an AFFCO meat works and Te Puke sewerage and timber mill leachate. All of this means that the river is now degraded with respect to nutrient levels, faecal coliforms, chemical oxygen demand and

algae. Despite all of this degradation there is still life in the river though very much in need of habitat improvement.

In 1990, spawning grounds for the most common whitebait species, inanga (*Galaxias maculatus*), were identified on the lower Kaituna River (Mitchell 1990). Inanga have a marginally catadromous life-cycle (McDowall 1987) which has been well described previously (McDowall 1978).

Three of the inanga spawning places were associated with the outflows of a group of ponds commonly known as The Borrow Pits, located on the true right of the Kaituna River (grid ref. U14 096 777). These ponds were created by the extraction of material to form the flood protection stop-bank in the mid 1950s. The area of the Borrow Pits is contained in a loop of riverbank outside the line of the flood protection stop-bank, within 1 km of the known top of the saltwater wedge on the Kaituna River. See arrow Photo 1.

Photo 2. The Borrow Pits on the Kaituna River, before enhancement. Showing tidal water entry points from the river, the culvert and the inanga spawning areas identified by C.P. Mitchell. Photo by Google Earth.

For the sake of the exercise, we name the entrances E1, E2 and E3 from the upstream end i.e. from the left of Photo 2. The centre of the pond system has a culvert off the end of the Main Channel (MC) from E2, connecting that pond system to the river. This culvert went from full to below empty with the movement and height of the tides and the constriction and force of the water kept a big open pool either side of the culvert (LP & RP). Feeding out from the pool on the left of the culvert is an estuarine pond that went from 0.8 m at high tide to empty on the lowest tides. Beyond a causeway at the upstream end of this Estuary Pond (EP) is another Small Pond (SP) with its own connection to the river at E1. This is shown with the spawning area

either side, in Photo 2. To the right, the culvert pond feeds back into the Feeder Channel (FC) which runs parallel to the stopbank, back almost to the By de Ley/Titchmarsh boundary. This channel feeds an area of raupo wetland which also gained water from a much shallower channel from E3. All areas of water, other than EP, maintained ~100-200mm of water depth at most low tides

As a project to enhance inanga habitat in the lower Kaituna River system, initiated by the Monitoring & Enhancement subcommittee of the Maketu Taiapure Trust and with the assistance of Kim Young from DoC, random monitoring observed the use of some of the known spawning sites at The Borrow Pits in the autumns of 2000 and 2001. In autumn 2002, a more extensive monitoring programme was undertaken. While no spawn was found, pre and post spawning fish were trapped. (Young & Ellery 2002)

Between 2003 and 2006 the Maketu Taiapure ensured that the area was fenced off, gorse clearance initiated and some native replacements planted, with a mix of funding from The Rainbow Warrior Fund, Te Kotahitanga O Te Arawa Waka and Environment Bay of Plenty's Environment Enhancement Fund. In 2006 funding for the construction of more ponds in the area to provide more off-river native fish habitat, was applied for and obtained from EBOP (see Drawing 1). This work required a Resource Consent but under the new Water and Land Plan, a Consent for environmental enhancement does not require an application fee and assistance is given by EBOP staff in presentation of the application. This assistance was gratefully utilized. Resource Consent No. 63887 was granted in March 2007.

The work started on the morning of 12 June 2007 with the removal of the culvert and the blocking of the culvert causeway and the E3 channel, at low tide. This isolated the whole of the area to be worked on by the digger, from the river. The aim of this was in order to have the lowest water level possible for the period of the work and to contain the sediment produced by the work within the Borrow Pits area, thus minimizing any increased sediment input into the river.

As much as could be done, in the rather wet conditions, was completed over the next two days, to 14 June 2007. Three ponds were formed roughly as proposed though the formation/shape/function is slightly different to what was proposed. This alteration to the plan was to get as much done as possible in the less than satisfactory wet conditions and to provide a flow of water right through the wetlands area (see Drawing 2).

The main channel was de-weeded and the site left for the sediment to settle before re-opening the central channel and replacing the culvert. A few small eels that were seen to be removed with the earthworks were returned to the water, no fish were seen to be removed.

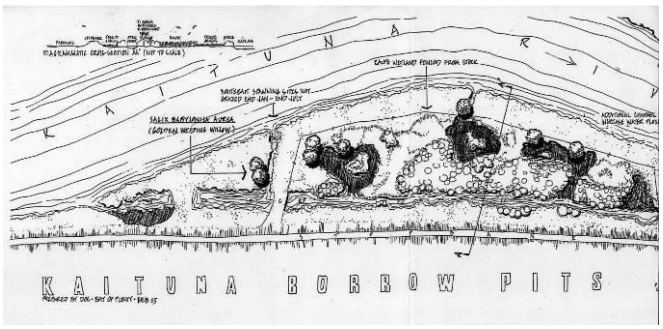
On the evening of 9 July 2007 the E3 channel was re-opened, to full low-tide depth, to have the water drain out of the whole of the developed area, for the replacing of the culvert on the low tide the following morning. This was to ensure that as low a water level as possible for the culvert replacement, to have no water flow through the culvert site. On the morning of 10 July 2007 the culvert was replaced, as planned, at low tide and the E1 channel into SP was cleared of willows and made slightly deeper and wider.

There was still 6 hours of digger time owing in this contract to be utilised in the summer when drier conditions would prevail.

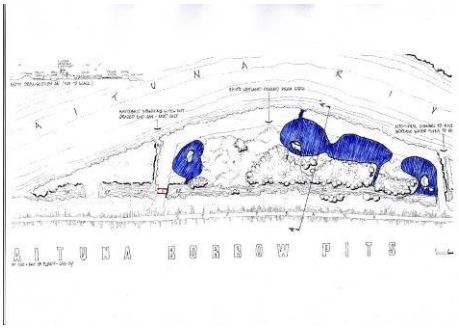
Photo 3. Creating the first new pond.

Photo 4. Enlarging the end of the feeder channel to make the east new pond.

Photos by P.Ellery.



Drawing 1. Proposed ponds in funding application



Drawing 2. What we actually ended up digging in the first expansion

Original Drawing by Simon Smale, DoC. Rotorua

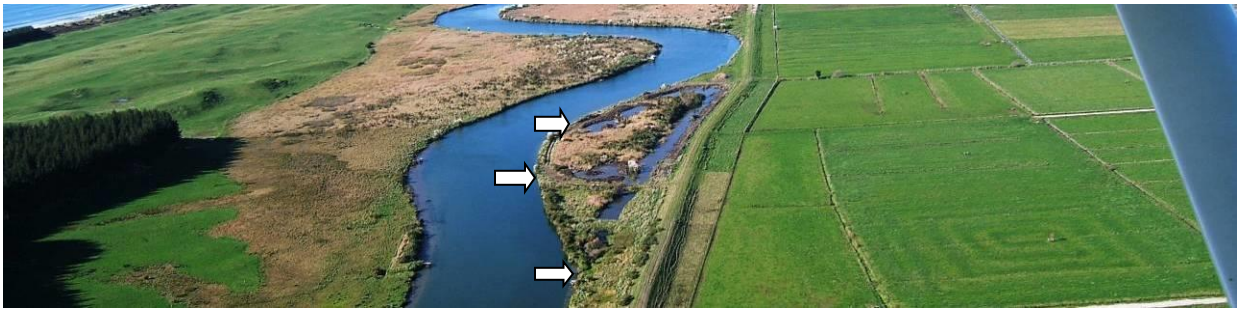


Photo 5. The Borrow Pits after first expansion of pond areas showing the E1, E2 & E3 entry points. E1 at bottom. Photo by Red Barker.

The new ponds created were named, the First New Pond, the East New Pond and the Long New Pond.

One of the proposals to the currently developing Kaituna River and Maketu Estuary Strategy, is that there be one hundred hectares of wetland recreated in the Lower Kaituna watershed over the next ten years. It is my belief that if these proposed wetlands are based on chains of interconnected ponds off the river, that are best native fish habitat and associated vegetation, then all wetland species, and the river and the coastal environment, will benefit. Discussions are already underway on creating a similar chain of ponds to the Borrow Pits, across the river, on the Ford's property. As can be seen in Photo 5, the rushland contour is clearly visible, currently grazed, there is clear potential to return enhanced habitat to the mauri.

Some successful pond building for inanga habitat has been carried out recently in the South Island, in the Te Wae Wae Lagoon area on the Waiau River by the Waiau Fisheries and Wildlife Habitat Enhancement Trust. Assessment of their efforts has recommended that sills, to around 50cm below the height of the spring tides, be between ponds and the natural environment and between ponds and ponds. (Paterson R. and Goldsmith R. 2002, Smith C. 2004)

Creating such sills between the Kaituna River and the Borrow Pits to contain the water in the ponds to the smallest high tide (1.5m) with overflow on the bigger tides up to the spring tides (2.2m) rather than falling away to empty on the low tides, seemed very applicable to the Borrow Pits ponds area and a most beneficial way to utilize the left over digger time. Increasing the water level in the ponds by around a metre and holding that level across the low tides had the potential to greatly benefit the fish carrying capacity of the area. This has since proven to be the case.

On the 19th of February 2008, a pond was excavated leading away from a sill connected to the First New Pond, to connect with the Long New Pond. Sills were installed across each of the three entrance channels.

Over the next few days, some damage to the sills from the tidal flow was obvious, so on 26th February all of the three sills were strengthened. The sills at E1 and E2 each had four logs added into their structure, each was widened and had small associated ponds dug alongside them at the same level as the sill to help spread and minimize concentrated tidal flow impact. E3 was made much wider. Sills were also constructed between FNP and FC and between FC and ENP (see photos 6-17). About an hour was spent "grooming" the outer edges of LNP and ENP, i.e. flattening the angle from pond to top of ridge of spoil, so that the higher tide, the wider the ponds.

This day's work with the digger was donated to the project by Reads Transport Ltd of Paengaroa and Dion, a contribution which really makes the enhancement dollar go much further and many thanks to them.

The sill at E1, with only the flow in and out of SP and the associated "spreading pond" survived, as built, and quickly re-vegetated. It soon became evident that the sills at E2 and E3, which drained all of the rest of the ponds, would be cut down further than desired, by the concentrated tidal flow, if not further protected. After discussion with Ray Bushell and Charles Mitchell, the Maketu Taiapure Committee approved funding for 2 truck and trailer loads of rubble base rock, to protect the outlets of these sills. This was installed on 11 March 2008 (see photos 16 & 17).

Could be worth assessing benefits(?) of oxygenation created by rock outfall? How much could cumulative of several, make a difference to quality of river?

Photo 6. Sill at E1, just completed.

Photo 7. Sill at E1, covered by high tide.

Photo 8. Sill at E2, just completed

Photo 9. Sill at E2, covered by high tide.

Photo 10. Sill at E3, just completed,
high tide moving across.

Photo 11. Sill at E3 covered by high tide.

Photo 12. Sill between FC and FNP, just completed.

Photo 13. Sill between FC and FNP on high tide.

Photo 14. Sill between FC and LNP.

Photo 15. Sill between FC and LNP at high tide.

Photo16. Rock protection of the outfall at E2.

Photo 17. Rock protection at E3 outfall.

Drawing 3. Final expansion of ponds and installed sills.

CHAPTER 2: Bait Comparison Trial

2.1 Background:

Initial discussions in setting up this trapping program revealed a range of baits being used by those people trapping inanga. With Kim, we had always used cheese (Pam's Colby), tried some old brie one time, no catch. Apricot finger biscuits did work one day when I forgot to get more cheese on the way. Brendan said that cat biscuits worked well. Jared Millar who did a thesis on inanga in the lower Waikato River used vegemite (Millar 2001). Ray Tana, a fellow student, doing a thesis on torrentfish, said that he also used vegemite, in the small sachets, as easy to use baits.

2.2 Method:

A trial was set up in the Small Pond at the upriver end of the Borrow Pits.

6mm mesh Gee Minnow traps were baited; **2** with cheese, about a 2-3mm thick slice off the end of a 250gm block of Pam's Colby, crumbled into the trap, **2** with cat biscuits, about 20 biscuits per trap, **2** with a sachet of vegemite with the foil top removed and **2** with no bait. These traps were set, on two opposing sides of the pond, the same two sides as shown as spawning areas in Photo 2. So, 4 traps either side of the pond, one trap of each treatment on each side of the pond.

2.3 Results

Because trapping started on 29 June 2007, therefore autumn heading into winter and the period when inanga become less active, only briefly feeding on dusk, most of this trapping covered that evening change of light timeframe. Although reasonable numbers were caught at the start of the trial, there was a reducing catch over the period of the trial to very low numbers by the end. Over the 8 sessions, a total of 211 inanga, 29 smelt (*retropinna retropinna*) and 40 bullies were caught. The bullies appeared to be a mix of common bullies (*gobiomorphus cotidianis*) and giant bullies (*gobiomorphus gobioides*) and are combined as bullies in the results.

See Appendix One for raw data

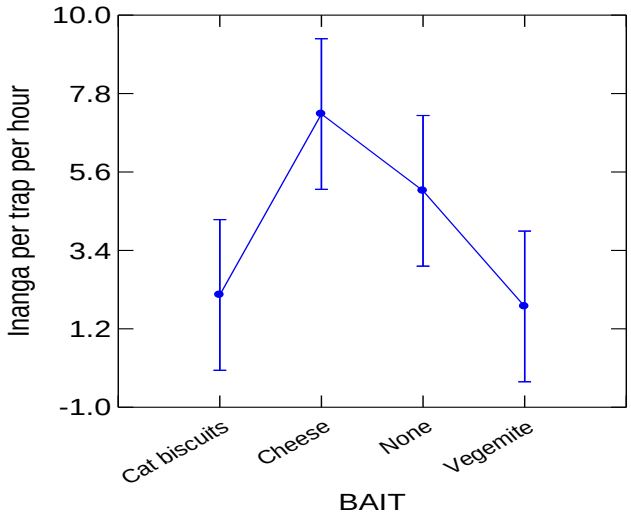


Figure 1. Least squares mean catch rates of inanga in Gee minnow traps set for 30-60 minutes in old off-river pond between 29 June and 15 July 2007.

Bait	*N*	Inanga catch rate (fish trap^{-1} hour^{-1})					
		Minimum	Maximum	Median	Mean	SD	CV
None	16	0	36.0	0.6	5.1	10.0	1.97
Cheese	16	0	45.6	4.0	7.2	12.3	1.71
Cat biscuits	16	0	14.6	0.0	2.1	4.5	2.09
Vegemite	16	0	14.6	0.0	1.8	3.7	2.05

Table 1. Mean catch rates of inanga in Gee minnow traps set for 30-60 minutes in old off-river pond between 29 June and 15 July 2007.

There was not enough difference between bait types (Kruskal Wallis $P = 0.264$). $N = 16$ for each bait treatment. The CVs (coefficients of variation, or SD/mean) are very large (1.7-2.1). A target CV is less than 0.5, and 0.2 would be much better. CV can be reduced by a) less variability or b) more trapping (larger *N*).

2.4 Conclusions

As with all baits, in all fishing, there is high variability in the attraction of baits to fish. Any bait can be “flavor of the day” and that can be different on any day. This was a short trial with probably fewer traps than would be preferred, when inanga were becoming increasingly inactive. Figure 1 and Table 1 show that there is too little difference to have a clear winner but I will continue to use cheese, though it is interesting that no bait caught within the range of baited traps. I think that for these trap types catching the species that they do, any high protein bait will do. And if you forget your bait you’re still liable to get some catch.

Some random trapping continued through the winter to test for inanga presence, until the whitebait started running in the spring, showing generally declining catches. The first inanga was caught in a new pond (FNP) in the first week in September, which was also when the first eels showed up in traps. Obviously “wake-up” time from winter inactivity for many species.

Predation of fish in traps by eels and larger bullies was evident from this time on.

Chapter 3. Evaluation of artificial habitat use by inanga, smelt, bullies and eels.

3.1 Introduction

While this small area, as the recorded spawning site for inanga on the right side of the Kaituna, is at the downstream limit of their normal adult habitat range on the river, it is a set of ponds on the fresh/saltwater interface which contains a very diverse range of fish species not to mention the diversity of plants, invertebrates, and birds. As can be seen in Photo 2, it is an extremely small piece of the habitat of the farmed, channelized, stop-banked, drain that is today's Kaituna River. It seemed obvious that any increase in the number of ponds in this area has to have a beneficial increase in habitat carrying capacity for our native fish. My focus with this study is; what is the response of the fish when you dig some new holes to create fish ponds, to enhance an established wetland or create a new one?

Previous observations have shown some year-round inanga presence in the Borrow Pit ponds, so the study focuses on data from trapping sessions, to allow the assessment of the comparative levels of inanga presence in the area and their colonization, or not, of the new ponds but the by-catch of the inanga trapping process will have its own story to tell, as to the use of these ponds by other species of fish.

The area to be trapped is easily divided into river, old off-river ponds and new off-river ponds.

The trapping dates were; 30th October, 30th November, 16th December, 2007, 16th January, 13th February, 2008.

3.2 Methods

In order to track the presence of inanga (and other fish) in the new ponds as compared to the old ponds and the river, 50 trap sessions were carried out monthly from October 2007 to March 2008. The 10 traps in the river were set in pairs, each pair about 75m apart. Each pair was 1 Gee Minnow trap and one Collapsible trap set about 4-5m apart. Of the 20 traps in the old ponds, Small Pond had 5, and the Feeder Channel had 15. In the new ponds First New Pond had 6, East New Pond had 6 and the Long New Pond had 8. Each pond had 1 Gee Minnow trap and the rest Collapsible. All traps were baited with cheese (Pam's Colby as per the bait trial).

All collapsible traps had the entrance rings flattened to an oval of ~20mmx70mm to minimize the entry of bigger bullies and eels. However even the size bullies and eels which could enter the trap obviously killed and ate smaller fish in the traps. All fish in the traps, alive, dead, partial but identifiable, were counted as trapped. Unable to obtain enough 3mm mesh Gee Minnow

traps and requiring to catch juvenile as well as adult inanga, 6 mm mesh traps were covered with pantyhose material, taped on, as per photo 18.

The first session on 30 October 2007 was just a morning set with up to 5 inanga per trap measured, as a trial run. After that, all trap sessions were overnight. Traps were set on nights when there was a low tide evening and morning, to fish overnight, across the high tide. This ensured that the traps were set in water at low tide and therefore always submerged. Setting the 50 traps took about two and a half hours and used most of two 250 g blocks of cheese. Traps were lifted next morning and all fish counted. Up to 10 inanga, in any trap containing them, were measured to fork length. Inanga were stunned by melting ice water. See photo 20

A 1.5 L Coke bottle, ¾ filled with water and frozen , (a full bottle can burst). The water from the melting ice used to put a depth of 30- 50 mm of chilled water in a 5 L bucket. This is enough to cover the contents of most traps, after the eels have been tipped out. As the ice in the bottle melts, the water that comes out is usually between 3 and 6 degrees C though it can get up to about 7.5 on a hot day, towards the end of the bottle. This is perfect for stunning fish for long enough to measure them but when flipped back into the water from the measuring board, they instantly swim away to cover. Two bottles was enough to cover any trap lifting sessions and most sessions involved measuring around 100 inanga. The lifting, counting and measuring session usually took about 4-5 hours.

Photo 20. Forty Collapsible compared to 12 Gee Minnow.

Photo 19. Gee Minnow trap with pantyhose covering.

Photo 21. Inanga on the measure board after chilling.

3.3 Results

The five trapping sessions caught a total of 831 inanga, 394 smelt, 1066 bullies, 143 eels.

The total catch in the river was; 0 inanga, 31 smelt, 540 bullies, 16 eels.

The total catch in the old off river habitat was; 299 inanga, 32 smelt, 157 bullies and 58 eels.

In the new off river habitat the total catch was; 532 inanga, 331 smelt, 369 bullies and 69 eels.

Low numbers were caught in October but by the November session sufficient numbers were caught to start showing some measurable results.

In the November analysis; Inanga catches were greater in pond habitat than in the river (Figure 2; Kruskal-Wallis P = 0.013). No inanga were caught in river habitat. Conversely, bully catches were much greater in river habitat than in the ponds (Figure 3; Kruskal-Wallis P < 0.001).

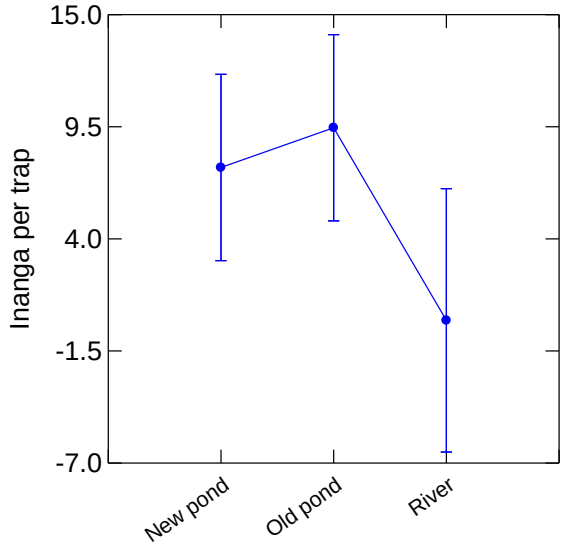


Figure 2.

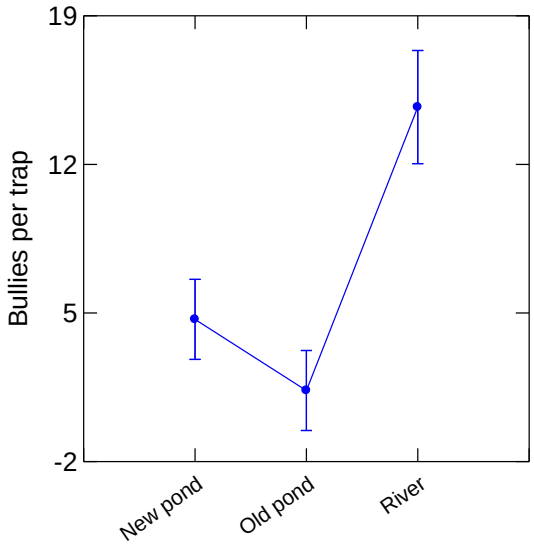


Figure 3.

Mean catch rate (fish per trap per night) on 30 November 2007.

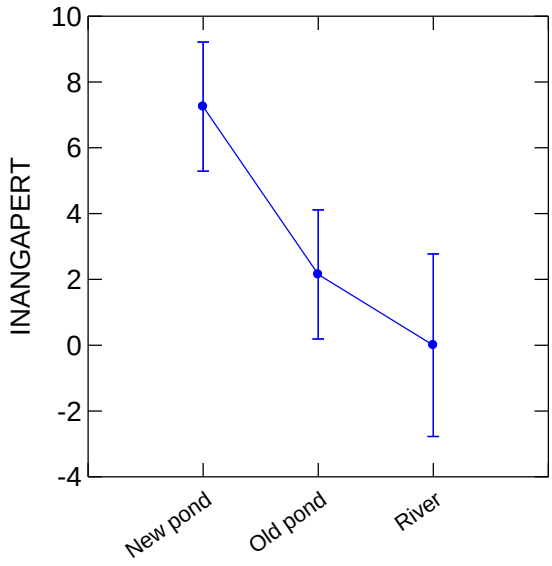


Figure 4. Catch comparison for December 2007

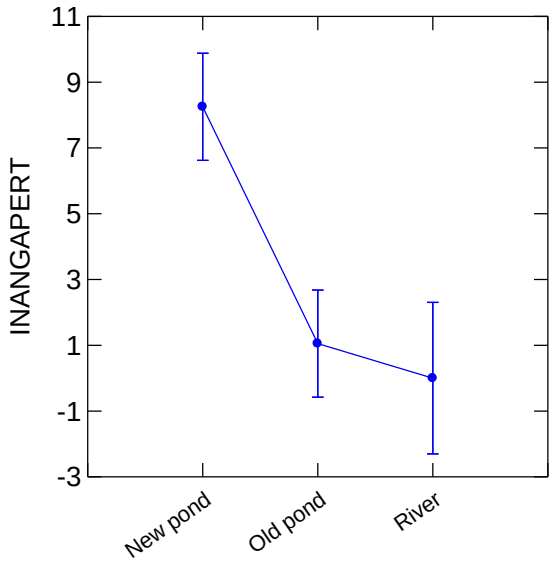


Figure 5. Catch comparison figures for January 2008

3.4 Salinity test

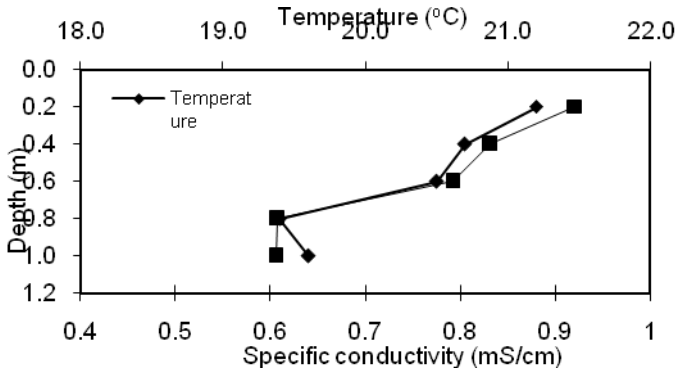


Figure 6. Salinity measurements at FNP 1

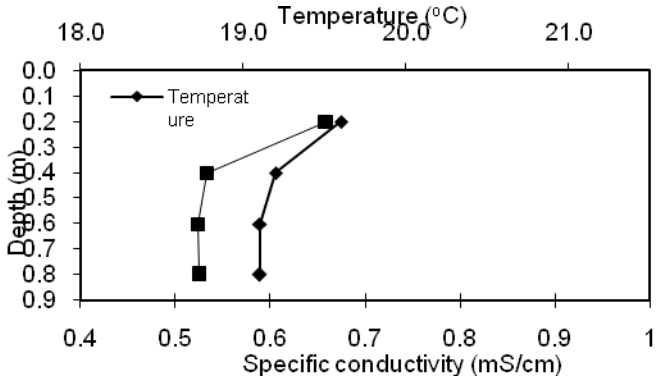


Figure 7. Salinity measurements at SP 1

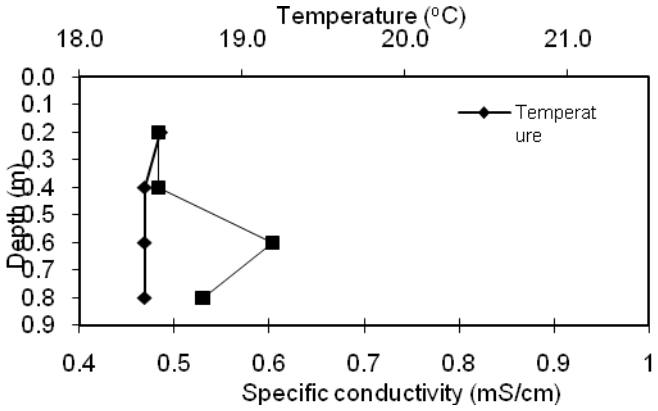


Figure 8. Salinity measurements at RS1

3.5 Comparison between Gee Minnow and Collapsible Traps.

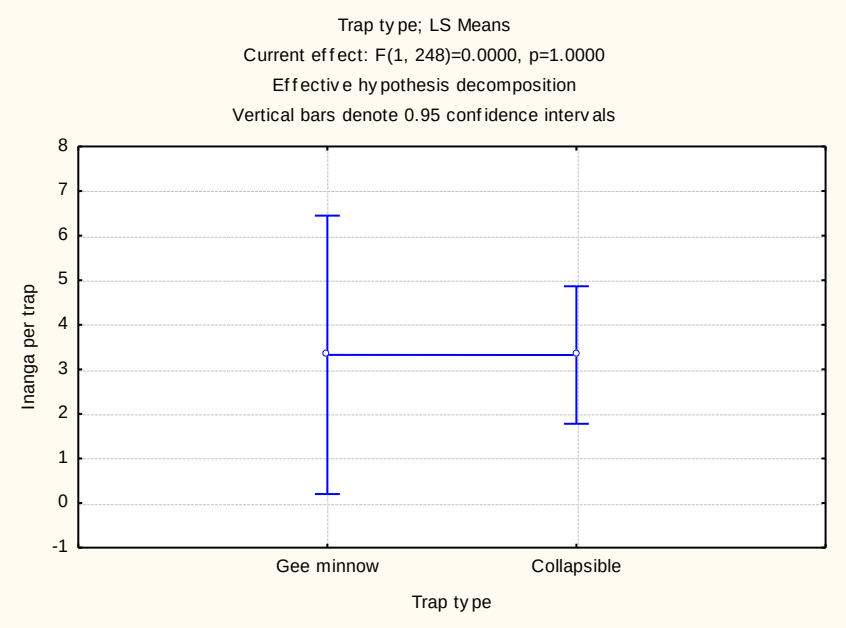


Figure 9. Comparison of catch rate between Gee Minnow and Collapsible traps.

There is no difference in mean catch but the different confidence level in Gee minnow comes from fewer traps with a few large catches averaging out to the same as the Collapsible traps.

3.6 Inanga length frequency comparison between habitats

Comparing the length frequency of the inanga trapped, from spring through summer, between the old ponds and the new ponds, clearly shows bigger fish predominating in the old ponds and the recruitment of juveniles into the new ponds.

Date	Length (mm)						ANOVA
	Old pond			New pond			*P*
	N	Mean	SD	*N*	Mean	SD	
30-Oct-07	2	62.0	1.0	6	85.7	7.6	0.141
1-Dec-07	40	76.3	3.3	17	73.2	4.7	0.614
16-Dec-07	37	78.1	2.8	71	68.3	2.0	0.004
16-Jan-08	21	78.2	3.7	86	76.3	1.9	0.653
13-Feb-08	43	90.8	2.7	41	76.1	2.7	<0.001

Table 2. Mean lengths of inanga caught in old and new artificial ponds in the lower Kaituna River floodplain between 30 Oct 2007 and 13 Feb 2008. Analysis of variance (ANOVA) compares means for old ponds and new ponds for each sampling date.

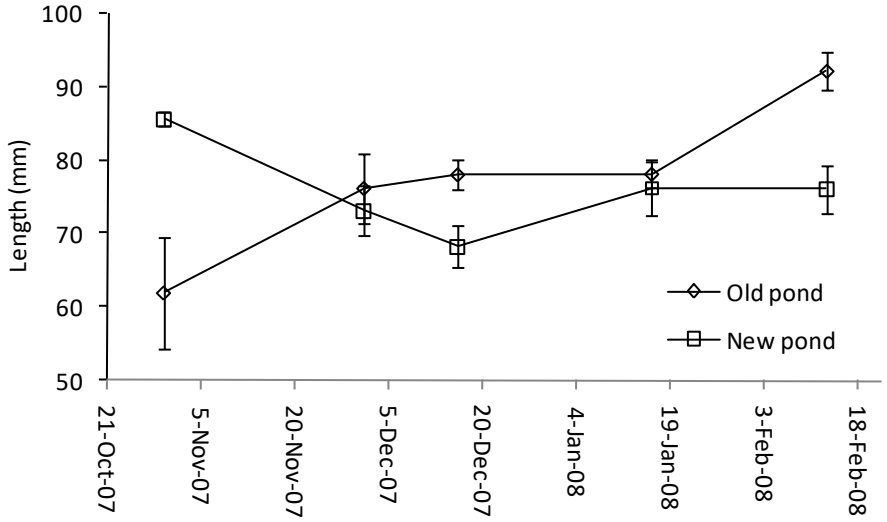


Fig. 10. Mean lengths of inanga caught in old and new artificial ponds in the lower Kaituna River floodplain between 30 Oct 2007 and 13 Feb 2008. Vertical bars are one standard error of the mean.

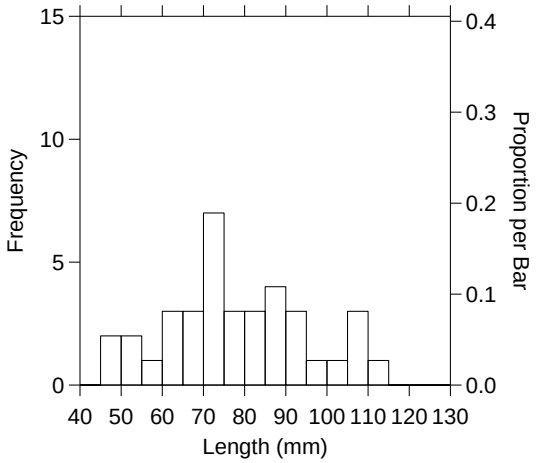


Fig 11. Length frequency, December 2007, old ponds

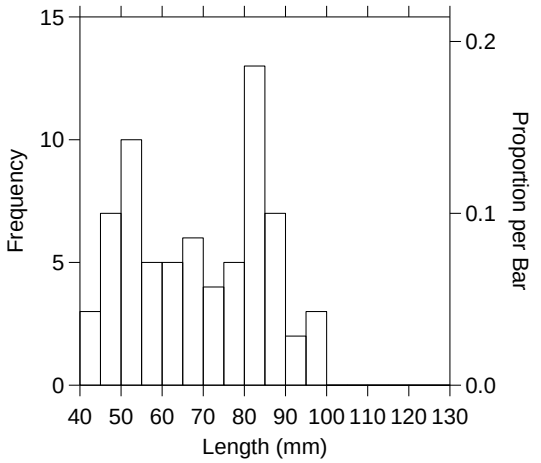


Fig 12. Length frequency December 2007, new ponds

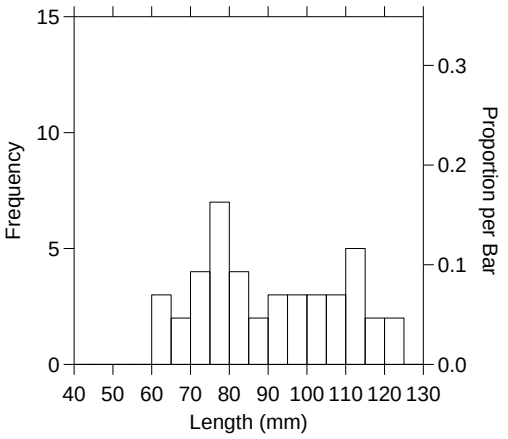


Fig. 13 length frequency February 2008, old ponds

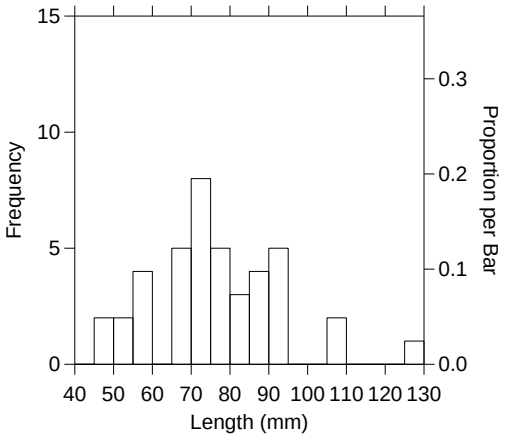


Fig. 14 length frequency February 2008, new ponds

3.7 Conclusions

As can be seen from Figures 4 and 5, as spring progressed into summer and the ponds “aged” from algae through to development of aquatic macrophytes and the regrowth of pond-margin overhang, the inanga, readily spread into the new ponds and were caught in higher numbers there than in the established habitat.

The salinity test shows brackish water with a thermal halocline in the river and thermal stratification in the ponds.

This method of trapping does not adequately sample newly arrived whitebait or smelt numbers, compared to observed numbers in the ponds. Whitebait and smelt have more pelagic habits than the other 3 species sampled and shoals of whitebait and smelt could often be observed bypassing the trap with little interest shown in the bait. It was not until they coloured into the adult form that they started to readily enter the traps. Conversely, the adult inanga, bullies and eels could often be observed within minutes of setting a trap, readily investigating and entering the trap.

Observations throughout the trapping process noted that as the shoals of whitebait and smelt arrived at the pond complex in the spring, being more pelagic than the trapped species, they readily entered the open water of the new ponds. At the same time overwintering adult inanga became active in the old ponds and some foraged into the new ponds. Both habitats received some recruitment but the old pond’s fish show a greater level of bigger fish whereas the new ponds, while gaining some adult fish, mostly shows the development of this season’s cohort from juveniles to adult. Clearly an increase in productivity of the area, by whatever is the number of fish that the new ponds can accommodate.

Eels also readily entered the new ponds as they came out of winter “hibernation”. No time was spent determining which species of eel were represented in the catch. Eels, bigger than could enter my trap, were occasionally observed. Some damage to the collapsible traps was caused by eels being able to “bite and twist” a hole through the plastic mesh. Not known if that was from inside or outside.

The bullies maintained their higher presence in the river but were present in variable numbers throughout all of the habitat surveyed. No time was spent determining just how many species of bullies might have been included in the overall “bullies” total. Bullies, much bigger than could enter my traps, were observed in large numbers after dark throughout the ponds.

Where the trap is set, across different areas of fish usage, is more important than trap type. The Collapsible is easier to transport more of, than the Gee minnow but did suffer some eel damage requiring repair, which does not happen with Gee minnow.

Species observed but not trapped include kahawai, yellow eyed mullet, parore, stargazer, and juvenile and adult flounder. Different methods of sampling need to be applied to fully determine the range of species using these ponds for whatever part of their life cycle.

No inanga were caught in the river which shows the importance of off-river habitat for our most important whitebait species. This project shows that they, and associated species, will readily occupy any new pond habitat that is connected to the river.

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APPENDIX ONE: Raw data for the bait comparison trial

Date	Time set (mins)	Trap number	Bait	Inanga per trap	Smelt per trap	Bullies per trap	Time set	Time lifted	Actual mins	Tauranga high tide time
29-Jun-07	30	1	None	6	0	0	16:15-16:30	17:00-17:20	47	18:36
29-Jun-07	30	2	Cheese	4	0	0	16:15-16:30	17:00-17:20	47	18:36
29-Jun-07	30	3	Cat biscuits	4	0	2	16:15-16:30	17:00-17:20	47	18:36
29-Jun-07	30	4	Vegemite	3	0	2	16:15-16:30	17:00-17:20	47	18:36
29-Jun-07	30	5	None	2	1	1	16:15-16:30	17:00-17:20	47	18:36
29-Jun-07	30	6	Cheese	6	0	0	16:15-16:30	17:00-17:20	47	18:36
29-Jun-07	30	7	Cat biscuits	9	0	1	16:15-16:30	17:00-17:20	47	18:36
29-Jun-07	30	8	Vegemite	3	0	0	16:15-16:30	17:00-17:20	47	18:36
3-Jul-07	30	1	None	4	0	0	16:45-17:05	17:20-17:45	37	9:00
3-Jul-07	30	2	Cheese	17	2	1	16:45-17:05	17:20-17:45	37	9:00
3-Jul-07	30	3	Cat biscuits	0	0	0	16:45-17:05	17:20-17:45	37	9:00
3-Jul-07	30	4	Vegemite	9	0	3	16:45-17:05	17:20-17:45	37	9:00
3-Jul-07	30	5	None	2	0	1	16:45-17:05	17:20-17:45	37	9:00
3-Jul-07	30	6	Cheese	2	0	0	16:45-17:05	17:20-17:45	37	9:00
3-Jul-07	30	7	Cat biscuits	9	0	0	16:45-17:05	17:20-17:45	37	9:00
3-Jul-07	30	8	Vegemite	0	0	1	16:45-17:05	17:20-17:45	37	9:00
7-Jul-07	30	1	None	1	1	0	14:30-14:50	15:20-15:40	50	12:12
7-Jul-07	30	2	Cheese	4	0	0	14:30-14:50	15:20-15:40	50	12:12
7-Jul-07	30	3	Cat biscuits	1	0	0	14:30-14:50	15:20-15:40	50	12:12
7-Jul-07	30	4	Vegemite	0	0	0	14:30-14:50	15:20-15:40	50	12:12
7-Jul-07	30	5	None	0	0	0	14:30-14:50	15:20-15:40	50	12:12
7-Jul-07	30	6	Cheese	38	9	0	14:30-14:50	15:20-15:40	50	12:12
7-Jul-07	30	7	Cat biscuits	0	0	0	14:30-14:50	15:20-15:40	50	12:12
7-Jul-07	30	8	Vegemite	0	0	0	14:30-14:50	15:20-15:40	50	12:12
7-Jul-07	30	1	None	1	0	1	17:20-17:40	17:50-18:10	30	12:17
7-Jul-07	30	2	Cheese	0	0	0	17:20-17:40	17:50-18:10	30	12:17
7-Jul-07	30	3	Cat biscuits	0	0	0	17:20-17:40	17:50-18:10	30	12:17
7-Jul-07	30	4	Vegemite	0	0	0	17:20-17:40	17:50-18:10	30	12:17
7-Jul-07	30	5	None	0	0	0	17:20-17:40	17:50-18:10	30	12:17
7-Jul-07	30	6	Cheese	0	0	0	17:20-17:40	17:50-18:10	30	12:17
7-Jul-07	30	7	Cat biscuits	0	0	0	17:20-17:40	17:50-18:10	30	12:17
7-Jul-07	30	8	Vegemite	0	0	0	17:20-17:40	17:50-18:10	30	12:17
8-Jul-07	30	1	None	0	0	0	12:30-12:50	13:00-13:20	30	13:17
8-Jul-07	285	2	Cheese	41	7	1	12:30-12:50	13:00-13:20	30	13:17
8-Jul-07	30	3	Cat biscuits	0	0	0	12:30-12:50	13:00-13:20	30	13:17
8-Jul-07	30	4	Vegemite	0	0	0	12:30-12:50	13:00-13:20	30	13:17
8-Jul-07	30	5	None	0	0	0	12:30-12:50	13:00-13:20	30	13:17
8-Jul-07	30	6	Cheese	0	0	0	12:30-12:50	13:00-13:20	30	13:17
8-Jul-07	30	7	Cat biscuits	0	0	0	12:30-12:50	13:00-13:20	30	13:17
8-Jul-07	30	8	Vegemite	0	0	0	12:30-12:50	13:00-13:20	30	13:17
9-Jul-07	30	1	None	18	0	0	1700-1720	1730-17-50	30	14:05
9-Jul-07	30	2	Cheese	0	0	0	1700-1720	1730-17-50	30	14:05
9-Jul-07	30	3	Cat biscuits	0	0	1	1700-1720	1730-17-50	30	14:05
9-Jul-07	30	4	Vegemite	0	0	1	1700-1720	1730-17-50	30	14:05

Date	Time set (mins)	Trap number	Bait	Inanga per trap	Smelt per trap	Bullies per trap	Time set	Time lifted	Actual mins	Tauranga high tide time
9-Jul-07	30	5	None	11	0	2	1700-1720	1730-17-50	30	14:05
9-Jul-07	30	6	Cheese	4	0	0	1700-1720	1730-17-50	30	14:05
9-Jul-07	30	7	Cat biscuits	0	0	0	1700-1720	1730-17-50	30	14:05
9-Jul-07	30	8	Vegemite	2	0	3	1700-1720	1730-17-50	30	14:05
14-Jul-07	60	1	None	0	0	0	1635-1700	1735-1800	60	19:03
14-Jul-07	60	2	Cheese	0	0	0	1635-1700	1735-1800	60	19:03
14-Jul-07	60	3	Cat biscuits	0	0	2	1635-1700	1735-1800	60	19:03
14-Jul-07	60	4	Vegemite	0	1	0	1635-1700	1735-1800	60	19:03
14-Jul-07	60	5	None	0	1	3	1635-1700	1735-1800	60	19:03
14-Jul-07	60	6	Cheese	0	1	3	1635-1700	1735-1800	60	19:03
14-Jul-07	60	7	Cat biscuits	2	0	3	1635-1700	1735-1800	60	19:03
14-Jul-07	60	8	Vegemite	0	0	4	1635-1700	1735-1800	60	19:03
15-Jul-07	60	1	None	0	3	0	1645-1710	1745-1805	60	19:55
15-Jul-07	60	2	Cheese	5	2	1	1645-1710	1745-1805	60	19:55
15-Jul-07	60	3	Cat biscuits	0	1	1	1645-1710	1745-1805	60	19:55
15-Jul-07	60	4	Vegemite	1	1	0	1645-1710	1745-1805	60	19:55
15-Jul-07	60	5	None	0	0	2	1645-1710	1745-1805	60	19:55
15-Jul-07	60	6	Cheese	0	0	0	1645-1710	1745-1805	60	19:55
15-Jul-07	60	7	Cat biscuits	0	0	0	1645-1710	1745-1805	60	19:55
15-Jul-07	60	8	Vegemite	2	0	0	1645-1710	1745-1805	60	19:55

Appendix 2. Raw data for habitat comparison trial.

Date	Trap type	Site	Trap number	Site type	Inanga per trap per day	Smelt per trap per day	Bullies per trap per day	Eels per trap per day
30-Oct-07	Gee minnow	RS	1	River	0	0	2	2
30-Oct-07	Collapsible	RS	2	River	0	0	0	0
30-Oct-07	Collapsible	RS	3	River	0	0	1	0
30-Oct-07	Gee minnow	RS	4	River	0	0	1	0
30-Oct-07	Collapsible	RS	5	River	0	0	1	0
30-Oct-07	Collapsible	RS	6	River	0	0	0	0
30-Oct-07	Gee minnow	RS	7	River	0	0	1	0
30-Oct-07	Collapsible	RS	8	River	0	0	0	0
30-Oct-07	Collapsible	RS	9	River	0	0	0	0
30-Oct-07	Gee minnow	RS	10	River	0	0	1	0
30-Oct-07	Collapsible	SP	1	Old pond	0	0	0	0
30-Oct-07	Collapsible	SP	2	Old pond	0	0	1	0
30-Oct-07	Collapsible	SP	3	Old pond	0	0	0	0
30-Oct-07	Gee minnow	SP	4	Old pond	0	0	0	0
30-Oct-07	Collapsible	SP	5	Old pond	0	1	0	0
30-Oct-07	Gee minnow	FC	1	Old pond	0	0	0	0
30-Oct-07	Collapsible	FC	2	Old pond	1	0	0	0
30-Oct-07	Collapsible	FC	3	Old pond	0	0	0	0
30-Oct-07	Collapsible	FC	4	Old pond	0	4	0	0
30-Oct-07	Collapsible	FC	5	Old pond	0	3	0	0
30-Oct-07	Collapsible	FC	6	Old pond	0	0	0	0
30-Oct-07	Collapsible	FC	7	Old pond	0	0	0	0
30-Oct-07	Collapsible	FC	8	Old pond	0	1	1	0
30-Oct-07	Collapsible	FC	9	Old pond	0	3	1	0
30-Oct-07	Collapsible	FC	10	Old pond	0	2	2	0
30-Oct-07	Collapsible	FC	11	Old pond	1	2	0	0
30-Oct-07	Collapsible	FC	12	Old pond	1	4	1	0
30-Oct-07	Collapsible	FC	13	Old pond	0	1	1	0
30-Oct-07	Collapsible	FC	14	Old pond	0	0	0	0
30-Oct-07	Collapsible	FC	15	Old pond	0	5	3	0
30-Oct-07	Gee minnow	FNP	1	New pond	0	0	0	0
30-Oct-07	Collapsible	FNP	2	New pond	1	60	0	0
30-Oct-07	Collapsible	FNP	3	New pond	0	6	0	0
30-Oct-07	Collapsible	FNP	4	New pond	0	80	0	0
30-Oct-07	Collapsible	FNP	5	New pond	0	11	0	0
30-Oct-07	Collapsible	FNP	6	New pond	1	14	0	0
30-Oct-07	Collapsible	ENP	1	New pond	0	17	2	0
30-Oct-07	Gee minnow	ENP	2	New pond	0	0	0	0
30-Oct-07	Collapsible	ENP	3	New pond	3	34	0	0
30-Oct-07	Collapsible	ENP	4	New pond	0	4	2	0
30-Oct-07	Collapsible	ENP	5	New pond	0	1	4	0
30-Oct-07	Collapsible	ENP	6	New pond	0	18	3	0
30-Oct-07	Gee minnow	LNP	1	New pond	0	1	0	0
30-Oct-07	Collapsible	LNP	2	New pond	1	8	0	0
30-Oct-07	Collapsible	LNP	3	New pond	0	3	0	0
30-Oct-07	Collapsible	LNP	4	New pond	0	7	1	0
30-Oct-07	Collapsible	LNP	5	New pond	0	0	0	0
Date	Trap type	Site	Trap number	Site type	Inanga per trap per day	Smelt per trap per day	Bullies per trap per day	Eels per trap per day
30-Oct-07	Collapsible	LNP	7	New pond	0	0	4	0
30-Oct-07	Collapsible	LNP	8	New pond	0	2	4	0
30-Nov-07	Collapsible	SP	1	Old pond	11	0	5	0
30-Nov-07	Gee minnow	SP	2	Old pond	20	3	0	0

30-Nov-07	Collapsible	SP	4	Old pond	0	0	4	1
30-Nov-07	Collapsible	SP	5	Old pond	0	0	1	0
30-Nov-07	Collapsible	FNP	1	New pond	104	0	0	5
30-Nov-07	Gee minnow	FNP	2	New pond	39	0	0	6
30-Nov-07	Collapsible	FNP	3	New pond	0	0	0	11
30-Nov-07	Collapsible	FNP	4	New pond	3	0	0	2
30-Nov-07	Collapsible	FNP	5	New pond	1	0	0	0
30-Nov-07	Collapsible	FNP	6	New pond	0	0	0	6
30-Nov-07	Collapsible	FC	1	Old pond	20	0	1	1
30-Nov-07	Gee minnow	FC	2	Old pond	0	0	0	6
30-Nov-07	Collapsible	FC	3	Old pond	91	0	0	0
30-Nov-07	Collapsible	FC	4	Old pond	0	0	0	4
30-Nov-07	Collapsible	FC	5	Old pond	7	0	0	0
30-Nov-07	Collapsible	FC	6	Old pond	1	0	0	0
30-Nov-07	Collapsible	FC	7	Old pond	2	0	0	0
30-Nov-07	Collapsible	FC	8	Old pond	30	0	0	0
30-Nov-07	Collapsible	FC	9	Old pond	1	1	3	0
30-Nov-07	Collapsible	FC	10	Old pond	0	0	2	0
30-Nov-07	Collapsible	FC	11	Old pond	0	0	3	0
30-Nov-07	Collapsible	FC	12	Old pond	0	0	0	0
30-Nov-07	Collapsible	FC	13	Old pond	3	0	2	0
30-Nov-07	Collapsible	FC	14	Old pond	0	0	2	0
30-Nov-07	Collapsible	FC	15	Old pond	3	0	3	0
30-Nov-07	Collapsible	ENP	1	New pond	0	0	1	0
30-Nov-07	Collapsible	ENP	2	New pond	0	0	3	0
30-Nov-07	Collapsible	ENP	3	New pond	0	0	1	1
30-Nov-07	Gee minnow	ENP	4	New pond	1	0	0	0
30-Nov-07	Collapsible	ENP	5	New pond	1	0	0	0
30-Nov-07	Collapsible	ENP	6	New pond	0	0	5	0
30-Nov-07	Collapsible	LNP	1	New pond	0	0	0	0
30-Nov-07	Gee minnow	LNP	2	New pond	0	0	3	0
30-Nov-07	Collapsible	LNP	3	New pond	0	2	9	0
30-Nov-07	Collapsible	LNP	4	New pond	0	1	6	0
30-Nov-07	Collapsible	LNP	5	New pond	0	1	10	0
30-Nov-07	Collapsible	LNP	6	New pond	1	1	12	0
30-Nov-07	Collapsible	LNP	7	New pond	0	4	13	0
30-Nov-07	Collapsible	LNP	8	New pond	0	5	31	0
30-Nov-07	Collapsible	RS	1	River	0	2	9	0
30-Nov-07	Gee minnow	RS	2	River	0	0	8	0
30-Nov-07	Collapsible	RS	3	River	0	2	9	0
30-Nov-07	Collapsible	RS	4	River	0	0	1	1
30-Nov-07	Gee minnow	RS	5	River	0	0	14	0
30-Nov-07	Gee minnow	RS	6	River	0	0	9	0
30-Nov-07	Collapsible	RS	7	River	0	8	57	0
30-Nov-07	Gee minnow	RS	8	River	0	0	14	0
30-Nov-07	Collapsible	RS	9	River	0	0	19	0
30-Nov-07	Gee minnow	RS	10	River	0	0	7	0
16-Dec-07	Collapsible	SP	1	Old pond	8	0	5	1
16-Dec-07	Collapsible	SP	2	Old pond	2	0	0	2
16-Dec-07	Gee minnow	SP	3	Old pond	0	0	12	0
16-Dec-07	Collapsible	SP	4	Old pond	0	0	3	2
16-Dec-07	Collapsible	SP	5	Old pond	0	0	8	0

Date	Trap type	Site	Trap number	Site type	Inanga per trap per day	Smelt per trap per day	Bullies per trap per day	Eels per trap per day
16-Dec-07	Collapsible	FNP	2	New pond	36	0	0	4
16-Dec-07	Gee minnow	FNP	3	New pond	1	0	4	1
16-Dec-07	Collapsible	FNP	4	New pond	10	0	4	0
16-Dec-07	Collapsible	FNP	6	New pond	17	0	2	0

Date	Trap type	Site	Trap number	Site type	Inanga per trap per day	Smelt per trap per day	Bullies per trap per day	Eels per trap per day
16-Dec-07	Collapsible	FC	1	Old pond	7	0	2	0
16-Dec-07	Collapsible	FC	2	Old pond	6	0	3	3
16-Dec-07	Gee minnow	FC	3	Old pond	17	1	0	0
16-Dec-07	Collapsible	FC	4	Old pond	1	0	0	0
16-Dec-07	Collapsible	FC	5	Old pond	0	0	0	0
16-Dec-07	Collapsible	FC	6	Old pond	0	0	1	0
16-Dec-07	Collapsible	FC	7	Old pond	0	0	1	0
16-Dec-07	Collapsible	FC	8	Old pond	0	0	0	0
16-Dec-07	Collapsible	FC	9	Old pond	0	0	3	0
16-Dec-07	Collapsible	FC	10	Old pond	1	0	0	0
16-Dec-07	Collapsible	FC	11	Old pond	1	0	0	0
16-Dec-07	Collapsible	FC	12	Old pond	0	0	0	0
16-Dec-07	Collapsible	FC	13	Old pond	0	0	0	0
16-Dec-07	Collapsible	FC	14	Old pond	0	0	2	0
16-Dec-07	Collapsible	FC	15	Old pond	0	0	0	3
16-Dec-07	Collapsible	ENP	1	New pond	0	0	0	0
16-Dec-07	Collapsible	ENP	2	New pond	4	0	0	0
16-Dec-07	Gee minnow	ENP	3	New pond	3	0	1	0
16-Dec-07	Collapsible	ENP	4	New pond	6	2	0	0
16-Dec-07	Collapsible	ENP	5	New pond	2	0	1	0
16-Dec-07	Collapsible	ENP	6	New pond	0	0	0	6
16-Dec-07	Collapsible	LNP	1	New pond	0	14	2	1
16-Dec-07	Collapsible	LNP	2	New pond	3	1	13	0
16-Dec-07	Gee minnow	LNP	3	New pond	1	0	12	0
16-Dec-07	Collapsible	LNP	4	New pond	0	0	23	0
16-Dec-07	Collapsible	LNP	5	New pond	0	5	11	0
16-Dec-07	Collapsible	LNP	6	New pond	1	0	12	0
16-Dec-07	Collapsible	LNP	7	New pond	1	1	2	0
16-Dec-07	Collapsible	LNP	8	New pond	4	2	7	0
16-Dec-07	Gee minnow	RS	1	River	0	0	2	5
16-Dec-07	Collapsible	RS	2	River	0	1	7	2
16-Dec-07	Collapsible	RS	3	River	0	3	33	0
16-Dec-07	Gee minnow	RS	4	River	0	0	8	0
16-Dec-07	Gee minnow	RS	5	River	0	0	20	0
16-Dec-07	Collapsible	RS	6	River	0	0	19	0
16-Dec-07	Gee minnow	RS	7	River	0	0	0	2
16-Dec-07	Collapsible	RS	8	River	0	5	23	1
16-Dec-07	Gee minnow	RS	9	River	0	0	21	0
16-Dec-07	Collapsible	RS	10	River	0	0	5	0
15-Jan-08	Collapsible	SP	1	Old pond	0	0	5	0
15-Jan-08	Collapsible	SP	2	Old pond	0	0	0	1
15-Jan-08	Collapsible	SP	3	Old pond	0	0	14	0
15-Jan-08	Gee minnow	SP	4	Old pond	0	0	11	0
15-Jan-08	Collapsible	SP	5	Old pond	0	0	2	1
15-Jan-08	Collapsible	FNP	1	New pond	0	0	1	0
15-Jan-08	Collapsible	FNP	2	New pond	19	0	0	4
15-Jan-08	Collapsible	FNP	3	New pond	10	0	1	1
15-Jan-08	Gee minnow	FNP	4	New pond	0	0	1	0
15-Jan-08	Collapsible	FNP	5	New pond	27	1	11	0
15-Jan-08	Collapsible	FNP	6	New pond	0	0	2	0
15-Jan-08	Collapsible	FC	1	Old pond	9	0	2	4
15-Jan-08	Collapsible	FC	2	Old pond	0	0	0	0
15-Jan-08	Gee minnow	FC	4	Old pond	3	0	3	2
15-Jan-08	Collapsible	FC	5	Old pond	0	0	0	3
15-Jan-08	Collapsible	FC	7	Old pond	0	0	1	4

15-Jan-08	Collapsible	FC	8	Old pond	0	0	0	0
15-Jan-08	Collapsible	FC	9	Old pond	1	0	2	0
15-Jan-08	Collapsible	FC	10	Old pond	3	0	2	0
15-Jan-08	Collapsible	FC	11	Old pond	0	0	0	1
15-Jan-08	Collapsible	FC	12	Old pond	0	0	2	1
15-Jan-08	Collapsible	FC	13	Old pond	0	0	2	0
15-Jan-08	Collapsible	FC	14	Old pond	0	0	0	0
15-Jan-08	Collapsible	FC	15	Old pond	0	0	0	3
15-Jan-08	Collapsible	ENP	1	New pond	29	2	4	0
15-Jan-08	Collapsible	ENP	2	New pond	0	0	0	0
15-Jan-08	Collapsible	ENP	3	New pond	19	0	0	0
15-Jan-08	Gee minnow	ENP	4	New pond	33	0	0	5
15-Jan-08	Collapsible	ENP	5	New pond	0	1	2	0
15-Jan-08	Collapsible	ENP	6	New pond	0	0	0	1
15-Jan-08	Collapsible	LNP	1	New pond	0	0	2	1
15-Jan-08	Collapsible	LNP	2	New pond	1	2	14	0
15-Jan-08	Collapsible	LNP	3	New pond	0	1	2	0
15-Jan-08	Gee minnow	LNP	4	New pond	5	5	3	0
15-Jan-08	Collapsible	LNP	5	New pond	15	0	5	0
15-Jan-08	Collapsible	LNP	6	New pond	2	3	7	0
15-Jan-08	Collapsible	LNP	7	New pond	5	0	13	0
15-Jan-08	Collapsible	LNP	8	New pond	0	0	7	0
15-Jan-08	Gee minnow	RS	1	River	0	0	3	0
15-Jan-08	Collapsible	RS	2	River	0	0	5	0
15-Jan-08	Collapsible	RS	3	River	0	0	0	0
15-Jan-08	Gee minnow	RS	4	River	0	0	17	0
15-Jan-08	Collapsible	RS	5	River	0	0	9	0
15-Jan-08	Gee minnow	RS	6	River	0	0	14	0
15-Jan-08	Gee minnow	RS	7	River	0	0	15	0
15-Jan-08	Collapsible	RS	8	River	0	5	12	0
15-Jan-08	Collapsible	RS	9	River	0	0	5	0
15-Jan-08	Gee minnow	RS	10	River	0	0	3	1
12-Feb-08	Collapsible	SP	1	Old pond	0	0	1	0
12-Feb-08	Collapsible	SP	2	Old pond	0	0	0	1
12-Feb-08	Collapsible	SP	3	Old pond	1	0	1	0
12-Feb-08	Collapsible	SP	4	Old pond	0	0	1	0
12-Feb-08	Gee minnow	SP	5	Old pond	0	0	2	0
12-Feb-08	Collapsible	FNP	1	New pond	0	0	0	0
12-Feb-08	Collapsible	FNP	2	New pond	9	0	0	2
12-Feb-08	Collapsible	FNP	3	New pond	1	0	3	0
12-Feb-08	Collapsible	FNP	4	New pond	0	0	0	0
12-Feb-08	Gee minnow	FNP	5	New pond	0	0	0	0
12-Feb-08	Collapsible	FNP	6	New pond	0	0	0	0
12-Feb-08	Collapsible	FC	1	Old pond	11	0	6	1
12-Feb-08	Collapsible	FC	2	Old pond	24	0	2	2
12-Feb-08	Collapsible	FC	3	Old pond	0	0	0	1
12-Feb-08	Collapsible	FC	4	Old pond	6	0	4	4
12-Feb-08	Gee minnow	FC	5	Old pond	0	0	0	0
12-Feb-08	Collapsible	FC	6	Old pond	0	0	3	0
12-Feb-08	Collapsible	FC	7	Old pond	0	0	0	0
12-Feb-08	Collapsible	FC	8	Old pond	0	0	0	1
12-Feb-08	Collapsible	FC	9	Old pond	0	0	4	0

Date	Trap type	Site	Trap number	Site type	Inanga per trap per day	Smelt per trap per day	Bullies per trap per day	Eels per trap per day
12-Feb-08	Collapsible	FC	11	Old pond	0	0	2	0
12-Feb-08	Collapsible	FC	13	Old pond	0	0	0	0
12-Feb-08	Collapsible	FC	14	Old pond	0	0	2	0
12-Feb-08	Collapsible	FC	15	Old pond	0	1	6	0

12-Feb-08	Collapsible	ENP	1	New pond	0	1	3	0
12-Feb-08	Collapsible	ENP	2	New pond	0	1	3	0
12-Feb-08	Collapsible	ENP	3	New pond	0	0	1	5
12-Feb-08	Collapsible	ENP	4	New pond	0	0	0	0
12-Feb-08	Gee minnow	ENP	5	New pond	6	0	0	5
12-Feb-08	Collapsible	ENP	6	New pond	1	0	4	0
12-Feb-08	Collapsible	LNP	1	New pond	0	0	5	1
12-Feb-08	Collapsible	LNP	2	New pond	1	0	10	0
12-Feb-08	Collapsible	LNP	3	New pond	0	0	9	0
12-Feb-08	Collapsible	LNP	4	New pond	9	0	2	1
12-Feb-08	Gee minnow	LNP	5	New pond	34	8	21	0
12-Feb-08	Collapsible	LNP	6	New pond	1	0	5	0
12-Feb-08	Collapsible	LNP	7	New pond	4	1	17	0
12-Feb-08	Collapsible	LNP	8	New pond	0	0	1	0
12-Feb-08	Gee minnow	RS	1	River	0	0	7	0
12-Feb-08	Collapsible	RS	2	River	0	0	23	0
12-Feb-08	Collapsible	RS	3	River	0	0	17	0
12-Feb-08	Gee minnow	RS	4	River	0	0	13	0
12-Feb-08	Gee minnow	RS	5	River	0	0	5	2
12-Feb-08	Collapsible	RS	6	River	0	2	24	0
12-Feb-08	Collapsible	RS	7	River	0	1	13	0
12-Feb-08	Gee minnow	RS	8	River	0	1	22	0
12-Feb-08	Gee minnow	RS	9	River	0	0	8	0
12-Feb-08	Collapsible	RS	10	River	0	1	33	0