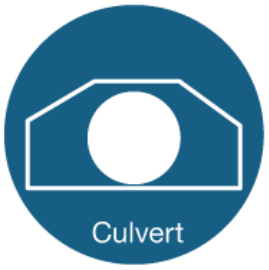
Lessons Learnt 10

Mussel spat rope and rubber apron remediation of Tōtaranui Road culverts.

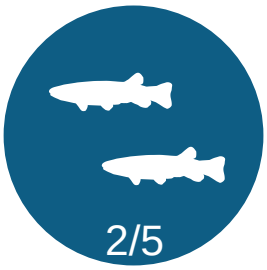
October 2020

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 culvert can also affect fish populations by introducing invasive species to new areas.



STRUCTURE TYPE



IMPROVEMENT RATING*

What was the problem?

Large storm events during 2011 impacted the road to Tōtaranui in the Abel Tasman National Park. Many of the culvert crossings were washed out and a massive rebuilding effort was undertaken, which was completed in 2012.

The streams intersected by the road to Tōtaranui are steep (see Table 1), with typical summer flows in these creeks of about 4-5 l / sec, so only climbing species are expected here, including kōaro, longfin eels / tuna and banded kōkopu.

Due to cost restraints, culverts, which overhung the stabilising rock rip rap of the road embankments, were installed instead of bridges. The newly installed culverts formed a complete barrier to fish passage with a 6-8 m vertical fall and a 0.3-0.5 m horizontal undercut (Figure 1).

Table 1: Geographical statistics for the three culverts.

Culvert number	Gradient (for 500 m downstream)	Distance inland (km)	Height above sea level (culvert inlet)
9 (Awaroa Road)	9%	3.90	139
18 (Tōtaranui Road)	17%	1.99	163
31 (Tōtaranui Road)	21%	2.40	270

What was the solution?

In February 2013, we retrofitted the culverts with mussel spat rope and rubber aprons to allow fish to climb up the vertical drop. We attached mussel spat rope at the inlet of the culvert and all the way through to the stream below. The aprons were attached to the outlet of the culvert.

The aim of the remediation work was to reconnect the downstream and upstream habitat for climbing fish species at three culverts perched by over 6 m (see Figure 1). The objective was to enable fish to access good quality native bush habitat upstream of the culverts.

This remediation took c. 1.5 person hours to complete and cost less than $40 in fixings, with all other materials being donated. Six strands of spat rope were used through each culvert, attached to the culvert with bolts, and extended just beyond the downstream end of the apron (a total length of 32 m of spat rope for culvert 18).

*Improvement rate: 2/5 – Some improvement in passage over part of the barrier and / or for some species

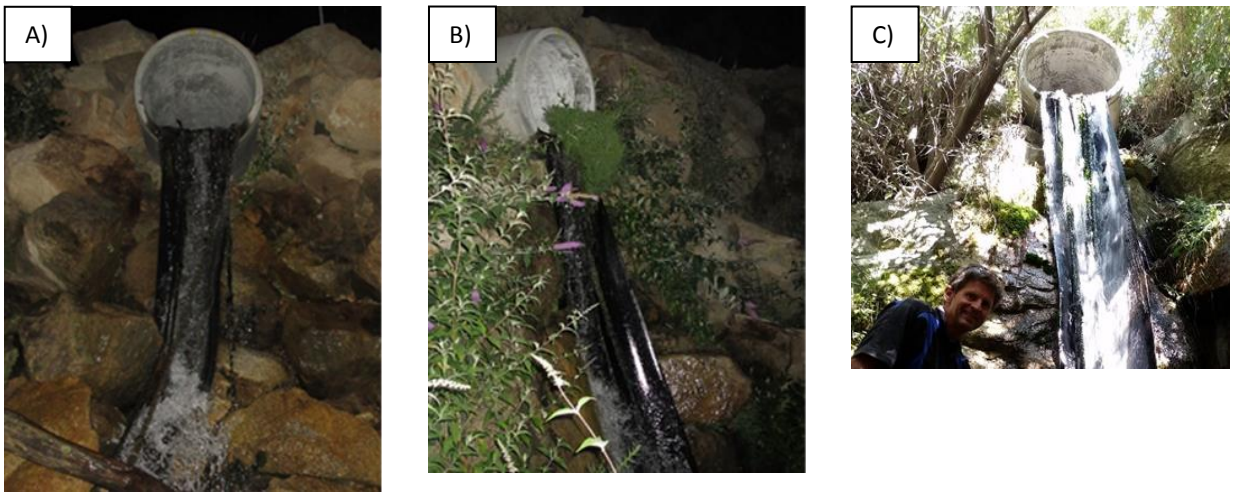


Figure 1: Examples of the retrofitted culverts with rubber apron and mussel spat rope on Tōtaranui and Awaroa Roads, Abel Tasman National Park in 2014. A) Culvert 9, B) Culvert 18, C) Culvert 31. (Photos: Tasman District Council)

Monitoring results

We undertook three spotlighting surveys at each of the three culverts, 1, 2 and 6 years (2014, 2015 and 2019, respectively) after installing the rubber apron and spat rope. This was to determine whether fish passage remediation was successful. Spotlighting was completed upstream and downstream of the three culverts for a distance between 20 m and 80 m, depending on the terrain. We were unable to survey the fish community up- and downstream of the culverts before the retrofit as access was restricted due to the road closure after the flood.

Figures 2 to 4 show the number of fish found above and below each culvert, in 2014, 2015 and 2019. In summary:

- Juvenile kōaro were observed upstream and downstream of culverts 18 and 31, during all sampling years.
- Kōaro ranged between 50-110 mm in length in 2014 and 2015, whereas in 2019 there was a larger range of sizes with maximum lengths reaching up to 180 mm.
- Tuna were found upstream of Culvert 31 in 2015 and 2019.
- Upstream and downstream of culverts 18 overall fish abundance increased dramatically in 2019.
- At culvert 9, kōaro were observed in low numbers both upstream and downstream, but only in 2014. No fish were seen upstream of culvert 9 in the 2015 and 2019 surveys.
- As expected, no other fish species were found during sampling.

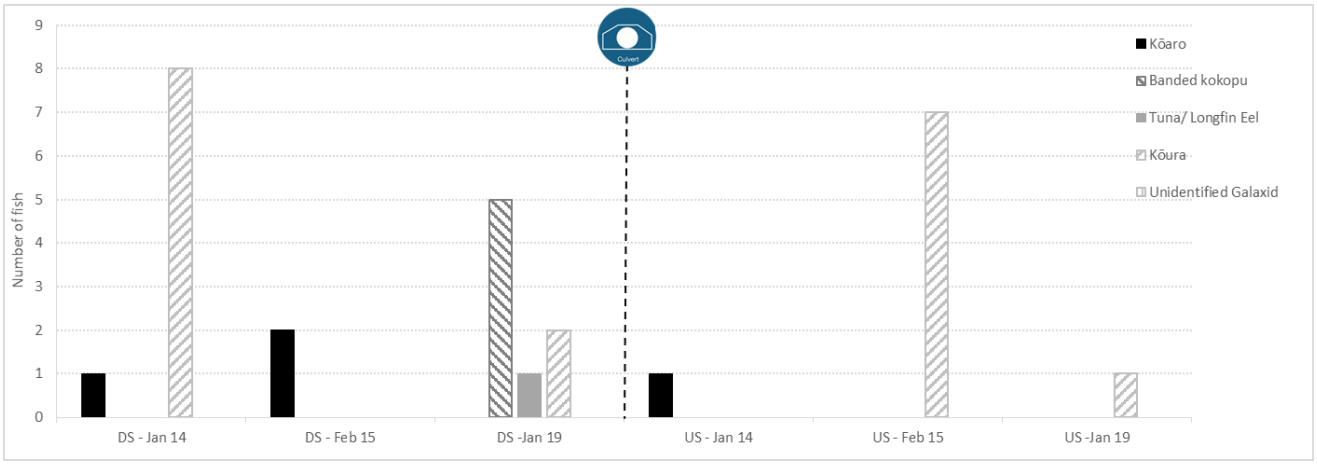


Figure 2: Number of fish for each species present upstream (US) and downstream (DS) of Culvert 9 in 2014, 2015 and 2019.

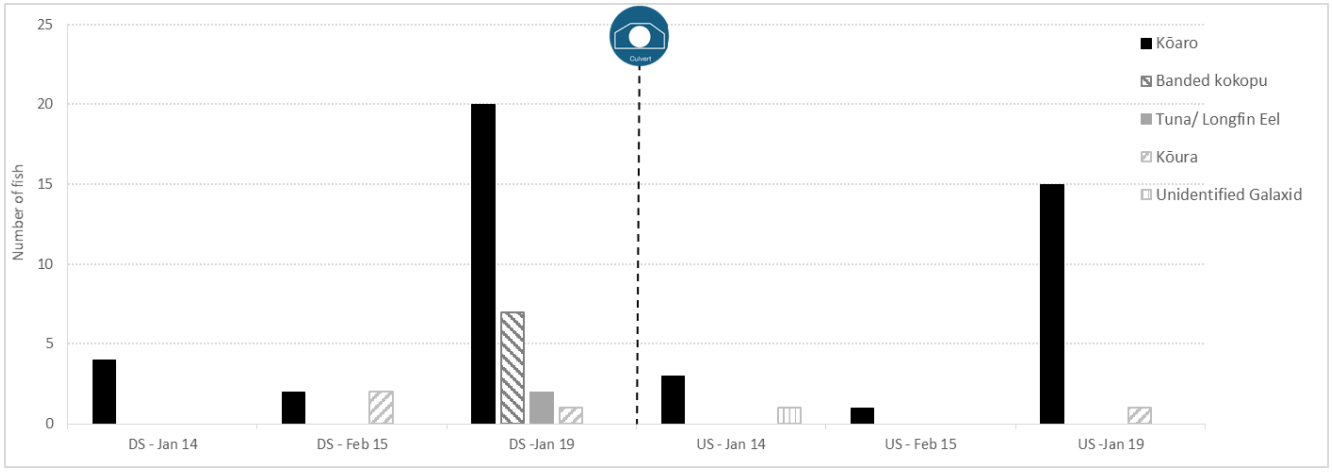


Figure 3: Number of fish for each species present upstream (US) and downstream (DS) of Culvert 18 in 2014, 2015 and 2019.

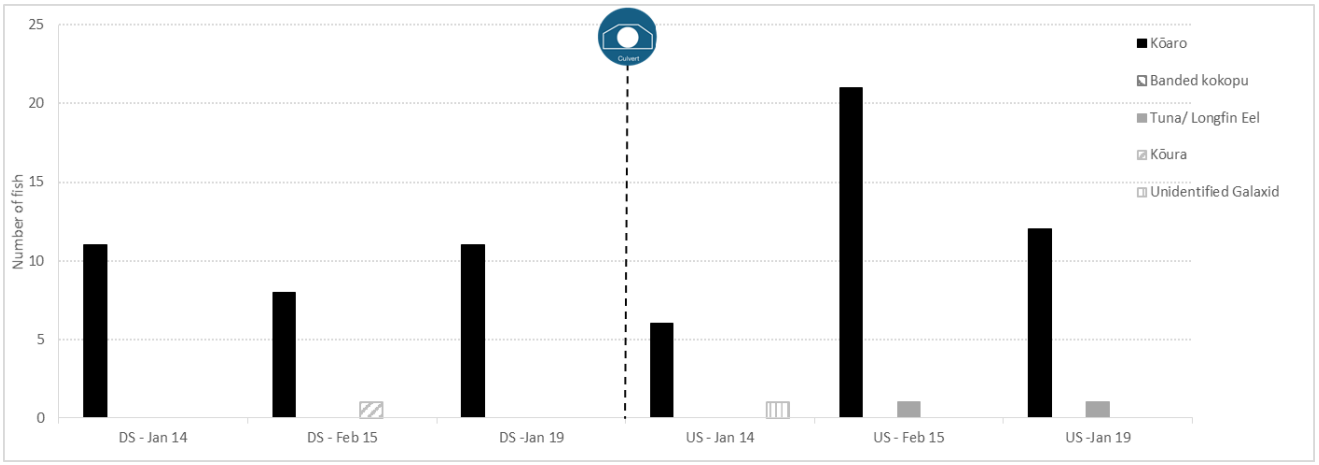


Figure 3: Number of fish for each species present upstream (US) and downstream (DS) of Culvert 31 in 2014, 2015 and 2019.

Did it work?

The presence of juvenile kōaro upstream of two of the retrofitted culverts, and tuna upstream of one culvert, after remediation shows that fish have successfully used the rubber apron, the ropes, or both to pass up the near-vertical slope and through the culvert.

The abundance of fish upstream of the culverts was low on the first two sampling events. This was likely due to fish populations recovering after a very large (1:100 year) storm event that occurred in 2011.

While the streams in this study are small, very steep and contain numerous waterfalls up- and downstream of the study sites, they can support freshwater fish, albeit with species diversity naturally limited to climbing species that are able to navigate the numerous natural barriers downstream of the culverts.

Lessons learnt

1. Retrofitting the outlet of perched culverts with vertical drops of over 4 m to 6 m with mussel spat ropes and rubber aprons can provide passage for climbing fish (e.g. tuna and kōaro) where it was not possible previously. While fish were not observed climbing the apron or spat ropes, they appeared to have made it up over multiple recruitment periods.

2. The value of monitoring over several years showed how successful the remediation was. If we had only sampled fish once or twice, we would have thought it was marginally successful, given the small number of fish that made it. The third sampling event took most people by surprise with how many fish there could be in such a small rugged creek upstream of several significant natural waterfalls. This shows that we need to consider the effect that the initial storm events may have had in delaying the recovery of fish populations.
3. The one situation where no fish were found upstream of culvert 9 appears to be due to the rip-rap rock protection and the water flowing between the rock and not on the surface (i.e. downstream of the culvert). High numbers of fish were observed in the stream below this rock rip rap but none above it or upstream of the culvert. This suggests that the rock rip rap is at fault. It would be useful to install a longer apron to extend over the rock work and then sample again after a spring upstream migration.
4. The rubber apron and spat ropes have remained intact and have not required maintenance for the six years between installation and last inspection in 2019.

For further information

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