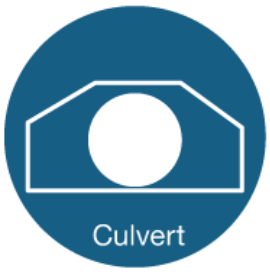
Lessons Learnt 002

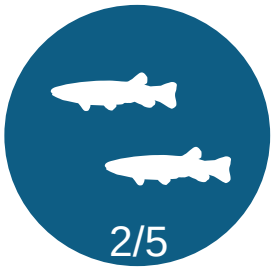
Installation of mussel spat rope to retrofit a perched culvert to improve passage for climbing fish

April 2020 V2

This case study forms part of a series of factsheets that provides key information and guidance about attempts to improve a fish passage barrier in a New Zealand waterway. While providing fish passage is advantageous to most fish, it is important to consider potential impacts of introducing invasive species to new areas by removing or remediating barriers.



STRUCTURE TYPE



IMPROVEMENT RATING*

What was the problem?

Small numbers of climbing fish (banded kokopu, *Galaxias fasciatus;* and redfin bully, *Gobiomorphus huttoni*) were found upstream of a severely perched culvert in a Coromandel stream (treatment site). By comparison, a nearby stream with similar attributes and no significant barrier (control site) had good numbers of fish.

A field trial was undertaken to test whether the relative abundance of "young-of-the-year" migratory fish species would increase following installation of mussel spat rope at the perched culvert.

The fish passage barrier was a single barrel concrete culvert (8.0 m long x 1.5 m diameter) and since installation, this culvert has eroded away from the downstream end to create a 2.4 m high perch and 1.0 m horizontal undercut.

Reinstating riverine connectivity for native species to undeveloped land where other human pressures are minimal was considered a key action to promote better protection of climbing diadromous freshwater fish.

What was the solution?

Mussel spat ropes (UV stabilised polypropylene 'Super Xmas Tree') were installed to address both the culvert perch that was preventing upstream access for climbing species, and also to reduce flow velocity within culvert barrel that had been found to inhibit passage (see inset photo Figure 1).

Ropes (26 m) were installed using waratahs and 'D' shackles rammed into the upstream stream bed and fixed to a downstream gabion basket (built on site) to create eight lines of rope (13 m each) that disperse the concentrated culvert flow.

Figure 1. Perched culvert with spat rope installed. Inset shows spat rope within culvert (January 2012; Photo: Bruno David).

* Improvement rating: 2 - Some improvement in upstream or downstream passage and for some species life stages over the entire barrier

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Installation costs were $250 for rope and installation materials, including approximately 100 m rope (@$1-2/m), 6 waratahs (4 at top, 2 at bottom), 6 stainless 'D' shackles and 1 gabion basket filled with local rock. We took approximately 4 hours for 2 people to complete the install.

Monitoring results

Monitoring showed a three to four-fold increase in fish abundance relative to the control stream a year after installation of the ropes (Figure 2). The increased abundance was primarily driven by the significant increase in banded kokopu observed. We undertook standardised spotlighting over a 150 m reach in both the control and treatment streams 3 x annually from 2009-2011.

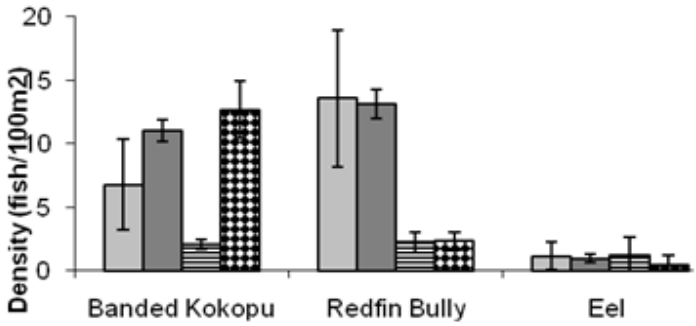

Figure 2. Mean density of each fish species recorded by standardised spotlighting methods on three occasions over 150m for control (pre-2009 = light grey, post 2010 = dark grey), and treatment (pre-2009 = horizontal lines, post 2010 = black diamonds) streams. Error bars expressed as standard deviation around the mean.

Two follow up visits, in 2015 and in 2019, found the ropes to still be in excellent condition, remaining taut with biological growth of mosses and filamentous algae covering the ropes around the inlet and outlet areas where more light was available (Figure 3).

Figure 3. Photos from follow up visits to the perched culvert, showing that the ropes were still in excellent condition and remained taut with biological growth of mosses and filamentous algae covering (2015 and 2019. Photo: Bruno David).

In 2019, we revisited the site to sample the macroinvertebrate community within the culvert and on the ropes. We surveyed the macroinvertebrates by placing a fine-mesh net downstream of the culvert and shaking the ropes and electro-fishing the area to dislodge as many invertebrates as possible. More than 6,500 macroinvertebrates, including 51 taxa (including 20 different mayfly, stonefly and caddisfly taxa) were found demonstrating that this substrate may be colonised and used by a wide variety and number of invertebrates.

Did it work?

- A significant increase in relative abundance of young-of-the-year banded kokopu was observed, relative to the control site, but no significant change was found for redfin bullies or eels during the study period.
- Redfin bullies were seen aggregating at the base of the ropes, indicating that this species could not negotiate the culvert and ropes in the displayed configuration.
- Eels were in very low abundance at both the control and treatment sites throughout the 2009 / 2010 study and adding the ropes did not result in a measurable change over this period.

Lessons learnt

1. Mussel spat rope can significantly improve passage at perched culverts for climbing fish species but may not be effective for all species present.
2. A 2.4 m vertical rope climb is achievable for "young-of-year" banded kokopu but is too far for redfin bullies. Investigations of other retrofit options (e.g. ramps) to reinstate passage for this species at these perch heights are needed.
3. The results from this study cannot conclusively demonstrate if spat ropes aid eel passage at this height, although observations of successful eel passage at lower perch heights elsewhere have been made.
4. Control site monitoring is essential to evaluate magnitude of retrofit response —fish recruitment could vary within years and mask outcomes and lead to a false positive result.
5. Method and effort consistency are essential to minimise variance unrelated to treatment.
6. Over time, ropes can provide a suitable substrate for accommodating diverse and abundant aquatic invertebrate communities within concrete culvert barrels. Consequently, ropes can assist to partially offset the loss of productive streambed area that can occur following a bare culvert installation.

For further information

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References:

David, B., and Hamer, M. 2012: Remediation of a perched stream culvert with ropes improves fish passage. *Marine and Freshwater Research* 63: 440-449.

David, B. Hamer, M., Tonkin, J. Bourke, C. 2014: *Appropriate use of mussel spat ropes to facilitate passage for stream organisms*. Waikato Regional Council Technical Report 2014/29.

This is an updated version; original was published in September 2015.