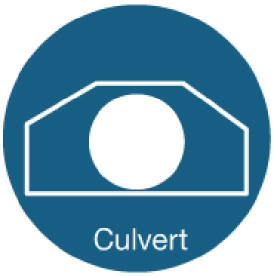
Lessons Learnt 001

Installation of a fish ramp and baffles to restore fish passage at a perched culvert

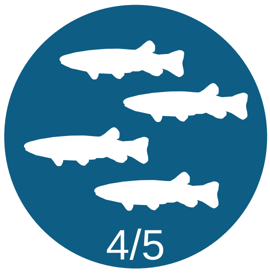
March 2020 V2

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



What was the problem?

Several indigenous fish species were excluded from Bankwood Stream, Hamilton, by a perched concrete culvert (1.5 m diameter; 73.8 m length; gradient 0.3–2.55°). The culvert had not been built to facilitate fish passage, and as such the barrel water velocities were too high to permit upstream passage for swimming fish, such as inanga (*Galaxias maculatus*) and common smelt (*Retropinna retropinna*), and the outlet had become perched.

Declines in indigenous fish species, such as inanga and common smelt, are a significant concern for local communities in the catchment.

We considered protection and restoration of access to upstream habitats for these whitebait species a priority, as the whitebait fishery is of cultural and recreational importance. Our key aim for this work was to restore upstream passage for non-climbing fish species, such as inanga and smelt.

What was the solution?

We initially installed a fish ramp at the outlet of the pipe culvert. The ramp was made of concrete, embedded with cobbles and angled horizontally (5°). A receiving pool (approximately 2 m x 2m) was installed at the top of the ramp. The final built ramp was 16 m long and 0.9 m wide, with a slope of 5.7°.

Monitoring showed that the fish ramp alone did not provide passage for the target species because of high water velocities in the culvert. In response, we installed spoiler baffles within the culvert.

Thirty-six UV stabilized polyethylene spoiler baffle sheets (2 x 0.9 m; Rotational Plastics Ltd.), with baffles (0.25 x 0.10 x 0.12 m) spaced 0.10 m apart laterally and 0.25 m longitudinally, were secured to the culvert base with 5 mm Dynabolts™ and 20 mm stainless steel washers. Baffles were configured in alternating offset rows of 3–4 baffles.

BEFORE

April 2007. *Photo: NIWA*

AFTER

September 2009. *Photo: NIWA*

* Improvement rating: 4/5 – Improved upstream and downstream passage for expected species.

Monitoring results

Monitoring showed that installation of a ramp allowed common bully and torrentfish passage upstream, and the ramp and baffles enabled juvenile banded kokopu, smelt, inanga and torrentfish to migrate upstream (Figure 1). Follow-up surveys since 2010 have shown that both smelt and inanga have continued to be present. We undertook quantitative electrofishing annually in January in two 50 m^2 reaches upstream of the culvert, and a few supplementary surveys were also carried out around the time the fixes were installed.

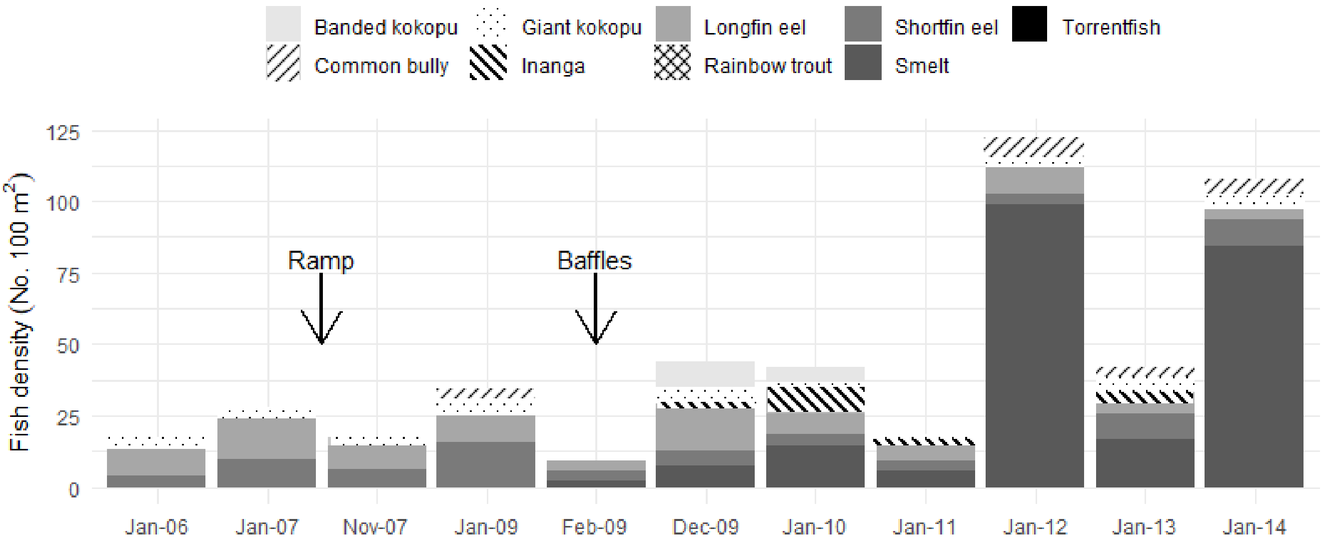


Figure 1. Results of fish community monitoring before and after ramp and baffle installation upstream of the culvert over time.

Mark-recapture trials on both the ramp and baffled culvert were carried out using elastomer tags in 2009. After 9 hours 27.1% of inanga had passed the 16 m long fish ramp, with the first fish getting there within 60 minutes and the majority reaching the top within 4 hours. The fastest inanga took 5 hours to reach the top of the culvert (73.8 m) after the baffles were installed, with 7.9 % of trial inanga getting to the top in 24 hours.

Passage through the culvert was retested in 2015 using the staining method set out in the NZ Fish Passage Guidelines (Franklin et al. 2018). After 24 hours 28% of the inanga (47-85 mm) had successfully reached the top of the culvert. There was no statistically significant difference in the size of inanga that successfully passed the culvert relative to those that did not pass.

The close to five-fold difference in success of inanga passing the culvert between the 2009 and 2015 tests was attributed to the difference in the fish marking methods used. Elastomer tagging is more stressful for the fish than the staining process. Trials have shown no significant difference in the passage success of stained and unstained fish, hence the recommendation in the NZ Fish Passage Guidelines to use the staining method for monitoring and evaluation of fish passage success.

Did it work?

Yes. Installation of the fish ramp and spoiler baffles at this culvert overcame migration barriers for weak swimming fish (including inanga and common smelt) under low-flow conditions and enhanced the composition of the upstream fish community.

Lessons learnt

1. Outcome monitoring is critical as we found that installing a fish ramp alone did not provide passage for the target fish species.
2. This remediation configuration could be used successfully for other structures with similar characteristics and dimensions and can probably be adapted to other size structures.
3. The baffle sheets must be secured correctly as inadequate fixings led to a small number of baffle sheets failing after the initial installation. Once this was corrected, the sheets remained in place with no maintenance for 10 years. A couple sheets that failed recently after 10 years were replaced.
4. The receiving pool at the downstream end of the culvert needs to be large enough to provide resting areas for fish and dissipate energy without causing turbulent conditions unsuitable for fish.

For further information

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References:

Franklin, P., Gee, E., Baker, C., Bowie, S. 2018: *New Zealand Fish Passage Guidelines for structures up to 4 metres.* NIWA client report 2018019HN, Hamilton. P226.

Franklin, P.A.; Bartels B. *2012: Restoring connectivity for migratory native fish in a New Zealand stream: effectiveness of retrofitting a pipe culvert.* Aquatic Conservation: Marine & Freshwater Ecosystems 22(4)*: 489–497.*

This is a revised/updated version, original was published in September 2015.