Evaluation Of Cone Fishways To Facilitate Passage Of Small-bodied Fish

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Australasian Fish Passage Services

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22nd International RIVER SYMPOSIUM
EXCELLENCE – COLLABORATION – INTEGRATION

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Small Juvenile Fish Migration

22nd International RIVER SYMPOSIUM

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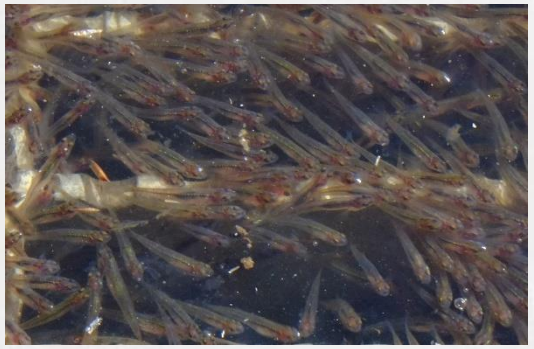
- Traditional migration models concentrate on large adult fish migrations.
- Small juvenile fish have significant migrations, often a BILLION Strong
- Passage of small juvenile fish problematic due to poor swimming ability.
- Affects the livelihoods of millions of subsistence fishers and recreational anglers



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Barrier Effects - Small Fish

- Free movement critical to ensuring survival of year classes and maximising productivity
- Increased predation of migrating fish
- Increased disease risk
- Reduces population resilience
- Prevents recruitment of juveniles to freshwater habitats
- In tidal systems may lead to extinctions upstream

IT'LL DO: Les Scheuber settles for a perch

Anglers mourn missing mullet

By FRANK SANDERSON

WHERE have all the mullet gone? Veteran Burnett River anglers have been asking themselves this question as they haul in the yellow belly and silver perch.

The Burnett River, which rises near Monto and is fed by rivers and creeks draining a huge hinterland from central Queensland and the South Burnett to Mt Perry, has been a favourite fishing spot for decades.

But the main variety of fish caught has changed. In years past, the Burnett anglers could have always been sure of a feed of mullet, caught on a long bamboo fishing rod with floats holding the line on the surface and a drop of about half a metre from the main float to a hook baited with creek moss.

But the mullet are no longer there. They have disappeared, much to the chagrin of veteran river angler Les Scheuber, of Gayndah, whose family has fished the river for generations.

Another veteran angler, Jimmy Dwyer, who lives on the Burnett at Mingo Crossing on the way to Mt Perry, is also saddened by the loss.

He says he has not seen a mullet for five years or more and blames the difficulty the fish have moving upstream from the sea to spawn, and the decade or more of drought which has gripped the region.

Nobody really knows, but they care and have called for an investigation into where the mullet have gone.

Hundreds of native catfish are caught but are considered trash and nobody will eat them. The native jewfish and perch are caught and ceratodus (lung fish) are plentiful, but their protected status is always respected.

This leaves the yellow belly, silver perch and bass — all of which are not native to the river.

They are introduced through the efforts of a river stocking group, which is hearing fish.

Les Scheuber and his fishing mate, David Fuchs, were happy enough last week with a brace of yellow belly taken just below the flooded Gayndah weir... but they reckoned mullet would have been better.

The fish stocking group at Gayndah has released about 250,000 fingerlings into the streams in the past few years.

Fishways – Success Passing Small Fish

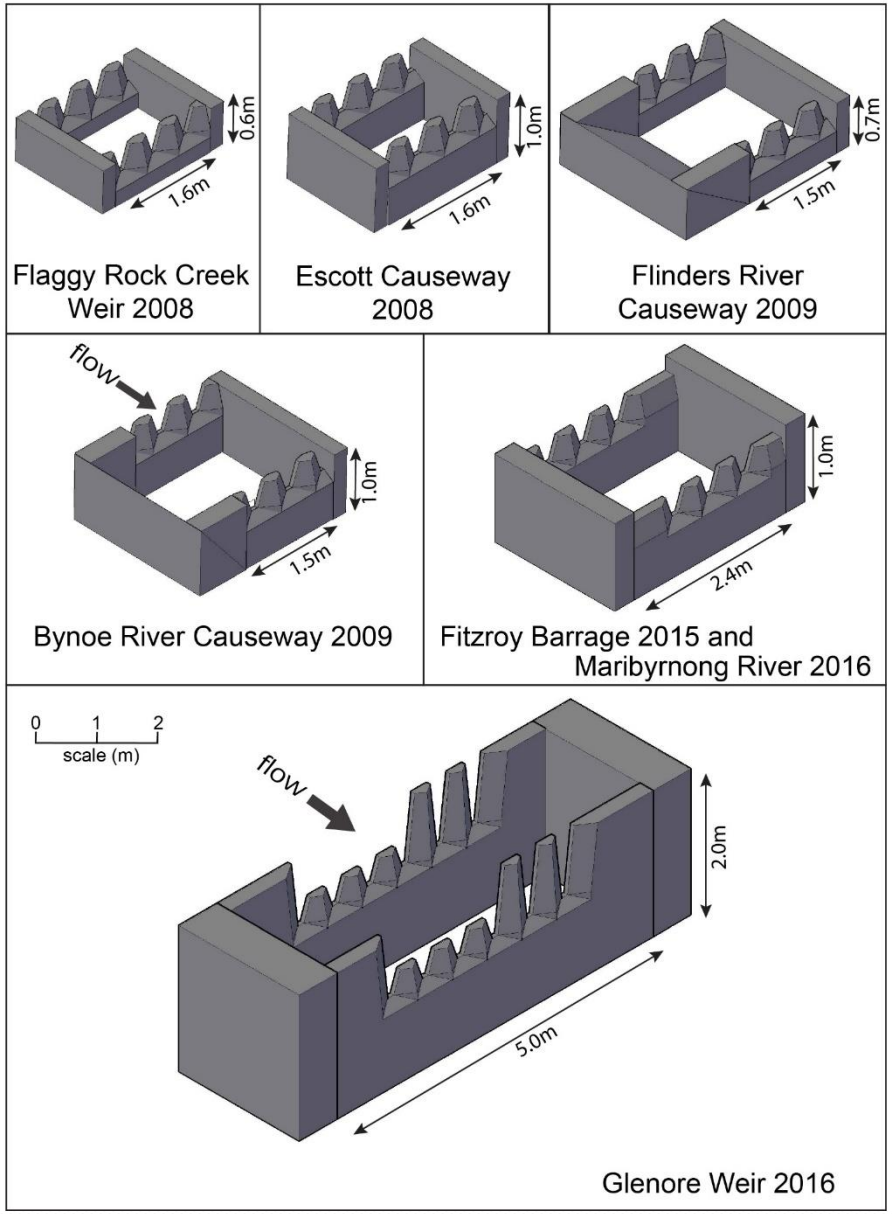
- Mixed success for small fish
- Rock Ramp fishways – Often excellent small fish passage
- Large Vertical Slot Fishways – Generally bad without modification (locks)
- Small Vertical Slot Fishways – OK for medium fish (>40mm)
- Pool and Weir – Very Poor due to large steps and high turbulence
- Locks and Lifts – OK if designed to have a small fish mode (low velocity and turbulence)

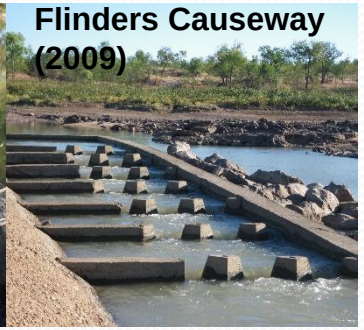
Background of Cone Fishways

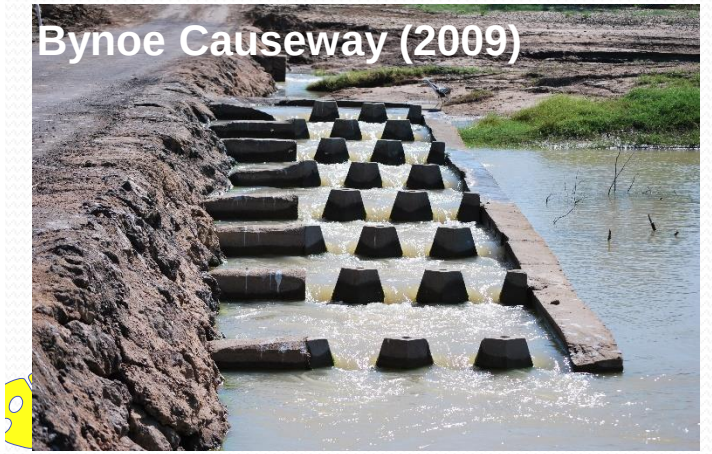
- Rock Ramps great for small fish, but rock not always available and can be difficult to build
- Cone fishways a concrete rock ramp
- Design initiated in the shed – progressed to flume – then into the wild
- The modification with wild fish proved most enlightening
- An iterative process to improve passage for small fish

Design Evolution

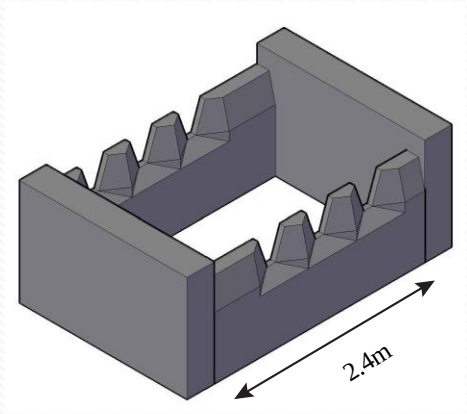
- **Initially:**
  - **Shorter Pools**
  - **Steeper Slopes**
  - **Narrower Channels**
  - **Larger Pool Steps**
  - **Higher Turbulence**
  - **Narrow Headwater Range**
- **Finally**
  - **Two Standard Channel Widths**
  - **Large Pools**
  - **Wide Channels**
  - **Smaller Pool Steps**
  - **Very low turbulence**
  - **Wider Headwater Range**
  - **Potential for High Discharge**





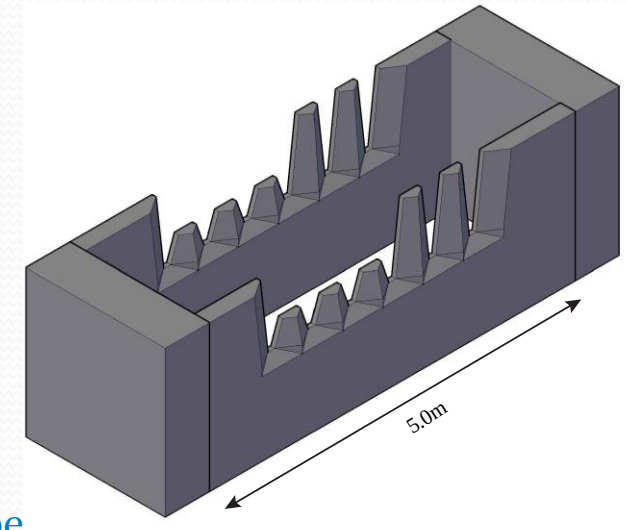


Final Designs



Low Cone Fishway (Fitzroy Barrage type)

- 2.4m wide channel
- 1.0m deep channel
- 1.5m between panels
- Very low turbulence
- 4 - 19 W/m3
- low discharge
- 0.06m3/s to 0.16m3/s



High/Low Cone Fishway (Glenore Weir type)

- 5.0m wide channel
- 2.0m deep channel
- 1.5m between panels
- Very low to high turbulence
- 4 - 100 W/m3
- Discharge low to moderate
- 0.153 m3/s to 3.2 m3/s

Demonstrating Success

- 3hr fine mesh trap sets
- Fish recorded at:
  - Fishway exit
  - Fishway entrance
- Fishway sampled all flow conditions
- Large fish excluded from sampling (Predation)

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Results

- 28,556 individuals recorded from all sites
- 45 Species recorded from all sites
- Generally little variation between top and bottom size ranges
- Cone fishways work well for small fish
- Some very small (<15mm) fish still inhibited

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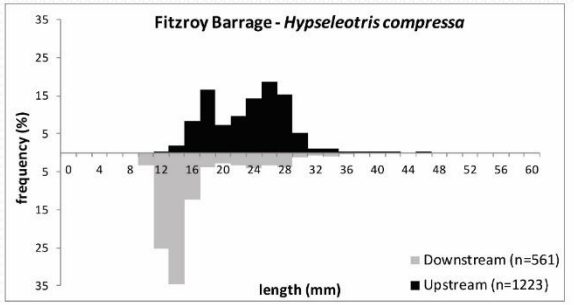
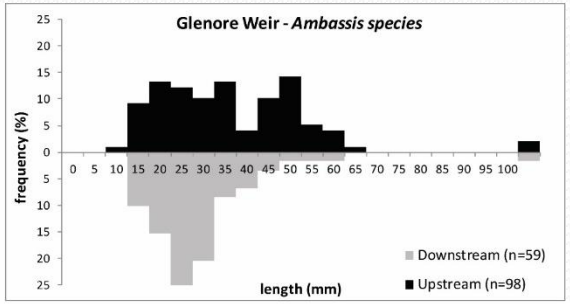
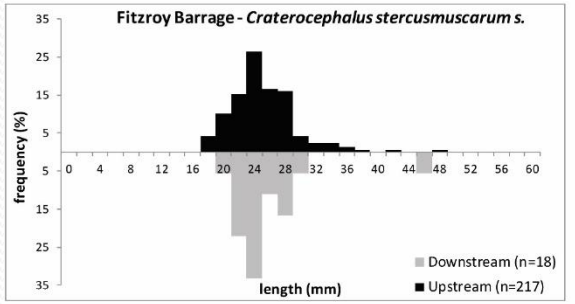
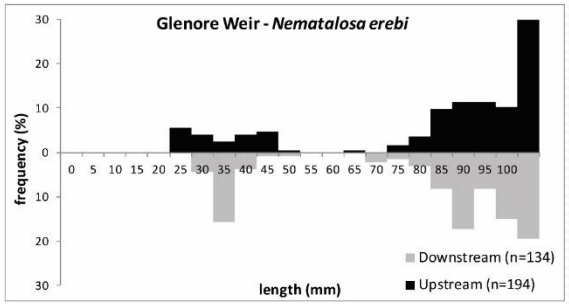
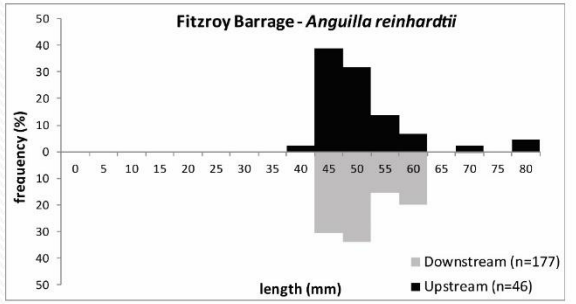
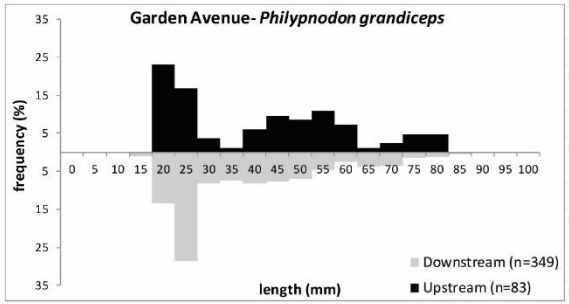


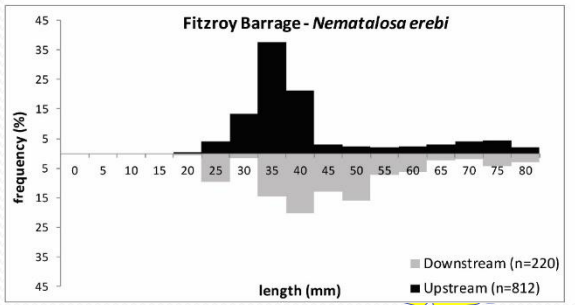


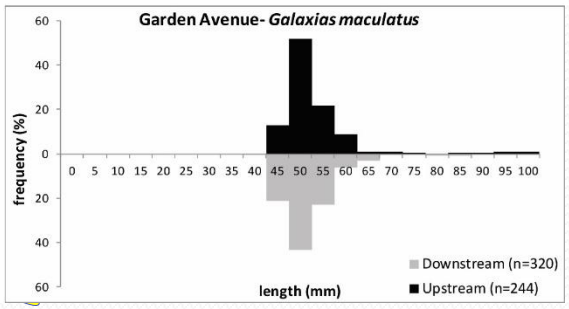












Conclusions

Mark I Cone Fishways

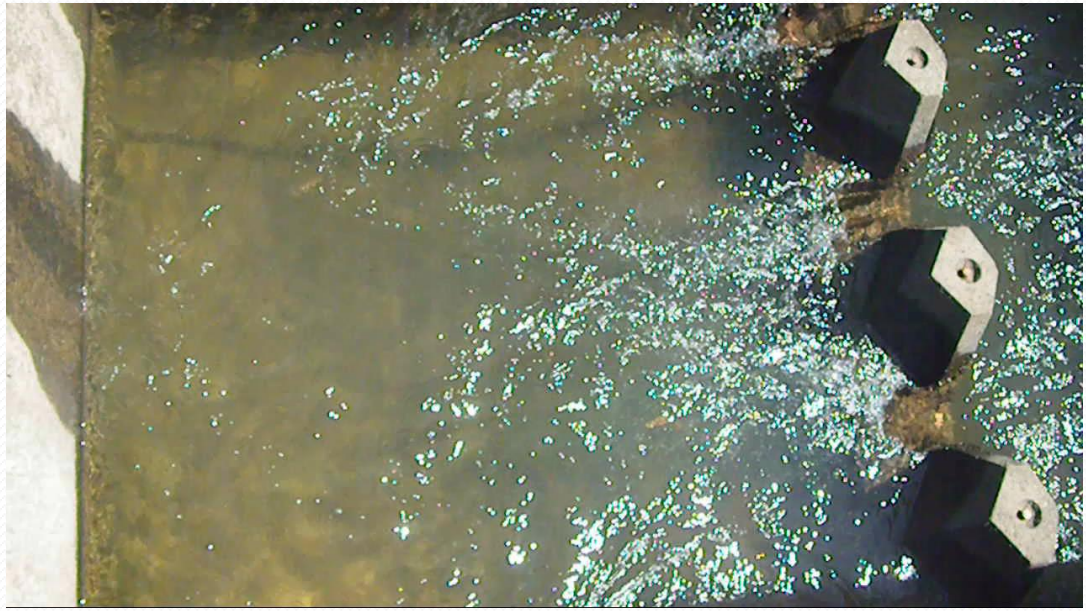
- Had issues passing small fish
- Small (10-20mm) fish only able to partially ascend or not at all
- Appears turbulence major issue
  - They could ascend R-Ramps of similar dimensions
  - In R-Ramps hugged edges and bottom
  - In Cones swam on surface in centre of pools
  - Could see that fish were constantly swimming

Mark II/III Cone Fishways

- Less issues passing small fish (<15mm fish still an issue)
- Quite successful at passing large numbers of small fish
- Rest areas seemed to be key to small fish passage
- Stabilised design available from Pre-cast concrete manufacturers

Fishway Dimensions

- Pools should be low turbulence – in the $<15 Wm^3$ range
- 3 slot cone, pool size at least: W=2.4m, L=1.5m, D=0.7m
- Drops between cells <80mm



Conclusions

Advantages

- Simple, flat transportable baffle
- Predictable hydraulics
- Suitable for small and large fish
- May have very high attraction discharge
- Does not operate below full storage level (does not require a gate)

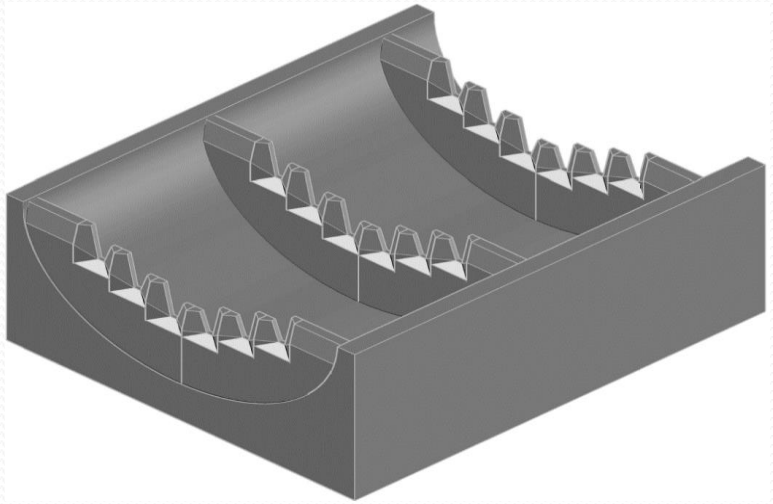
Disadvantages

- Does not operate below full supply level
- Headwater range more limited than vertical-slot (1.0m max.)
- Requires a concrete channel (currently investigating natural channels)
- High/Low design has wide construction footprint
- Hydraulics somewhat less effective for small fish at high flows

Future Directions

Design

- Extending network of availability
- Exploring more flexible installation options (natural channels)
- Refining design for very smallest fish at tidal barriers
- Roughness element incorporation
- Extending headwater range above and below full storage (submerged orifice/taller cones)



Small Fish

- Identifying design features inhibiting very small fish
- Energetics – refuelling very small fish?
- Habitat within the fishway?

Large Fish

- Demonstrating large fish use the fishway
- Movement within the cells and over the baffles
- Cell sizes for large fish

Kbal Hong Cone Fishway Stung Pursat - Cambodia

14 days Sampling - 34,000 fish - 61 Species