Lessons Learnt 011

Floating fish ramp provides passage for inanga in Irongate Stream

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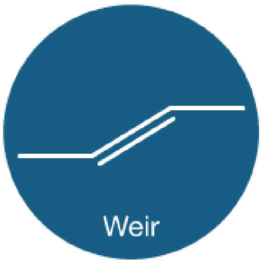
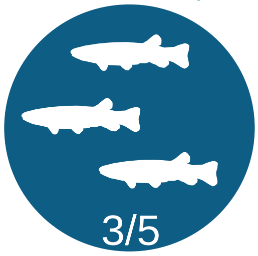
This case study forms part of a series that provides key information and guidance about how to potentially improve a fish passage barrier in a New Zealand waterway.

While providing fish passage is advantageous to most fish, removing or remediating a barrier can also affect fish populations by introducing invasive species to new areas.



STRUCTURE TYPE



IMPROVEMENT RATING*

What was the problem?

A weir located on the Irongate Stream in lowland Hawke's Bay was impeding passage of migratory fish such as inanga (*Galaxias maculatus*). The weir is located approximately 20 km inland, with a vertical drop height of approximately 0.5 m at base flow, and a turbulent plunge pool. In elevated flows, when the weir is inundated, the structure channelises downstream water such that a velocity barrier is created.

A survey of the fish community was conducted using 6 fine mesh fyke nets and 12 unbaited Gee minnow traps set 20 m apart over a 150 m reach. Nets and traps were set both upstream and downstream of the weir (i.e., a total of 12 fyke nets and 24 Gee minnow traps). Comparisons of the fish community caught up and downstream of the weir showed the structure was acting as a barrier to inanga, but not to longfin (*Anguilla dieffenbachii*) or shortfin (*Anguilla australis*) eels. Common bully (*Gobiomorphus cotidanus*) and goldfish (*Carassius auratus*) were caught in the downstream reaches, although their low abundances make it difficult to assess the impact of the barrier

What was the solution?

Hawke's Bay Regional Council installed a plastic floating fish ramp (2.4 m long; ATS Environmental) to improve inanga passage. Plastic baffled sheets, with small raised cusps modelled on a drainage product Miradrain® (Figure 1), were screwed to the ramp surface to break up the laminar flow and slow water velocities. The ramp and baffled sheet combination were based on initial NIWA research (Baker and Boubée 2006; Baker 2014) and developed by the Hawke's Bay Regional Council (Fake 2018) and ATS Environmental. The ramp featured a hinge made from 8 mm thick conveyor belt rubber, which provided a robust yet flexible attachment, allowing the ramp to rise and fall with water levels and to twist laterally with eddy currents in flood events, thus reducing shear strain on fixings.

A steel bracket was fabricated in order to provide a surface to attach the hinge to the structure. This bracket spanned the top of the weir and rose up 400 mm on each side to provide fixing to the upstream face of the weir walls (the steel bracket is unnecessary in perched culvert applications, as the hinge can be fixed directly into the culvert material using stainless steel mushroom spikes). In addition, a 4.5 m length of mussel spat rope (UV stabilised polypropylene 'Super Xmas Tree') was anchored in the centre of the hinge with a stainless steel 'P clip', so that 2 strands extended down the ramp. Lab trials of such ramps found spat rope improved passage of redfin bullies (Fake 2018).

* Improvement rating: 3/5 – Some improvement in upstream <u>and</u> downstream passage <u>and</u> for target species/life stages.

Figure 1: The floating fish ramp (with spat rope) on the Irongate Stream weir

Monitoring results

Table 1 summarises the monitoring results pre- and post-remediation. A pre-remediation survey of the fish community in April 2016 revealed a fragmented population of inanga, with 20 individuals caught downstream, but none upstream of the weir. The low catch rates downstream in the pre-remediation survey (relative to later surveys) are thought to be attributed to higher flows, which increased the depth of stream and may have reduced trapping efficiency. It was decided to use inanga response as the proxy for ramp efficacy in this setting, given their relative abundance downstream and general lack of climbing ability.

Table 1. Species' abundances from the Irongate Stream monitoring, from pre-remediation (before ramp installation, April 2016), post-remediation 1 (after installation of the sunken ramp, November 2016), and post-remediation 2 (after installation of the sealed ramp, April 2019).

	Pre-remediation 1 April 2016		Post-remediation 1 November 2016		Post-remediation 2 April 2019	
Species	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream
Inanga	20	0	504	0	1354	740
Common bully	1	0	1	1	13	0
Longfin eel	17	10	12	13	55	24
Shortfin eel	19	37	14	15	81	15
Goldfish	20	0	5	0	17	0

The post-remediation survey in November 2016 (post-remediation 1) found 504 inanga downstream, but none upstream. Upon inspection of the ramp, it was revealed that the ramp had sunk and was not providing passage for inanga. Water ingress had caused the ramp to partially sink, resulting in a much shorter, steeper ramp. It was hypothesised that the screw holes from the baffled sheets had leaked.

A new ramp was deployed in January 2019, with the baffled sheets plastic welded to the ramp, resulting in a fully sealed unit. This replacement ramp floated as intended. After installing the fully sealed ramp unit, another survey in April of 2019 (post-remediation 2) found 1354 inanga downstream and 704 upstream of the ramp.

The higher abundances of inanga downstream relative to upstream reaches in the April 2019 survey (Table 1) suggest the ramp may still be acting as a partial barrier, and could be favouring larger inanga with stronger swimming abilities (Figures 2 & 3). Inanga caught in upstream reaches were on average 10 mm longer than in downstream subreaches (Figure 2), and inanga <70 mm were less abundant in upstream reaches relative to downstream reaches (Figure 3).

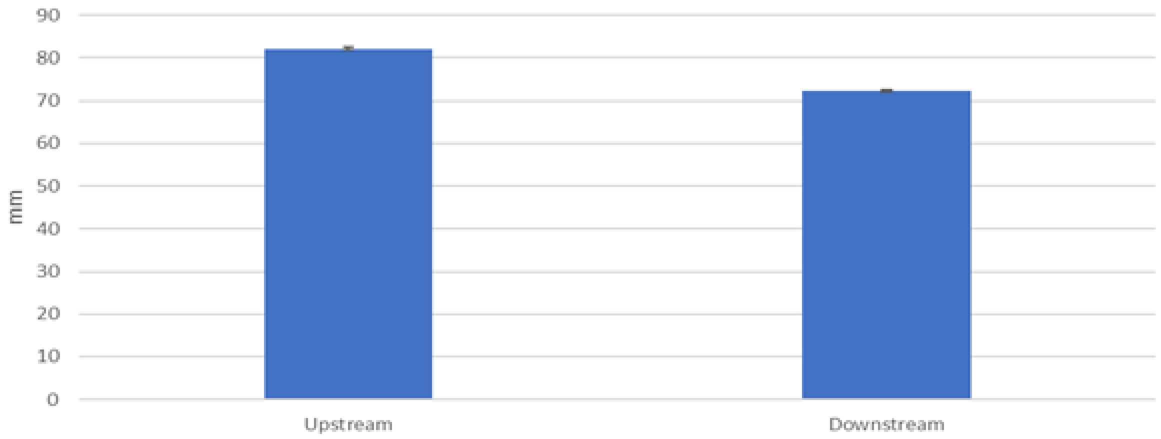


Figure 1. Average size (mm) of inanga upstream and downstream of the ramp in the second post-remeidation monitoring, April 2019.

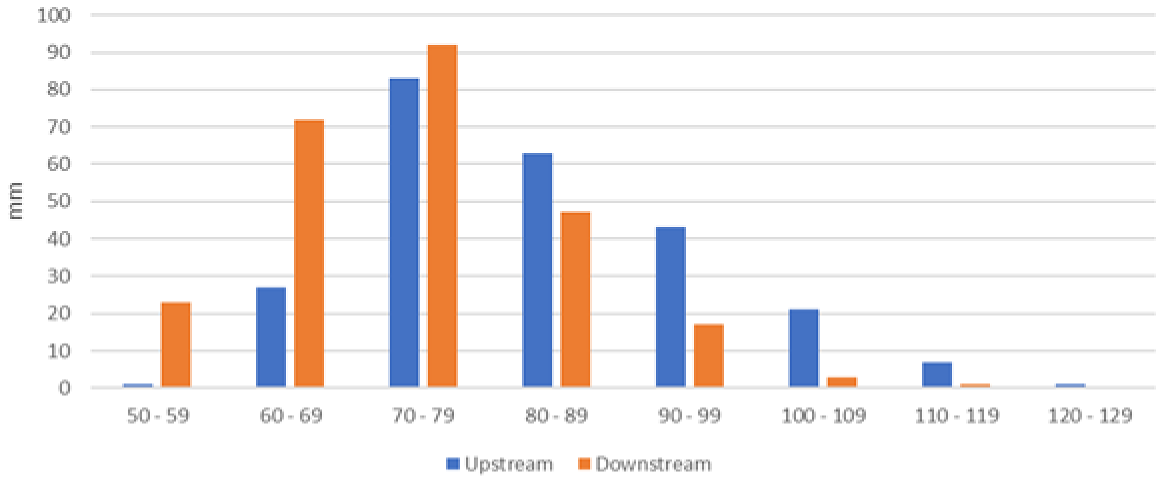


Figure 2. Size classes of inanga upstream and downstream of the ramp captured in the second post-remediation monitoring, April 2019.

The abundance of both longfin and shortfin eels varied greatly both between monitoring rounds, and upstream and downstream of the weir. Abundances in the pre-remediation (April 2016) and first post-remediation (Nov 2016) monitoring rounds suggest the weir was not acting as a barrier to eels, and overall abundances for both species were similar between these sampling rounds. In the second post-remediation (April 2019) monitoring round, eels were much more abundant downstream of the weir, but it is unlikley that this is as a result of the ramp installation.

Did it work?

Post-remediation monitoring showed the sealed ramp had enabled passage for inanga, although the higher abundance and smaller average sizes in the downstream reaches suggest the ramp may still be acting as a partial barrier for smaller fish with reduced swimming ability. Interestingly, in lab trials for these ramps, and at a parallel study site in the Awanui Stream, Hawke's Bay, inanga size did not affect passage success (Fake 2018). In addition, post-remediation monitoring in the Awanui Stream found inanga abundance was similar upstream and downstream. Perhaps the highly aerated and turbulent plunge pool at the Irongate Stream site (Figure 1) posed additional challenges to fish attempting to locate and navigate the barrier. By comparison, the Awanui Stream barrier has a lower perch height and a less turbulent plunge pool.

A single common bully was detected upstream of the ramp in the first (November 2016) post-remediation monitoring, but none were detected in the second monitoring. The overall low abundance of common bully makes it difficult to conclude whether the ramp is assisting the passage of this species. The floating entrance to the ramp in a large plunge pool may favour pelagic species such as inanga, compared with benthic bully species. Although not caught at this site, redfin bullies have been shown to locate and surmount these ramps in a tank setting (Fake 2018). Redfin bullies are capable of climbing wetted margins whereas common bullies must swim past impediments. This highlights the importance in understanding differences in behaviour during passage when considering remediation actions.

Goldfish were found downstream but not upstream of the ramp, however, their overall low abundances make it difficult to conclude if this species is using this ramp, or not.

It is not thought that the weir poses a barrier to elver migrations, as eels were found upstream and downstream of the structure.

Lessons learnt

1. Inexpensive baffled ramps can mitigate low head / small migration barriers for swimming fish species like inanga.

2. A full floating ramp (2.4 m) was installed at this site and improved passage over a perch height of 0.5 m. At their full length of 2.4 m, to target swimming species, floating ramps can be considered for perches up to 0.7 m. If only climbing species are being considered, floating ramps can provide passage at higher perches up to 1.7 m. Ramps can be cut to size in settings where plunge pool dimensions are such that a shorter ramp is needed, however, extra buoyancy may be needed if internal buoyancy is compromised.

3. By plastic welding the baffled sheets onto the ramp, and keeping it fully sealed, the ramp remained buoyant and facilitated better passage of inanga. The sealed ramp has now been in place for 2 years and is still buoyant.

4. Ensuring buoyancy of the ramp is crucial to success. If holes are drilled or the ramp is cut, the internal buoyancy will be compromised which is an issue in deep pools. In shallow systems the ramp sits on the bottom in base flows so does not become steeper.

5. The ramp may still be acting as a partial barrier and may be excluding smaller inanga. This may be due to the highly aerated plunge pool and steeper ramp angle at the Irongate Stream.

6. Further monitoring is required to assess the passage efficacy for other species such as common bully, and whether it is stopping upstream passage of goldfish.

For further information

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References:

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Baker, C.F., Boubée, J. 2006: Upstream passage of inanga *Galaxias maculatus* and redfin bullies *Gobiomorphus Hutton* over artificial ramps. *Journal of Fish Biology, 69: 668-681.*

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