Improved methodology for introducing threatened hatchery reared fish

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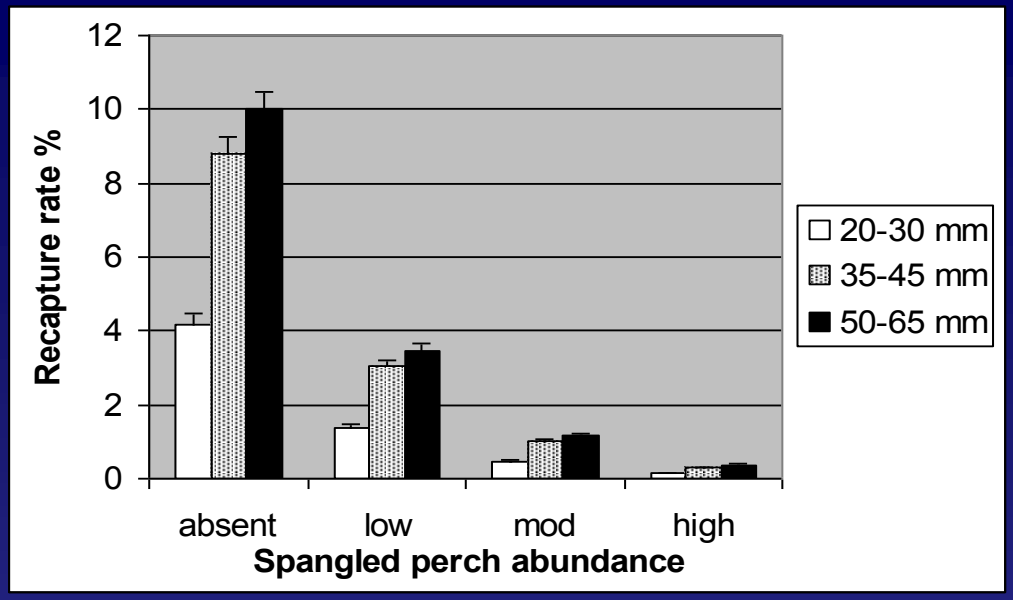
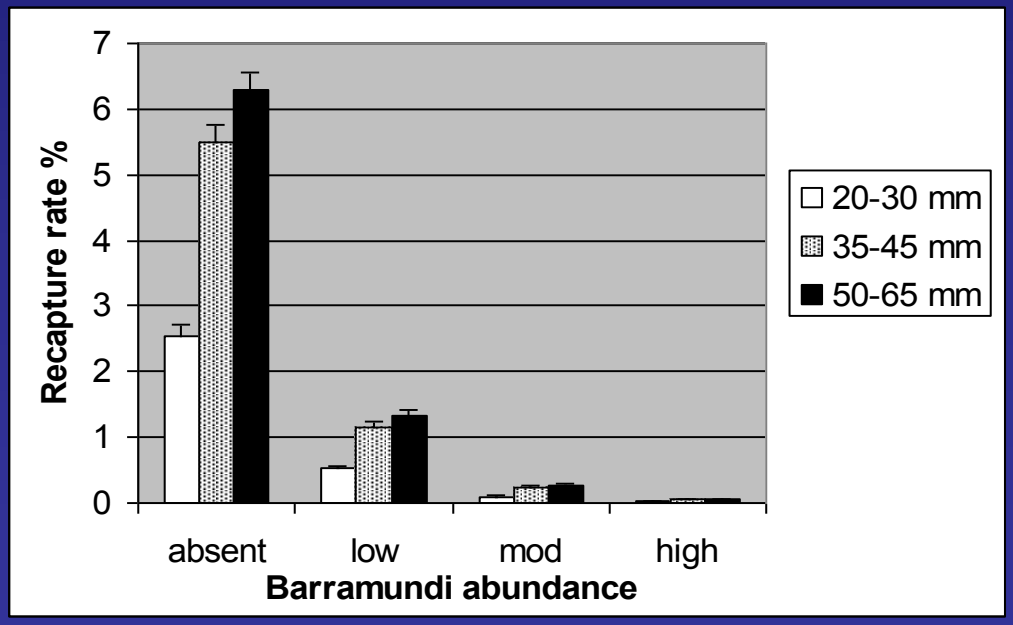
MURRAY-DARLING BASIN COMMISSION



Impact of spangled perch on bass stocking success



Impact of barramundi on bass stocking success

Background

In the Murray-Darling Basin a number of recreational fish species are classified as threatened and may require restocking to recover populations.

Past research on stocked impoundment fisheries by Hutchison *et al.* has shown that predatory fish can have a major influence on stocking success as well as reduced foraging ability.

Lintermans *et al*. found cormorants to have a negative impact on stocked sub-adult trout cod.

Threats

- A number of Murray Darling Basin (MDB) fish species have declined and are threatened in parts of, or even across their entire former range.
- In Qld this includes large bodied species such as Murray cod, 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 catfish in low numbers. Now appear to be absent from Paroo.
- Cod have not been caught in Paroo since 1980s.

Actions

The Native Fish Strategy (NFS) is addressing fish decline in various ways

- **Pest fish control**
- **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. Domestication also has implications for the success of stocking in impoundments for recreational purposes.

Objective

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

Project status

- Completed a review of the relevant literature.
- Completed a survey of hatcheries and grow-out facilities to evaluate exposure to predators in hatcheries.
- Completed mass training and a series of tank based validation experiments and partial analysis of data.
- Started planning for field based experiments.

Summary of literature

- For any given size of fish, survival of hatchery reared fish is poorer than wild fish of same size.
- Response to predators is poorer in hatchery reared fish than wild fish.
- Foraging behaviour of some hatchery reared fish is deficient compared to wild fish.
- Most mortalities occur immediately after stocking (days rather than weeks).
- One of the major causes of mortality is predation which is increased with transport stress.
- 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

Conclusions from review of literature

- 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.
- Fish can be trained to recognise and avoid predators
- Fish can be trained to take live foods
- Training of hatchery reared fish can be enhanced in presence of wild conspecifics
- The use of conspecific's skin extract in the presence of predator odours can be used to enhance training.

Review of Murray cod Facilities

	pond	tank	both
Grow-out	20%	100%	20%
Hatchery	87.5%	37.5%	25%

	pellet	live	both feeds
Grow-out	100%	0%	0%
Hatchery	25%	87.5%	12.5%

	Cannibalism	Fish	Bird
Grow-out	40%	0%	20%
Hatchery	62.5%	0%	87.5%

Review of silver perch facilities

	pond	tank	both p & t
Grow-out	85.7%	14.3%	0.%
Hatchery	100%	12.5%	12.5%

	pellet	live	both feeds
Grow-out	85.7%	14.3%	14.3%
Hatchery	75%	100%	75%

	fish	bird
Grow-out	0%	57%
Hatchery	12.5%	100%

Review of catfish facilities

	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)

- Hatchery reared fingerlings exposed to predators for 24, 48 and 72 hours.
- Skin extract added to training tank 3 times/day.
- Controlled 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

Murray cod

Spangled perch

Golden perch

500 fingerlings in training tank.
Average length = 55-70 mm

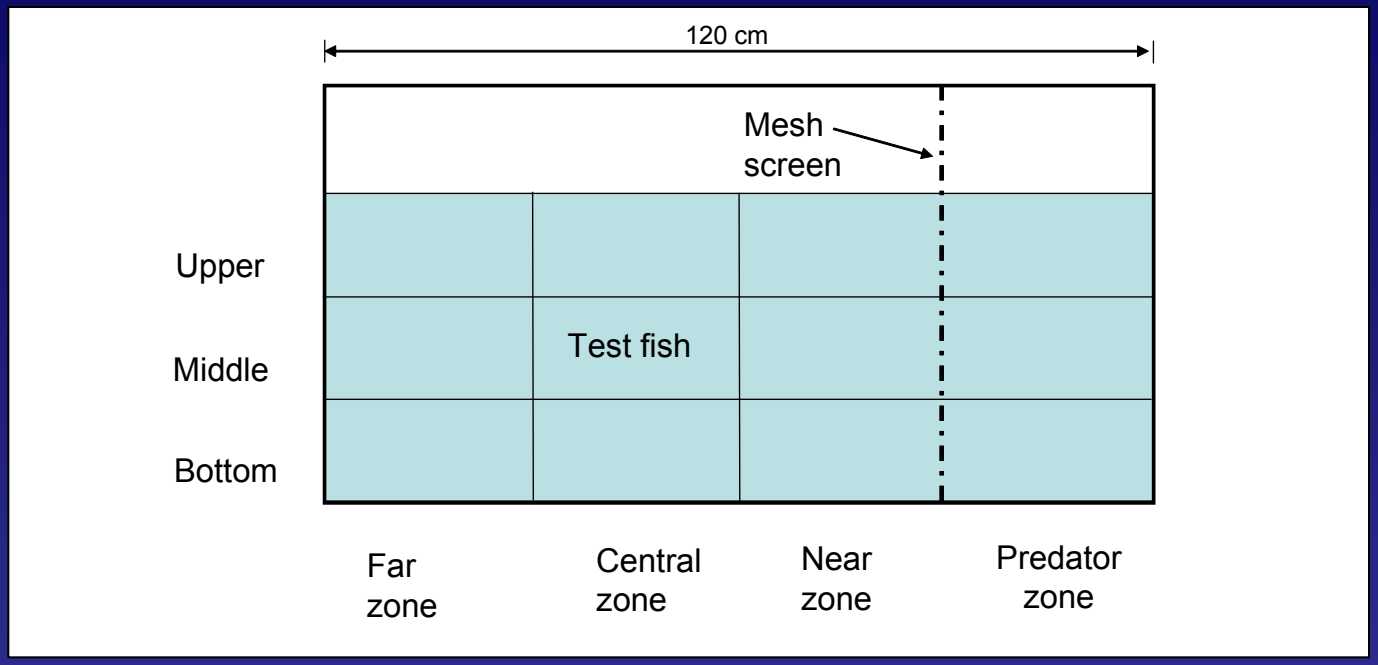
Bird predator training (fingerlings and sub-adults)

- Hatchery reared fish (fingerlings and sub-adults) were placed in tanks with artificial cover available.
- A dead cormorant (for predator odour) was used in conjunction with negative stimuli (skin extracts) and wooden cormorant silhouette (for shadow effects).
- Skin extract is added to training tank 3 times/day together with harassment from cormorant in net and wooden silhouette.
- Groups of fish are removed at 24, 48 and 72 hours.
- Control fish will not be exposed to birds.

Live food training (sub-adults only)

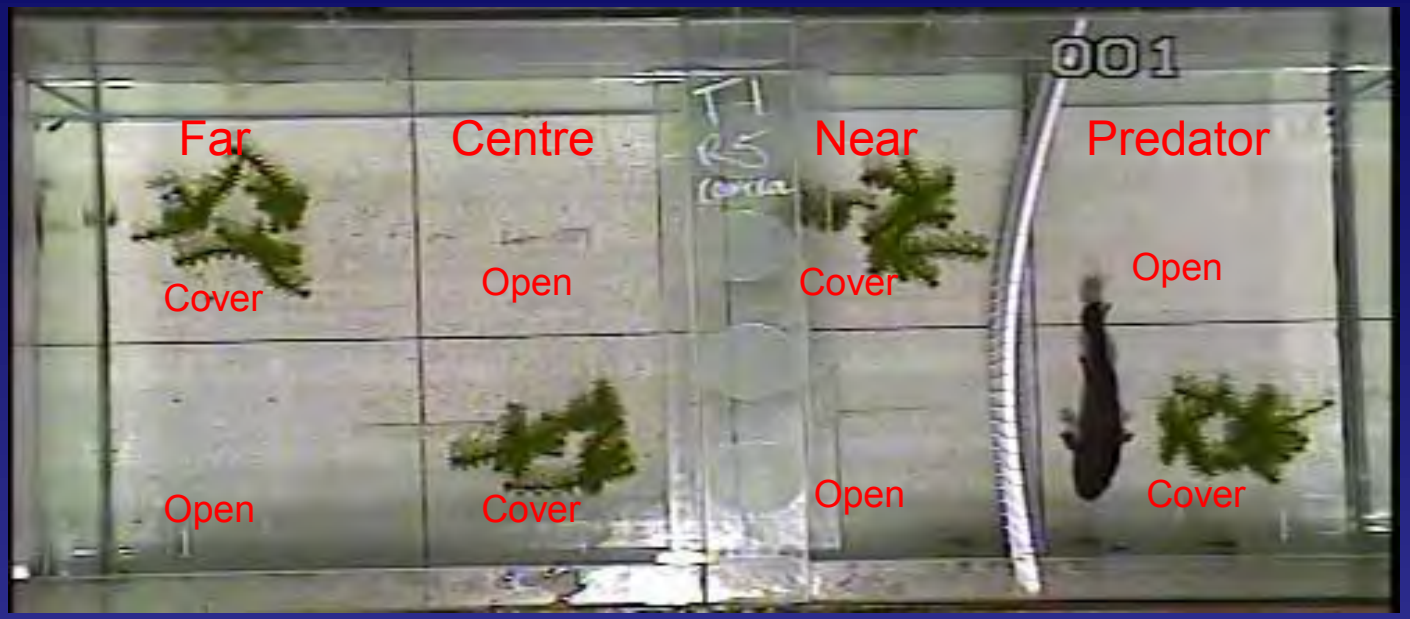
- Long-term pellet reared sub-adults will be exposed to live invertebrate prey (crustaceans, aquatic insects, worms). Environment will be enriched to encourage searching behaviour.
- Grow-out facility reared fish will be trained in company of wild con-specifics.
- Control fish will be fed a diet of pellets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

Tank-based evaluation – silver perch



- **Side view tank set up used for silver perch fingerling response to predatory fish (spangled perch and Murray cod). The tank is divided into a predator zone and test fish zone by a mesh screen. Four vertical and three horizontal zones are marked on the side of the tank.**

Tank-based evaluation – Murray cod and eel-tailed catfish response to fish predator



- 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 (16 replicates). Compare control and treatment groups.
- Schools of 8 (8 replicates). Compare control and treatment groups.

Tank-based evaluation – Bird predator response

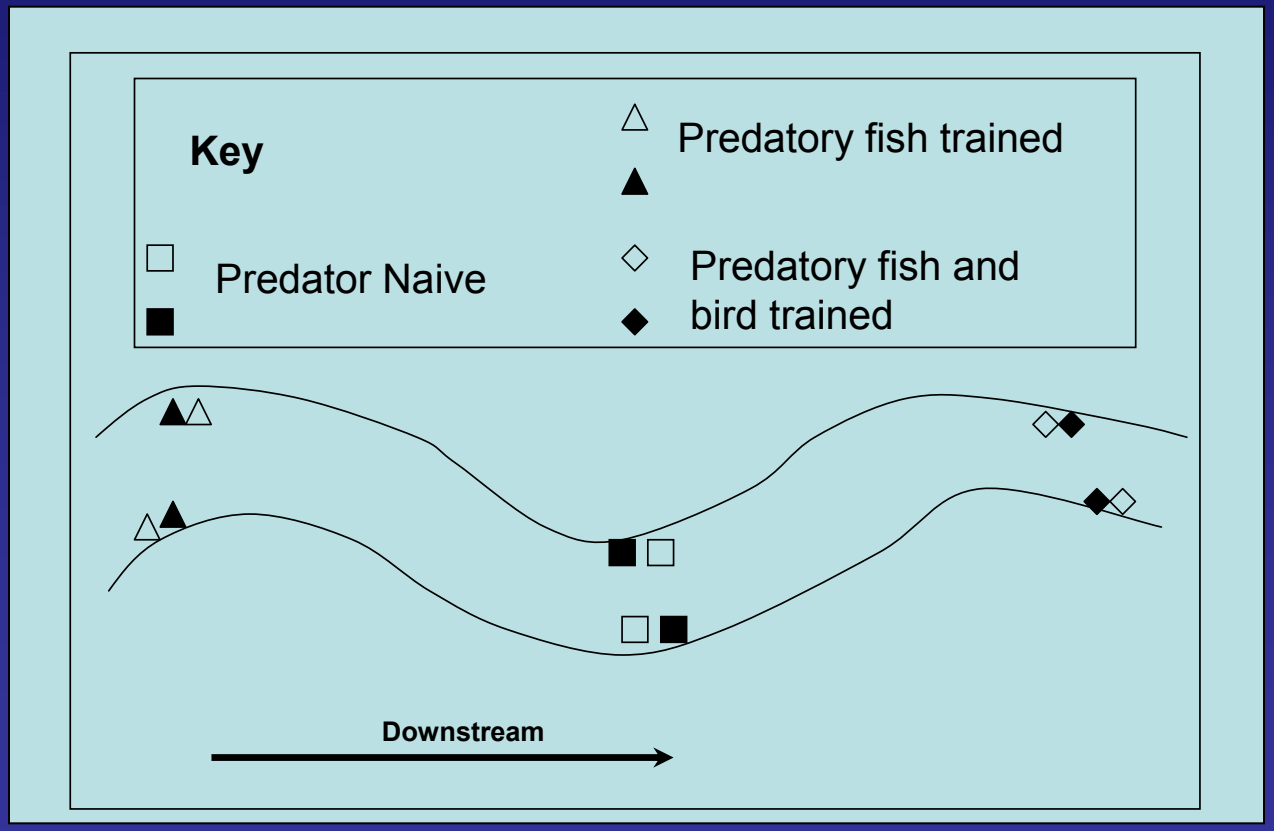
- Set up of bird predator response tank as viewed from above.
- 12 replicates of control and treatment fish (schools of 8 only).
- Evaluation of response to moving/diving bird shape in terms of use of cover and distance from predator.

Tank-based evaluation – Live feed

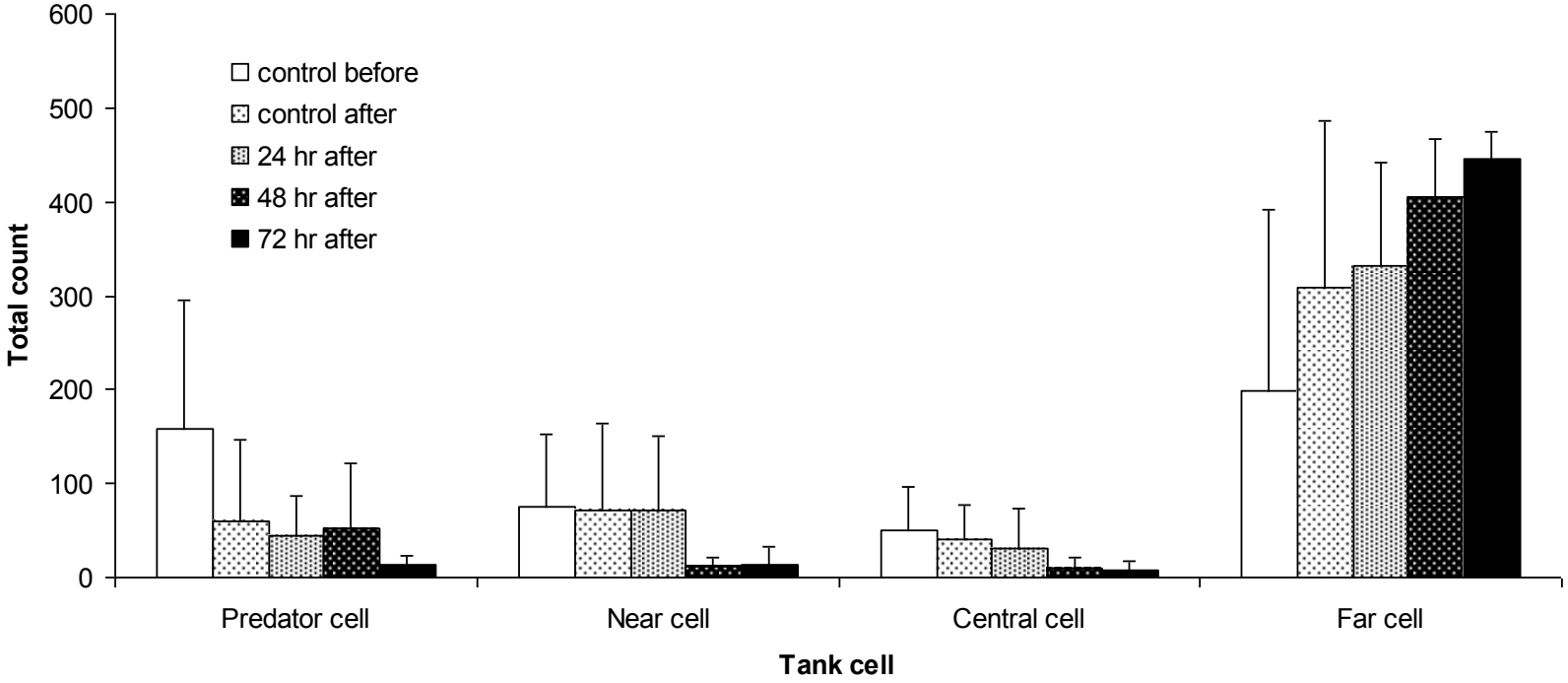
- Time taken to capture live prey items will be compared between trained and untrained sub-adult fish.
- A minimum of 16 replicates.

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.
- Soft release vs standard release will be evaluated.

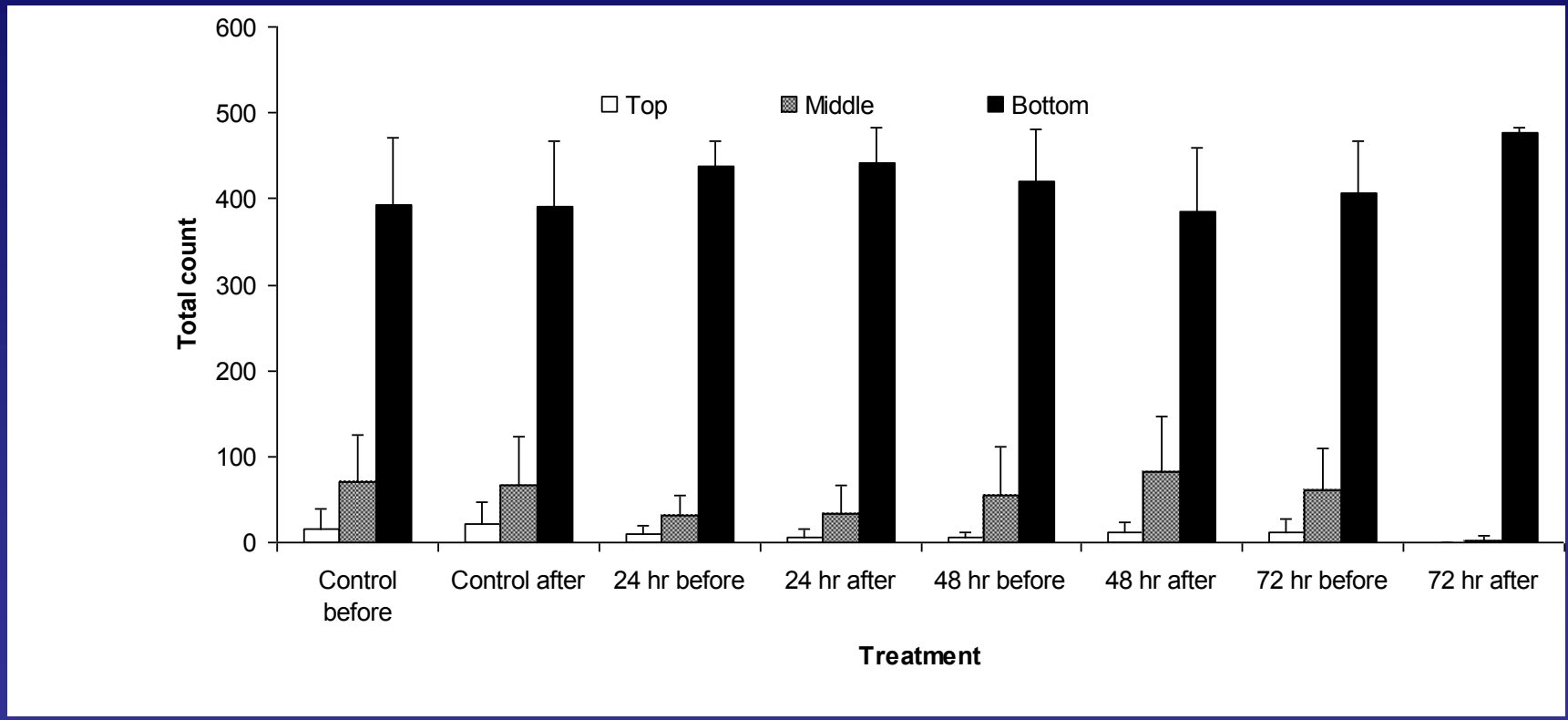


Results – silver perch



Use of tank cells by groups of eight silver perch before (control only) and after introduction of predator.

Results – silver perch



Mean total counts of groups of eight silver perch in water column zones.

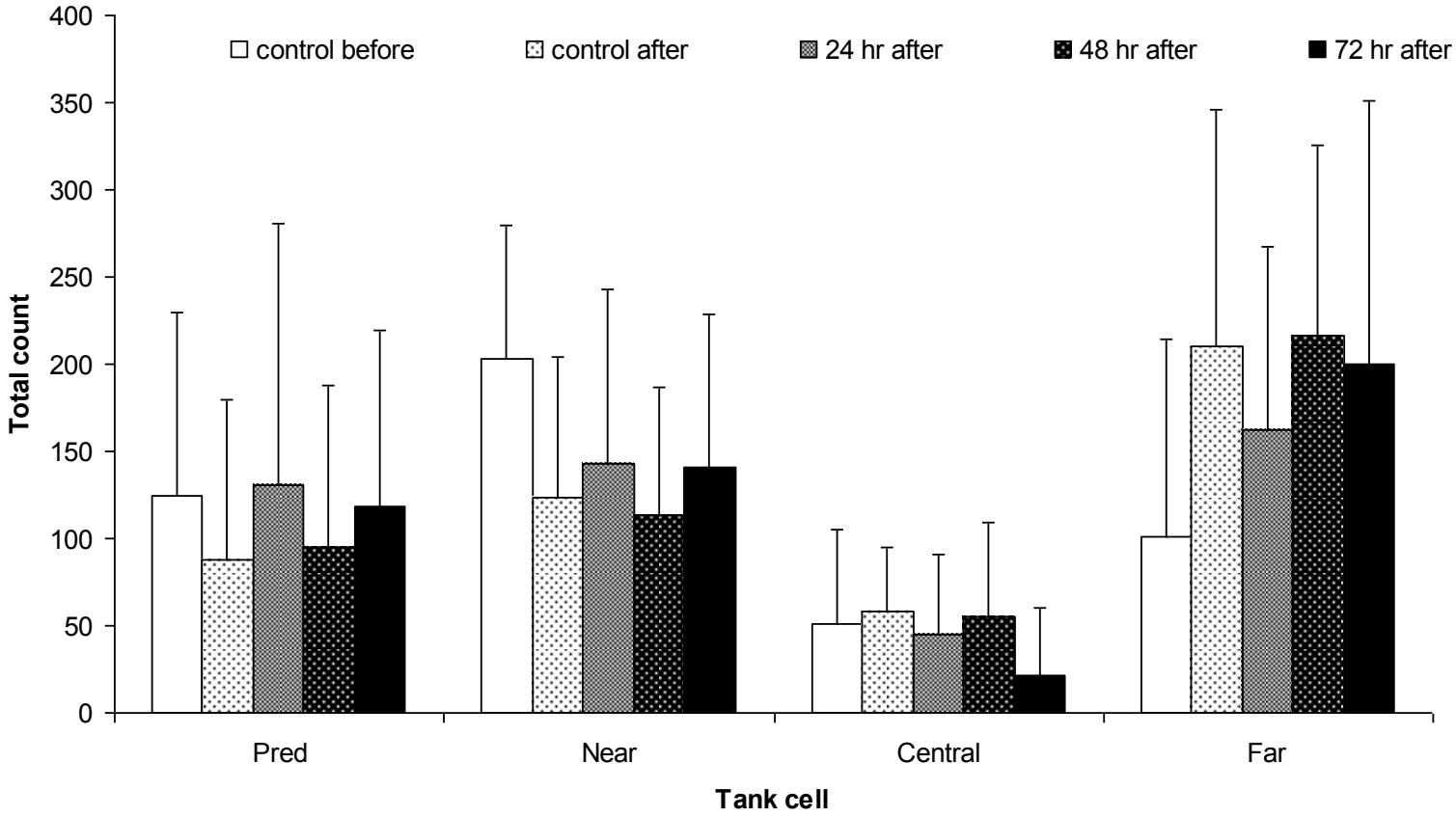
Typical response of control group of silver perch after introduction of Murray cod

Typical response of 72 hr trained silver perch after introduction of Murray Cod

Summary – Silver perch

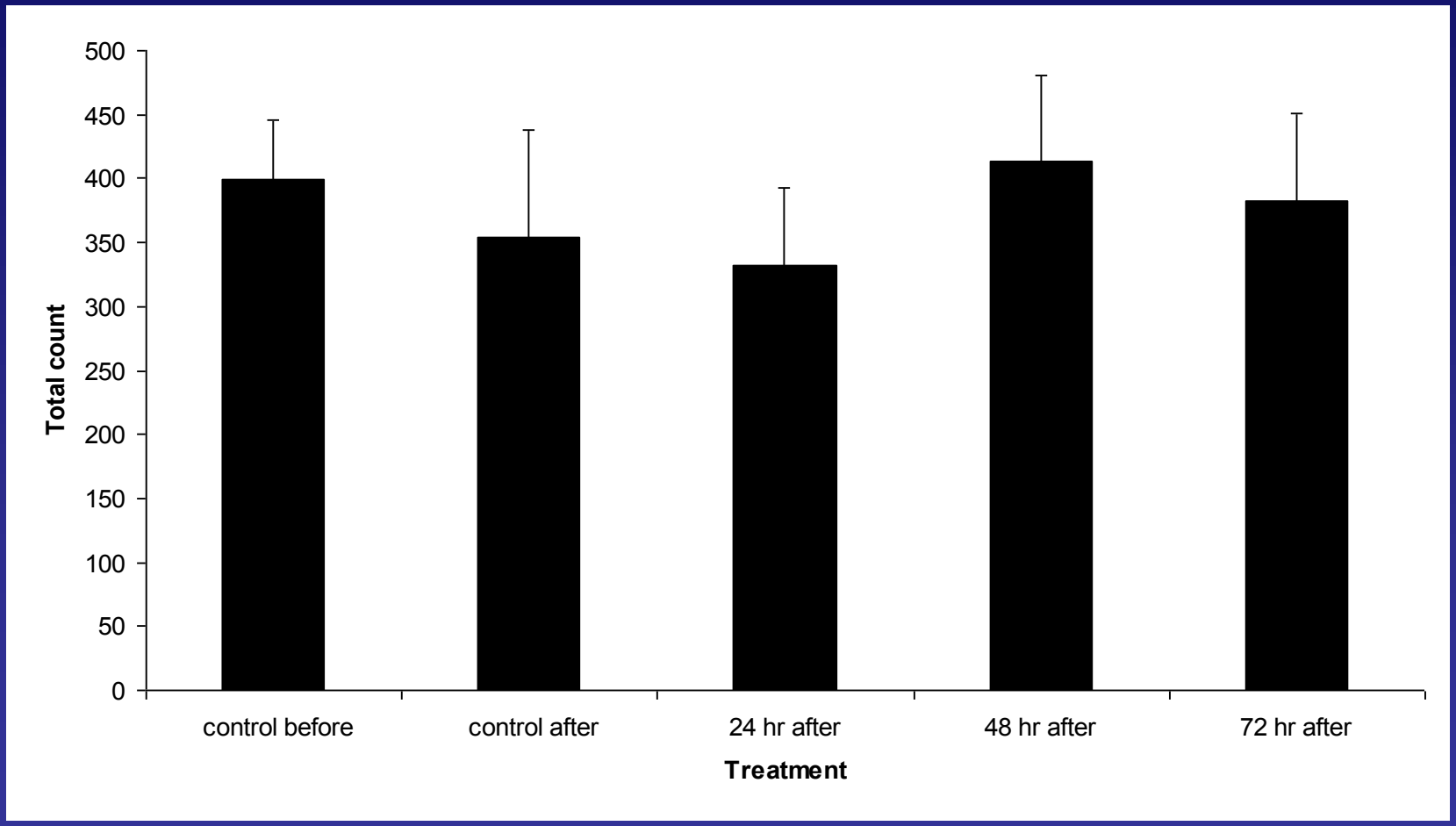
- Significantly more consistent (reduced variance) use of the far cell by 72 hour trained fish and a downward trend in use of other cells after the introduction of the predator.
- Significantly reduced use of the middle and upper water column by 72 hour trained fish after the introduction of a predator.
- Results suggest that 72 hour training is required for optimal response when training silver perch fingerlings in large groups.

Results – Murray cod



Use of tank cells by groups of eight Murray cod fingerlings before (control only) and after introduction of fish predator.

Results – Murray cod

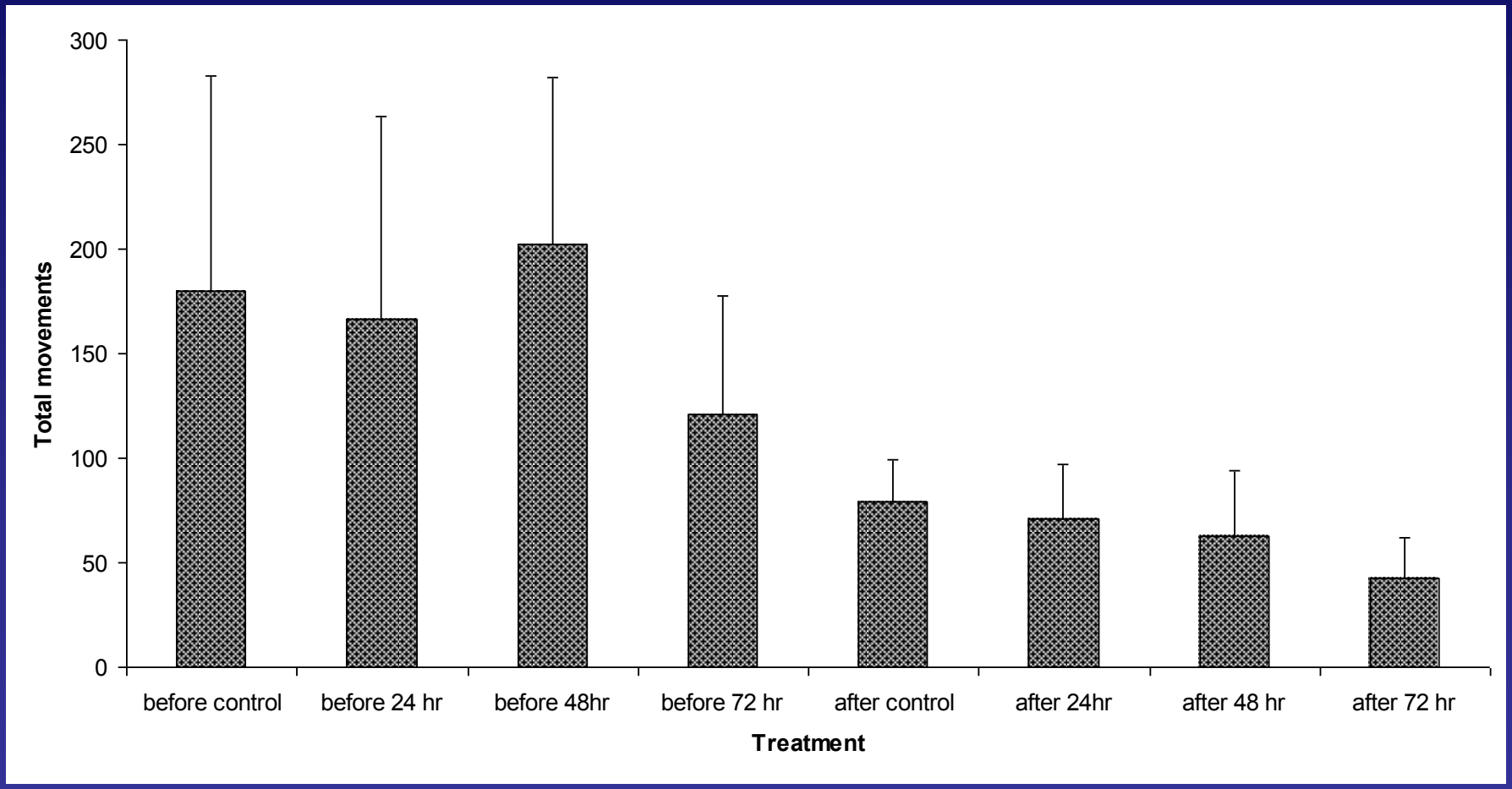


Use of cover by groups of eight Murray cod fingerlings before (control only) and after introduction of fish predator.

Results - Murray cod

Cod from all treatment groups showed a tendency to use cover cells and cells distal from an introduced predator. This image shows an example of a control group of Murray cod fingerlings.

Results – Murray cod



Total number of movements recorded in different treatments of groups of eight cod for 15 minutes prior and post introduction of predator (golden perch).

Results – Murray cod

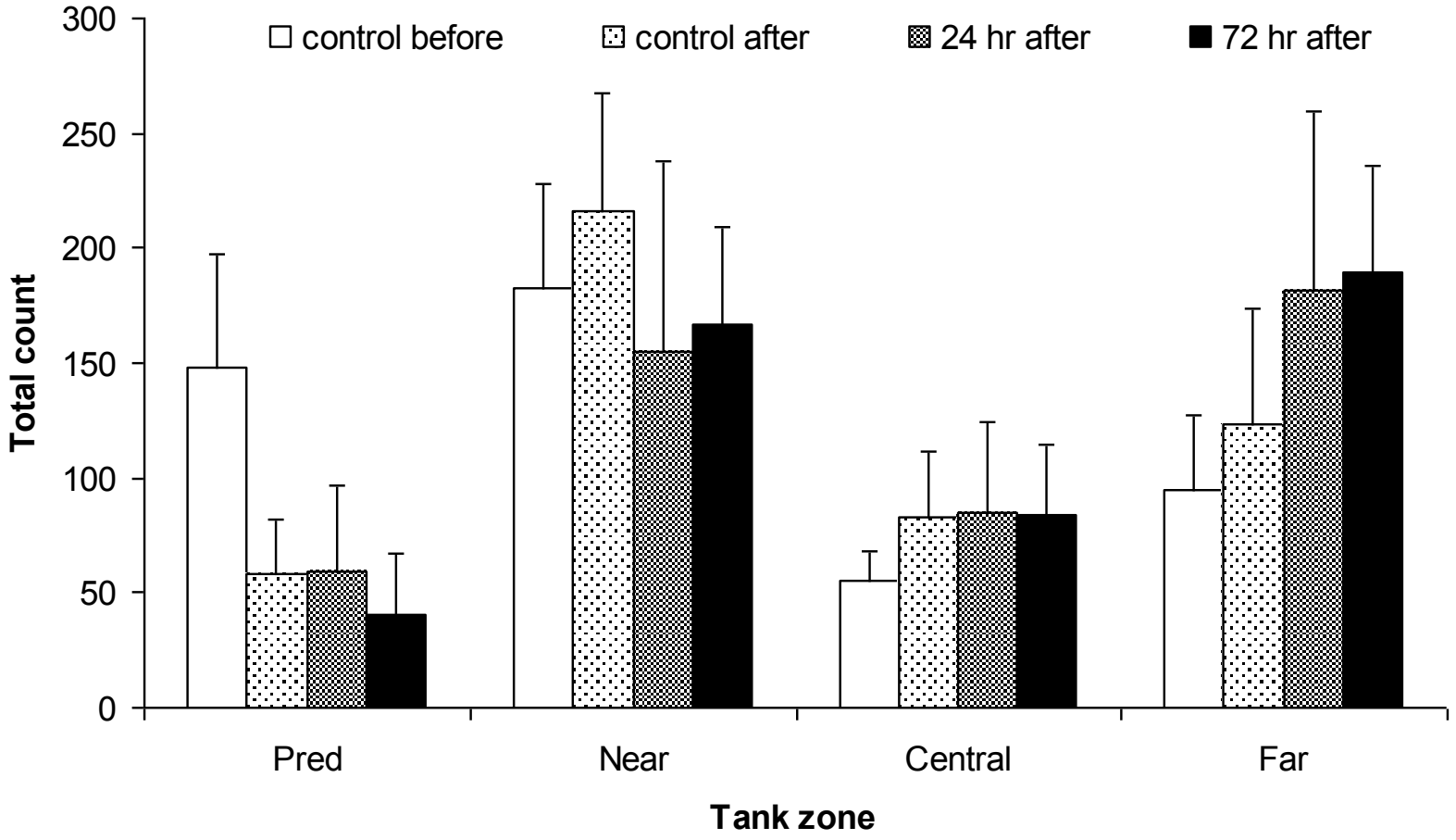
Use of cover cells by 72 hour trained cod shows improvement in concealment compared to control fish.

Summary – Murray cod

- Significant improvement in efficacy in use (reduced movement an territoriality) of cover cells by 72 hour trained cod after introduction of a predator.

- Preliminary results suggest that 72 hour training is required to achieve optimal results when training large groups of Murray cod fingerlings.

Results – eel-tailed catfish

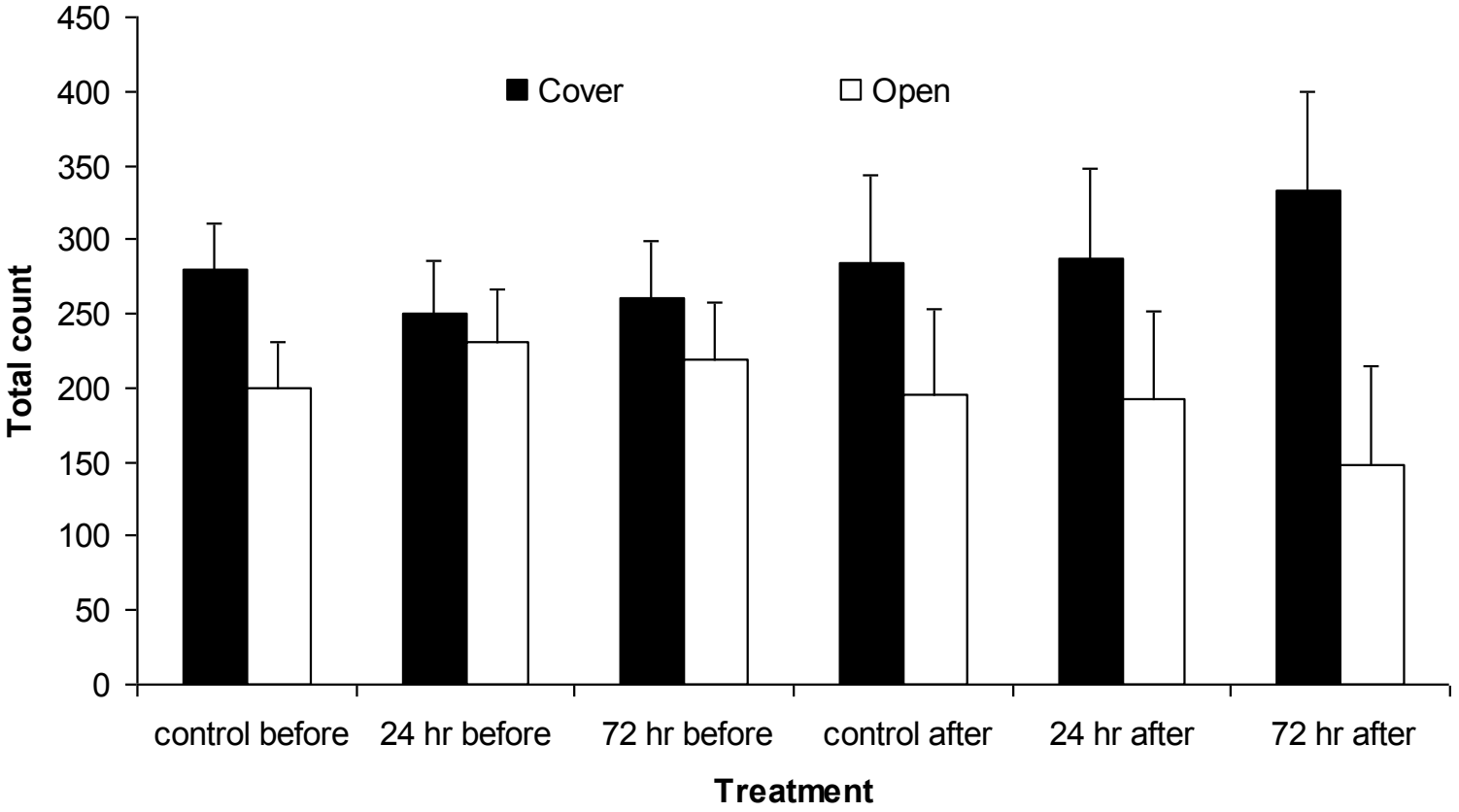


Use of tank cells by groups of eight eel-tailed catfish fingerlings before (control only) and after introduction of predator (Murray cod).

Results – eel-tailed catfish

Catfish trained for 72 hours showed a tendency to use far cells.

Results – eel-tailed catfish



Use of cover and open water cells by groups of eight eel-tailed catfish fingerlings before and after introduction of predator (Murray cod).

Summary – eel-tailed catfish

- Significant increase in use of the far cells by 72 hr trained catfish after introduction of a predator.
- Trend towards reduced use of near cells by trained catfish.
- Trend towards reduced use of predator cells by 72 hour trained catfish.
- Trend towards increased use of cover by 72 hour trained catfish.

Conclusions and further information

- Silver perch, Murray cod and eel-tailed catfish all showed some improvements in predatory fish avoidance behaviour following mass training.
- Best results achieved with at least 72 hours training.
- Analysis of bird predator experiments needed before inclusion into field trails. Preliminary analysis suggests effect of bird training on fingerlings. Prior exposure to birds in ponds may have led to no significant difference between control and treatment groups.
- Adult silver perch appear to have responded to bird training, but not cod.
- Live food training of sub-adults continuing
- Field trials to commence – November 2008 to February 2009.