Fish Passage Surveys

-Harley Road Culvert-

Olleycology Limited

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Contents

Scope

Undertake fish monitoring to assess the impact the fish passage remediations have made at the Harley Road culvert.

Introduction

This report details the findings of fish surveys completed at a culvert crossing of a small tributary of Field Stream, named hereafter as “Harley Creek” (Figure 1). The crossing is located approximately 1.2 kilometers inland from the Moutere Inlet and it the first structural barrier fish would encounter while moving up from the coast. The box concrete culvert is 1.25 m wide, 3 m long, has a gradient of 1% and max water velocities of 0.4m/s (Table 1). The culvert was also perched 0.45 m and undercut 1 m (Figure 2).

It was considered likely that the drop at the culvert outlet was impeding successful upstream passage of all fish species likely to be found within the catchment. The low gradient and roughened surface on the culvert floor were likely allowing complex flows and water velocities within the swimming capabilities of all fish species likely to be found within the catchment.

Based on the likelihood of this structure being a barrier to fish, the site was chosen for pre and post remediation monitoring. Passive trapping and eDNA sampling were used to assess the impact the fish passage remediation work had made.

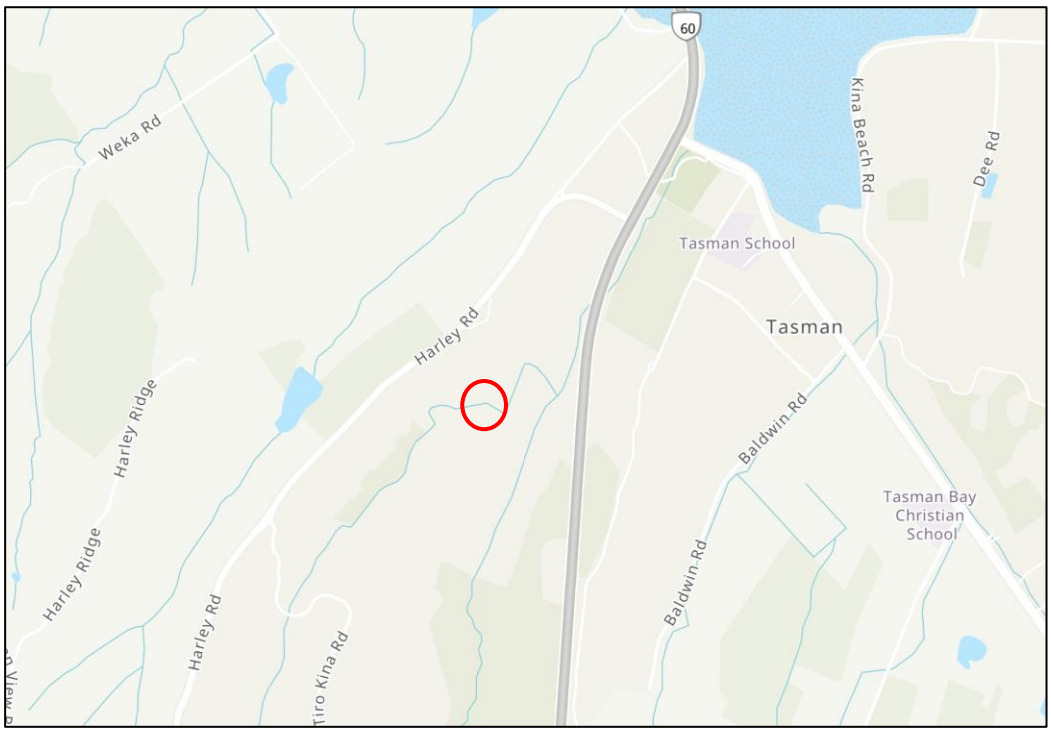

Figure 1. Site location (red circle).

Table 1. Culvert characteristics at Harley Creek.

Culvert type	Box
Culvert length (m)	3
Culvert width (m)	1.25
Culvert Gradient	1%
Culvert material	Concrete
Culvert perch height (m)	0.45
Culvert undercut length (m)	1
Max water velocity (m/s)	0.4

Figure 2. Perched box culvert at Harley Creek prior to remediation.

Methods

To assess the effectiveness of the remediation, an A-frame net was setup at the inlet of the box culvert to capture fish as they moved out of the structure (Figure 3). A second A-frame net was setup downstream of the structure, immediately below the plunge pool, to capture fish as they moved up to the culvert (Figure 4). Fine mesh netting was used to funnel fish into the A-frame nets, and the A-frame nets had “non return” zones to hold fish from escaping (Figure 5). The nets were checked daily (at 8am in the morning) to collect, record and release fish. Fish caught in the downstream net were released upstream into the culvert plunge pool, while the fish caught in the upstream net were released further upstream. Species and fish lengths were recorded along with conductivity and water temperature.

Prior to remediation the culvert was searched for fish, after which seven days of monitoring took place to assess whether fish were moving through the culvert. Post remediation, the nets were monitored for eleven days. The monitoring period spanned between the 14th to the 31st of October 2022.

At the conclusion of the trial the culverts were searched again to recover and record any fish that remained within the structure.

A passive eDNA sampler was placed upstream of the Harley Creek culvert prior to the fish passage remediation (3 replicates) and seven months after remediation (6 replicates).

Figure 3. A-frame net set at culvert inlet.

Figure 4. A-frame net set downstream of culvert.

Figure 5. View from inside the box culvert looking upstream into the A-frame net.

Fish passage remediation

Remediation at the site was completed on the 20th of October 2022, and aimed to improve upstream passage for all fish species likely to be found within the catchment without compromising culvert capacity and causing blockages.

Damage to the culvert floor had resulted in uneven flow at the structure outlet, therefore two ramps were used, one within the high flows on the true right and one within the low flows on the true left. With reference to the Fish Passage Remediation Training Aid 2022, the flexible fish ramps, both made of reinforced PVC rubber, were installed at the culvert outlet to negate the perch (Figure 6). The ramp sizes were 300mm x 1800mm and 700mm x 1800mm respectively and lay vertical. The ramps were fixed to the culvert floor with stainless-steel wedge anchors (M6.5 x 40 mm) and stainless-steel penny washers (32 mm) and included a bundle of looped mussel-rope fixed to the ramp invert running down the center of each ramp (figure 6).

Flexible ramps with mussel-rope are designed to offer aquatic species several choices when migrating e.g., passage over/through mussel-rope, adjacent to mussel-rope or on the wetted margins at the edges of the ramp.

Figure 6. Two flexible rubber ramps with mussel-rope at the culvert outlet.

Monitoring results

No fish were found during the search of the culvert prior to the start of monitoring.

In the seven days prior to any remediation no fish were recovered from the upstream net (Figure 7).

Following fish passage remediation, a total of 110 fish were recovered from the upstream net over the 11 day post remediation survey period (Figure 7).

Juvenile banded kokopu (*Galaxias fasciatus*) (size range 37-45mm) were the most common fish species caught throughout the experiment with 96 individuals captured.

Three other species of fish were also recovered from the upstream net, three koaro (*Galaxias brevipinnis*) (size range 48-50mm), five longfin eels (*Anguilla dieffenbachii)* (size range 90-320mm) and six shortfin eels (*Anguilla australis*) (size range 88-128mm) (Figure 7). Two koura (*Paranephrops spp.*) were also found within the upstream net.

Over the full 18-day trial period, 141 fish were captured in the net placed downstream of the culvert. As with the top net, juvenile banded kokopu also dominated the catch with 134 fish recorded (size range 36-45mm) (Figure 7). Three other species of fish were also captured including three inanga (*Galaxias maculatus*) (size range 80-120mm), three koaro (size range 48-50mm) and one longfin eel measuring 91mm in length (Figure 7).

At the conclusion of the monitoring, no fish were found following during the final search of the culvert.

Results from the eDNA sampler showed three species of fish were present upstream of the structure prior to the remediation - banded kokopu, longfin eel, and shortfin eel. Follow up eDNA sampling showed 5 species of fish were present upstream of the structure post remediation – banded kokopu, longfin eel, shortfin eel, inanga and smelt (*Retropinna retropinna*).

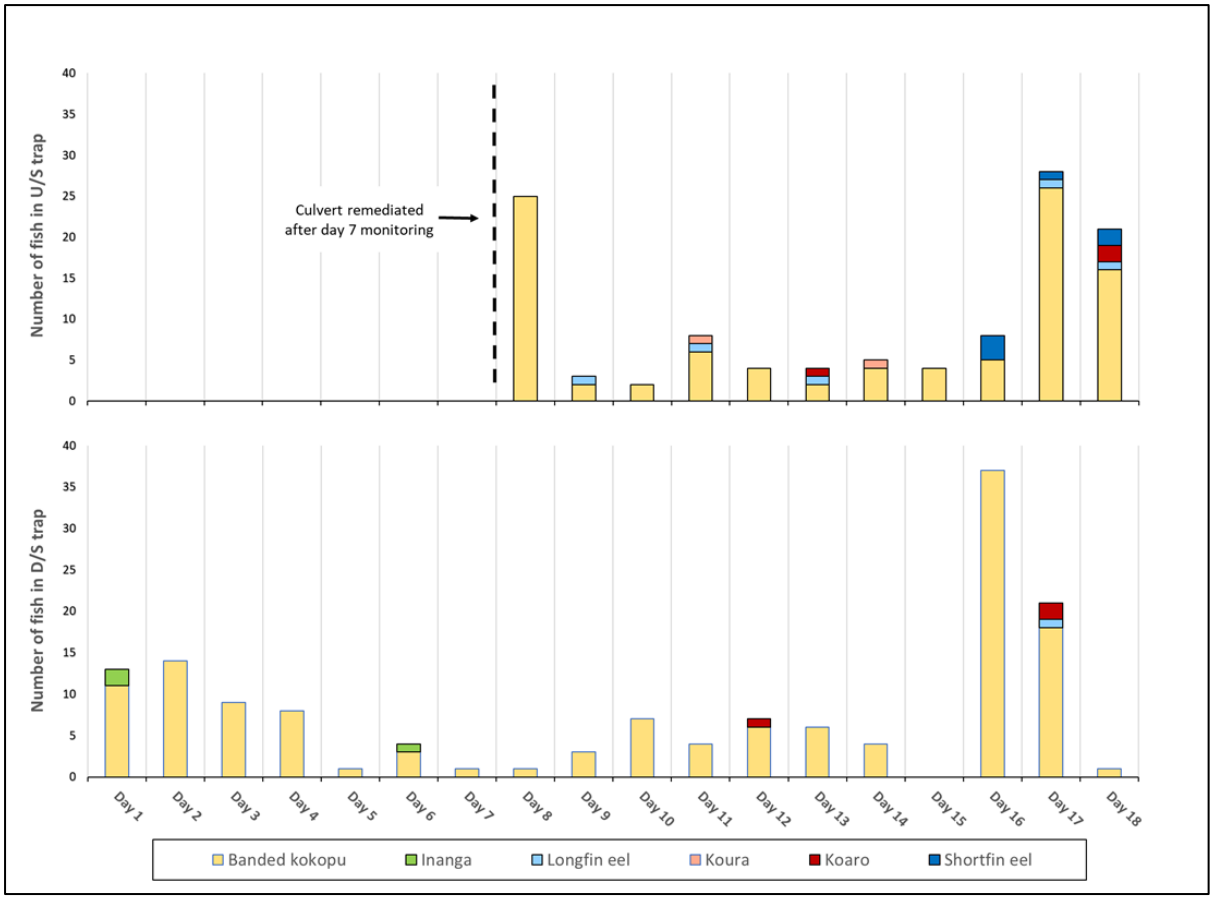

Figure 7. Numbers of fish caught in the A-frame nets upstream and downstream of the culvert pre and post remediation.

Discussion

The trapping results presented here suggest that the Harley Road culvert was a complete barrier to fish migration and that remediating this structure with flexible ramps and looped mussel-rope has improved passage for four species of fish, banded kokopu, koaro, longfin eel and shortfin eel.

No fish were recovered from the upstream net during the pre-remediation survey period. During this time, 50 fish were recovered from the downstream net indicating that fish movement/migration was occurring within the wider survey area. During the first night following remediation an initial pulse of 25 banded kokopu made their way up the ramps, through the culvert and into the upstream net. Over the following nine days consistent numbers of banded kokopu, koaro, long fin eels, shortfin eels and koura also transitioned through the culvert. Elevated flows resulting from overnight rain on day 16 appeared to have encouraged a surge of banded kokopu movement as 37 were captured in the downstream net the following morning. This trend was mirrored within the upstream net the following day suggesting a number of these fish had continued moving upstream. This surge seems to have continued for two days until numbers of fish captured dropped back as flows returned to normal on day 18.

One and two koaro were caught within the bottom net on days 12 and 17 respectively. The same respective numbers of koaro were also caught within the top net on days 13 and 18. The size of and specific markings of these fish suggest these fish had moved up the ramps

and through the culvert the day following being caught in the bottom net suggesting very little delay in migration.

Both juvenile longfin and shortfin eels were recovered from the top net following remediation of the Harley Road culvert. However one larger longfin eel measuring 330mm in length was also recovered suggesting the ramps provide passage for a range of eel sizes (Figure 8).

Three adult inanga measuring 80, 95 and 120mm were captured within the bottom net prior to remediation, however no inanga were recovered from the upstream net during the duration of the survey. This result doesn't necessarily mean that the ramps fitted to the culvert won't allow for inanga passage. While it is possible these inanga attempted and failed to negotiate the ramps there also may not have been a migratory urge to progress upstream once released into the culvert plunge pool following capture in the downstream net. The plunge pool offered excellent habitat for native fish in the form of deep water, shade, vegetation, and woody debris. With an abundance of cover and pool habitat available, the adult inanga may have preferred to inhabit the immediate area and made no attempts to migrate upstream.

eDNA monitoring suggests that banded kokopu, longfin eel and shortfin were present upstream of the Harley Road culvert prior to remediation. It should be noted that only three replicates were deployed. Current "best practice" advises six replicates to confidently identify all species present. The owner of this particular structure has in the past attempted to remediate the perched outlet with homemade fish ramps and this may explain the presence of those species upstream, otherwise it is assumed alternate unknown pathways for fish migration exist or have existed in the past. Preliminary eDNA sampling seven months after the remediation indicates that inanga and smelt can also gain access upstream. eDNA sampling one year after the remediation will continue to assess any long-term changes in the diversity of fish populations upstream of the culvert post remediation.

Figure 8. Adult longfin eel caught in the upstream net.

Conclusion

Trapping surveys suggest that remediating the Harley Creek culvert with a flexible ramp with looped mussel-rope has improved passage for four species of fish, banded kokopu, koaro, longfin eel and shortfin eel.

Additionally, eDNA sampling suggests the remediation may also allow passage for inanga and smelt.