Improving post-stocking survival of hatchery reared threatened fish species

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MURRAY-DARLING BASIN COMMISSION

Threats

- A number of MDB fish species have declined across the basin and are threatened in parts of, or even across their entire former range
- Includes large bodied species such as Murray cod, trout cod, Macquarie perch, silver perch and eel-tailed catfish
- In Qld MDB very few silver perch have been caught by LTMP, SRA and Mesoscale Movements project.
- In lower and middle reaches of Qld MDB tandanus catfish in low numbers. Now appear to be absent from Paroo.
- Cod have not been caught in Paroo since 1980s.

Actions

- The NFS is addressing fish decline in various ways
- Pest fish control (catfish and silver perch)
- Provision of fish passage
- Flow management
- Habitat restoration activities
- In some catchments local extinction or very low numbers of threatened fish may also require a carefully managed stocking program as part of a recovery strategy

- If the driving actions of the Native Fish Strategy are successful, then reintroduced hatchery reared threatened fish that survive should go on to produce self sustaining populations.

- However, conservation stockings are not always successful. Much of this has been attributed to domestication effects of captive rearing. This can influence foraging behaviour or predator avoidance behaviour

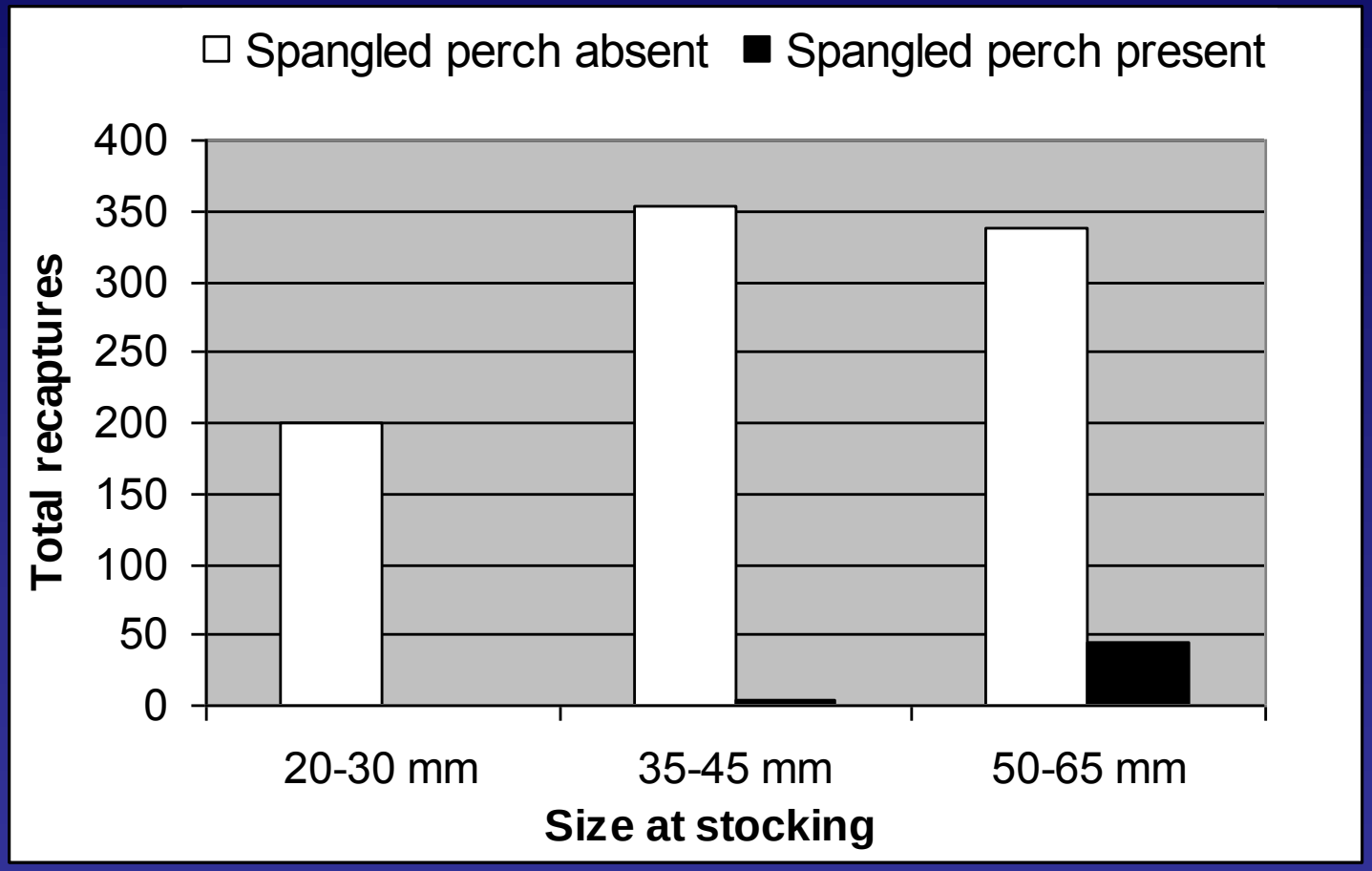
Objective

- The objective of this project is to develop strategies to reduce domestication effects and improve post-stocking survival of threatened fishes.

Project status

- The project is in a developmental phase. We have completed a review of the relevant literature
- Completed a survey of hatcheries and grow-out facilities
- Designed a series of tank experiments to commence this spring
- Planned for a field phase of the project if tank experiments are successful

Review of recent literature



Hutchison *et al.* (2002)

Review of recent literature

- **Stocking large fish does not always result in better returns. High losses of 30-40 cm hatchery reared trout cod compared to wild fish of same size. (90-100% mortality, cormorants implicated) (Ebner and Thiem 2006, Ebner *et al.* 2006)**

- **For any given size of fish, survival of hatchery reared fish is poorer than wild fish of same size (Various North American, Japanese and European Studies).**

- **Response to predators poorer in hatchery reared fish than wild fish (Various North American, Japanese and European Studies).**

- **Foraging behaviour of some hatchery reared fish deficient compared to wild fish. (Various North American, Japanese and European Studies).**

Review of recent literature

- **Reduced ability to compete for territories by hatchery reared fish (North American salmonid studies).**
- **Most mortalities occur immediately after stocking, *i.e* .in the first few days, rather than first few weeks (Brown and Laland 2001, Olla, *et al*. 1994).**
- **One of the major causes of mortality is predation (Olla *et al.* 1994). Buckmeier *et al* (2005) estimated 27.5% of stocked largemouth bass *Micropterus salmoides* fingerlings were taken by predators within 12 hours of stocking into a Texas Lake. In contrast mortality in predator-free enclosures was only 3.5% after 84 hours, indicating mortality from transport and other variables was low.**
- **Transport stress increases predation risk**

Review of recent literature

- **Fish can be trained to recognise and avoid predators (Brown *et al*. 2003)**
- **Fish can be trained to take live foods**
- **Training of hatchery reared fish can be enhanced in the presence of wild con-specifics**
- **Use of skin extracts of prey in presence of predator odours can be used in training.**
- **Pond reared fish generally have better post-stocking survival than tank reared fish**

Conclusions from review of literature

- **Domestication effects contribute to poor survival of hatchery fish relative to wild fish.**
- **Pond or extensively reared hatchery fish are likely to have better post-release survival than intensively tank-reared fish**
- **The increased size of the tank reared fish may confer on them a survival advantage.**
- **After accounting for the effect of stocking size and the type of hatchery rearing, further improvements in post-stocking survival can probably be made through pre-release predator awareness training and live food foraging training.**
- **Minimising transport stress and acclimation or habituation at time of release can also improve the ability of newly stocked fish to avoid predation.**

Review of Australian Hatcheries and Grow-out Facilities

- 84 contacted, 26 responded (31%)
- 10 grow-out facilities 16 hatcheries
- Predation by fish (excluding cannibalism in cod)
  6.25% of hatcheries 0% grow-out (low or none)
- Predation by birds (cormorants, herons, pelicans)
  Common 37.5% hatcheries 40% grow-out
  Rare 37.5% hatcheries 10% grow-out
  None 12.5% hatcheries 50% grow-out
- Bird control 50% hatcheries 20% grow-out

Review of Murray cod Facilities

	pond	tank	both
Grow-out (n=5)	20%	100%	20%
Hatchery (n=8)	87.5%	37.5%	25%

	pellet	live	both feeds
Grow-out (n=5)	100%	0%	0%
Hatchery (n=8)	25%	87.5%	12.5%

	Cannibalism	Fish	Bird
Grow-out (n=5)	40%	0%	20%
Hatchery (n=8)	62.5%	0%	87.5%

Review of silver perch facilities

	pond	tank	both p & t
Grow-out (n=7)	85.7%	14.3%	0.%
Hatchery (n=8)	100%	12.5%	12.5%

	pellet	live	both feeds
Grow-out (n=7)	85.7%	14.3%	14.3%
Hatchery (n=8)	75%	100%	75%

	fish	bird
Grow-out (n=7)	0%	57%
Hatchery (n=8)	12.5%	100%

Review of catfish facilities (n=3)

	pond	tank	both pond & tank
Hatchery	100%	0%	0%

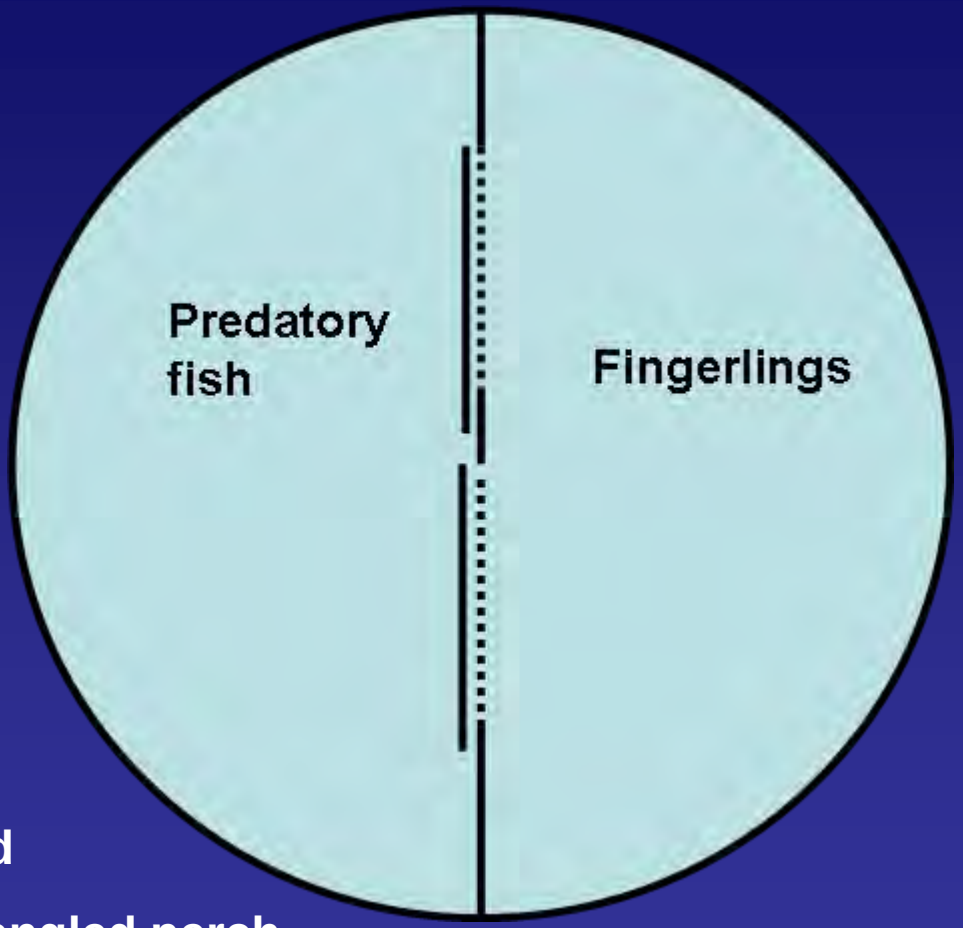
	live	pellet	both feeds
Hatchery	100%	0%	0%

	fish	bird
Hatchery	0%	100%

Proposed experiments

- Two phase approach
- Tank based training and tank based validation (Stop go point)
- If validated proceed with further tank based training followed by field trials

Fish predator training (fingerlings only)



Cod

Spangled perch

Golden perch

40-50 mm

- Keep hatchery reared fish with small group of wild conspecifics or related species
- Rear all fingerlings on live food
- Control exposure to predators with use of barriers and mesh permeable to fingerlings. Some predation may occur
- Maintain control group of fingerlings not exposed to predators
- Investigate use of skin extracts

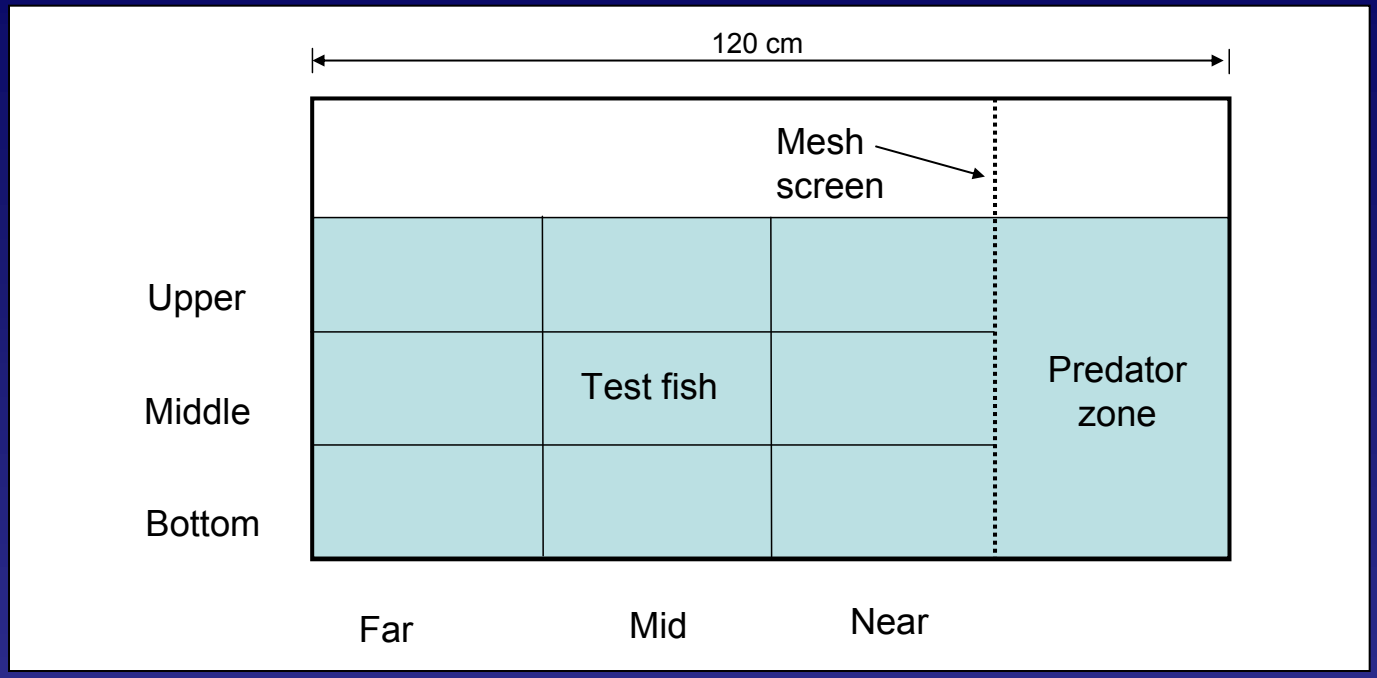
Bird predator training (fingerlings and sub-adults)

- Herons on site will be attracted to training tank. Access will be controlled. Tank will be provided with open and protected areas.
- If possible live cormorant (from wildlife park) will be used in controlled bursts to train fish.
- If live bird unavailable, model bird (with cormorant feathers for odour) will be used in conjunction with negative stimuli (netting in vicinity of model and temporary removal from water) and skin extracts
- Hatchery reared fish will be maintained with small sub-group of wild raised fish to enhance training
- Control fish will not be exposed to bird predators or wild con-specifics.

Live food training (sub-adults only)

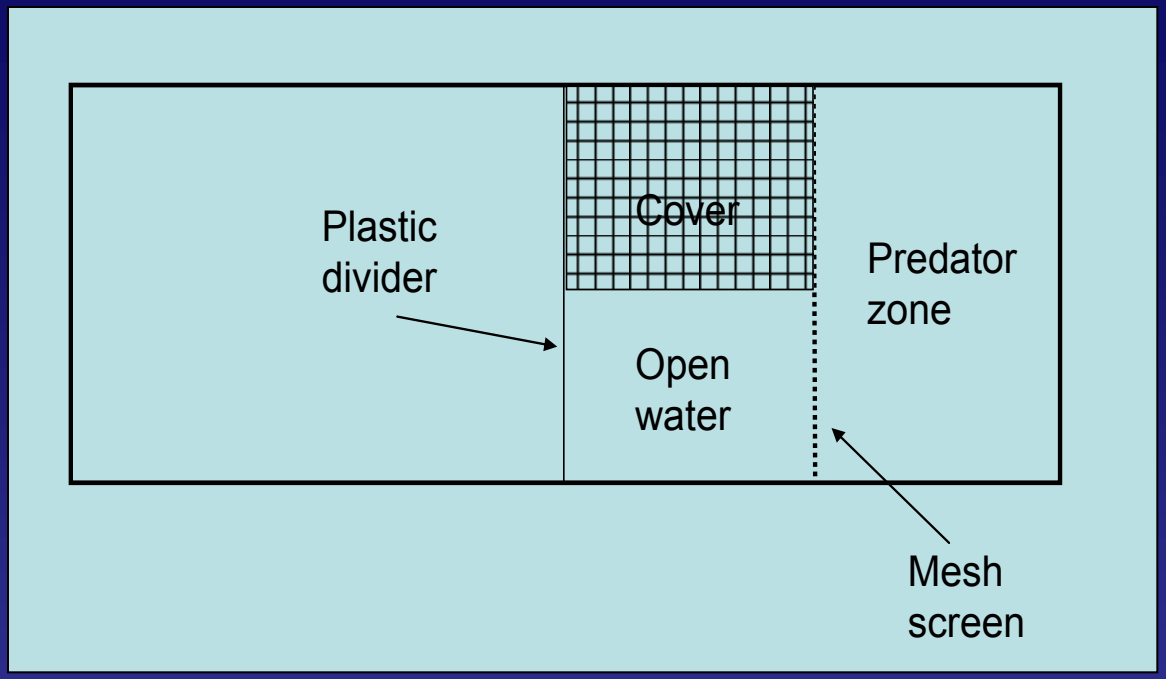
- Long-term pellet reared sub-adults will be exposed to live invertebrate prey (crustaceans, aquatic insects, worms). Environment will be enriched to encourage searching behaviour
- Grow-out facility reared fish will be trained in company of wild con-specifics
- Control fish will be fed a diet of pellets and will not be kept with wild reared fish

Tank-based evaluation



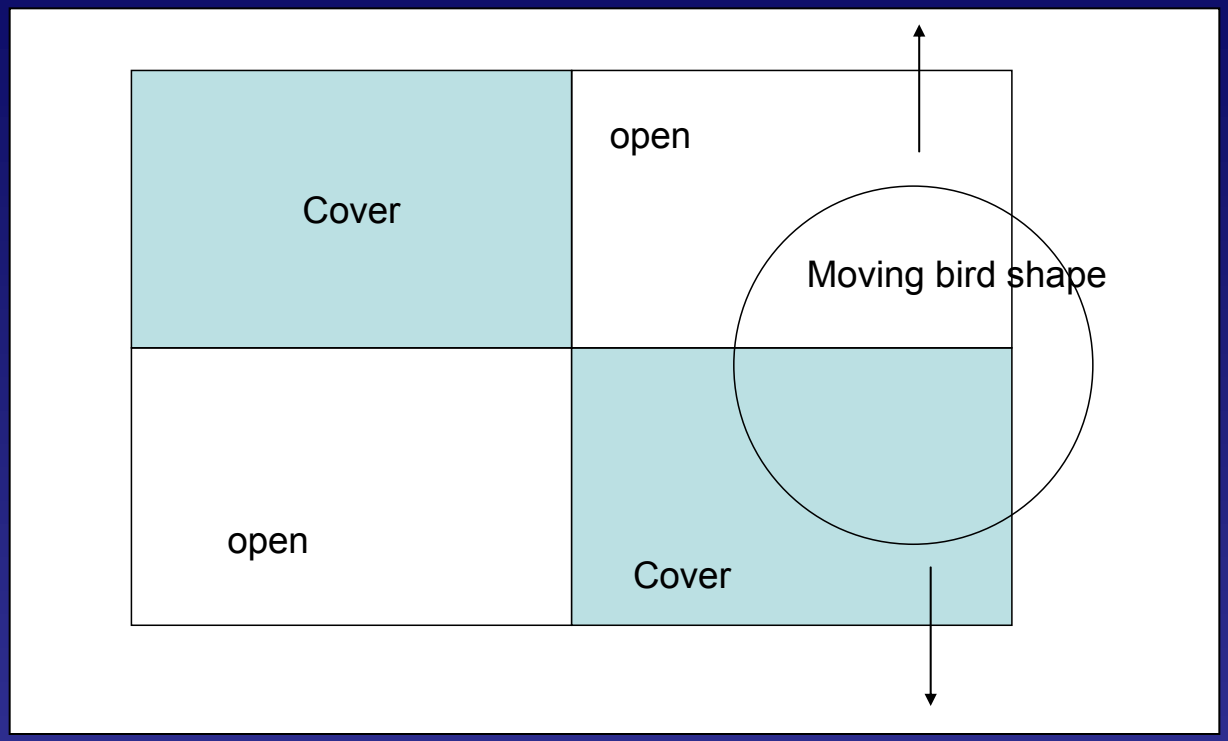
- **Side view of proposed tank set up for testing responses of fingerling fish to a predatory fish. The tank is divided into a predator zone and test fish zone by a mesh screen. Three vertical and three horizontal zones will be marked on the side of the tank.**
- **15 replicates of individual fish, 6 replicates of schools of 8 for treatment and control fish. Video monitoring**
- **Compare distance, depth and school density**

Tank-based evaluation



- **Proposed tank set up for testing use of cover by fish before and after exposure to a predator. The tank is viewed from above.**
- **Individual fish (15 replicates). Compare control and treatment groups.**
- **Schools of 8, 6 replicates**

Tank-based evaluation

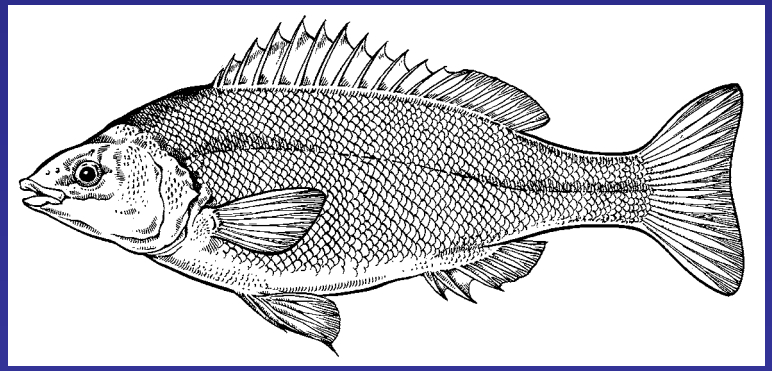


- **Set up of bird predator response tank as viewed from above.**
- **15 replicates of control and treatment fish. Response to moving/diving bird shape in terms of use of cover and distance from predator will be compared**

Tank-based evaluation

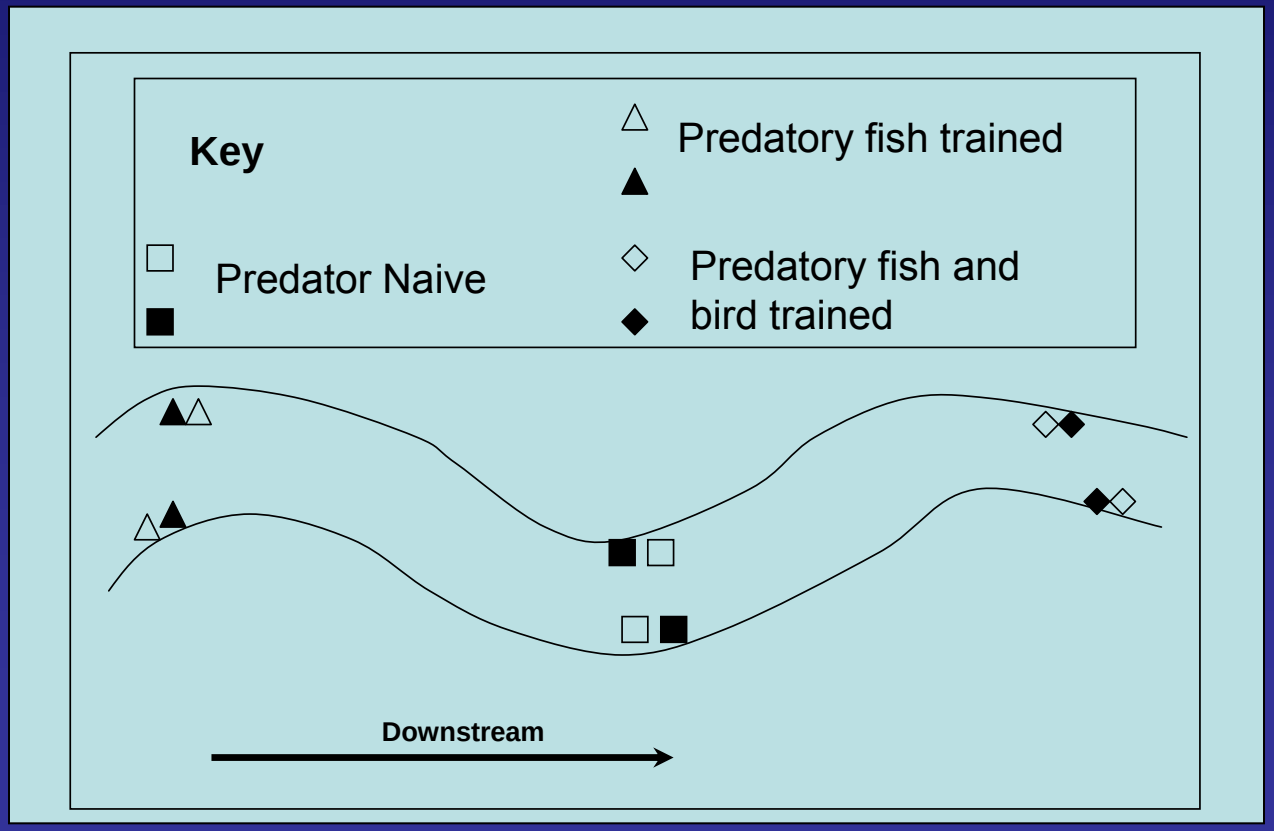
- Time taken to capture live prey items will be compared between trained and untrained sub-adult fish.

- A minimum of 15 replicates.



Field-based evaluation

- **Future research will depend on outcomes of tank based evaluation. Eg. bird predator training may be dropped for fingerlings.**
- **Sub-adults will be followed by radio-telemetry**
- **Survival of fingerlings will be evaluated by VIE batch tagging.**
- **Is proposed to evaluate soft release vs standard release.**



Solid symbols represent soft release.

Open symbols represent standard release

Field-based evaluation

	Predator cage prior to release	Standard release
Fish predator trained	850/species /site	850/species/site
Fish & bird predator trained	850/species/site	850/species/site
Predator naive	850/species/site	850/species/site

Planned number of fish to be stocked by treatment and release method at three sites in the Murray-Darling Basin