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.

What was the problem?

The Maitai River North Branch Dam in the Nelson Region augments the Nelson municipal water supply since 1987. The Maitai River catchment provides suitable habitat for eleven freshwater fish species, of which three are listed as ‘At Risk’ according to 2013 national conservation rankings. The earth dam has a spillway which overflows periodically depending on Nelson’s water demand. Physical characteristics of the dam include a weir, spillway chute, flip bucket and apron downstream of the flip bucket (Figure 1). The entire spillway is 22 m high, has a total length of 151 m and is 20 m wide at the upstream end, and 10 m wide at the downstream end.

Key fish passage issues identified at the Maitai Dam include:

- Very long and steep spillway
- Lack of wetted margins and rest areas for migrating fish during high flow
- Lack of flow/no flow on the spillway at times during elver and whitebait migration season
- High water temperatures in and around the Maitai Dam.

What was the solution?

As there were multiple issues inhibiting fish passage at different parts of the dam, multiple solutions were sought:

- Installation of a pump (Figure 2) to deliver water (capacity = 3.5 l/s) from the reservoir to the spillway crest, at times when the reservoir water level is too low for spilling to occur, ensuring continuous flow down the spillway during summer migration periods.
- Plugging the drainage outlets in the flip bucket with rubber bungs to maintain the pool that usually forms in this bucket when spilling occurs.
- Installation of ‘Xmas Tree’ mussel spat ropes (Figure 3) down the total length of the spillway (i.e., 151m) and downstream of the flip bucket, adjacent to the true right spillway wall, to provide additional cover, as well as resting and climbing opportunities for migratory fish. Two spat ropes side by side were installed with approx. 100mm between them.
- Installation of a short ramp (i.e., aluminium ramp with astro-turf lining and two mussel spat ropes) from the lip of the flip-bucket to the spillway apron below to allow climbing fish to avoid the steep transition into the flip-bucket (Figure 4).
- Outcome monitoring was undertaken to check effectiveness.

Figure 1. The Maitai Dam with weir, spillway, flip bucket and apron.

* Success rating: 3/5 – Successful improved passage upstream and downstream of the whole barrier for the target species.
Monitoring results

Eel elvers were observed climbing the spillway during three spotlight surveys in the summer of 2016 (Table 1). These elvers ranged in size from ~80-130 mm long (estimated lengths). Elvers were the only fish seen on or in the vicinity of the spillway, aside from medium to large trout and eels consistently observed patrolling in the vicinity of the bottom of the spillway in the plunge pool below, and occasionally also in the reservoir above. Two koura (freshwater crayfish) ~50 mm long were seen crawling down the spillway and at the spillway crest.

Video surveillance was used to monitor fish movements over the spillway crest. Although a few elvers were observed within five metres of the spillway crest on each survey occasion, only two were seen to have passed beyond the crest (Table 1), with one of these entering the reservoir and swimming away during observation. Note the high numbers of elvers in the flip bucket during the first and last sampling event. These elvers appeared to be resting in the flip-bucket, presumably after climbing the first section of the dam apron. Some may also have returned to the flip-bucket after unsuccessful attempts to climb the spillway to the weir crest (some elvers were observed moving downhill on the spillway toward the flip-bucket, but it was not clear whether this was due to the
disturbance of being spotlighted.) The flip-bucket provides a predator free resting pool for these elvers before they attempt the climb up the spillway (by contrast, they are exposed to predation risk from large eels and trout lurking near the bottom for the spillway apron).

Table 1. Summary of elver numbers observed on and in the vicinity of the Maitai Dam spillway during spotlight surveys on three different sampling occasions.

<table>
<thead>
<tr>
<th>Survey date</th>
<th>Number of elvers on the spillway</th>
<th>Numbers of elvers beyond the spillway crest</th>
<th>Number of elvers holding in the flip bucket</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 Jan 2016</td>
<td>21 (incl several descending)</td>
<td>0</td>
<td>&gt;100</td>
</tr>
<tr>
<td>10 Feb 2016</td>
<td>14 (incl 3 descending)</td>
<td>0</td>
<td>~8 seen</td>
</tr>
<tr>
<td>15 Feb 2016</td>
<td>24 (incl 2 descending)</td>
<td>2</td>
<td>&gt;30</td>
</tr>
</tbody>
</table>

The spat rope was being used for cover by resting elvers, particularly in the flip-bucket pool (Figure 5), but also on the spillway. The spat rope was also observed being used to assist climbing by a few elvers, the majority of climbing occurred in the wetted splash zone on the spillway, away from the spat ropes.

**Did it work?**

Notwithstanding the apparently low numbers of elvers successfully completing the climb, the remediation modifications carried out during autumn 2015 have undoubtedly improved the situation for elvers attempting to climb the spillway. Before the installation of the pumped water supply and bungs in the flip-bucket drains, the spillway was often dry for long periods during summer. For example, during the summer migration season (December to March inclusive) of 2014/15 the reservoir was below the spillway level for all but approximately one month (between 21 December 2014 and 20 January 2015). Consequently, there was no opportunity for fish passage during the rest of the migration season. The spillway was not spilling during any of the spotlight surveys discussed above. So all elvers observed attempting to climb the spillway, including the two seen successfully beyond the spillway crest (Table 1), were only able to climb due to the pumped water supply.

**Lessons learnt**

1. Constant and appropriate water flow are required to allow fish passage during peak migration periods.

2. Mussel spat ropes provided cover for juvenile eels at certain parts of the dam and was also aiding upstream passage for some individuals, however, the majority of climbing occurred in the wetted splash zone on the spillway, away from the spat ropes.

3. Given the apparent degree of difficulty for elvers of scaling the spillway and the apparent low numbers successfully reaching the reservoir via this route, it would be prudent to continue and intensify existing trap and transfer operations to augment fish numbers passing the dam. Trap and transfer also has the advantage of avoiding concentrating migrants in locations that are easily predictable by predators, rendering them vulnerable to predation.

4. The spillway with a total length of 151 m and 22m height can be considered a significant barrier despite the fish passage remediation measures described above. We suggest the installation of further rest areas along the spillway.

5. Further monitoring during migration periods would be useful to identify if other species attempt any up- and/or downstream movement.
For further information

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Reference: