# Hands-on operational experience and training at the Port Stephens Research Institute (PSRI) marine finfish hatchery, Port Stephens Fisheries Institute, Taylors Beach, NSW

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AUSTRALIAN SEAFOOD COOPERATIVE RESEARCH CENTRE

## Project No. 2012/719

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## NON-TECHNICAL SUMMARY

**PROJECT NO: 2012/719 Hands-on operational experience and training at the Port Stephens Research Institute (PSRI) marine finfish hatchery, Port Stephens Fisheries Institute, Taylors Beach, NSW**

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### (PROJECT) OBJECTIVES OF RESEARCH TRAVEL GRANT/ INDUSTRY BURSARY

This grant provided the opportunity to broaden both knowledge and practical skills through gaining experience with new species and hatchery techniques in a premiere aquaculture research facility. Objectives included:

- Expanded knowledge of marine finfish hatchery practices and their application to species other than cobia
- A broader base on which to work with Pacific Reef Fisheries (PRF) to develop their marine finfish hatchery.
- A report on operations at Port Stephens Research Institute, highlighting differences in operation between PSRI and Bribie Island Research Centre (BIRC) hatcheries.
- Maintain currency in best-practice methods of hatchery and live feed production for evaluating and improving practices at BIRC finfish production facility.
- Development of stronger collaborative links between PSRI, BIRC and PRF through staff transfers.

### NON TECHNICAL SUMMARY:

I travelled to Port Stephens Fisheries Institute (PSFI) for one week from 19 - 24 August 2012, to gain hands-on operational experience and training under the guidance of NSW fisheries staff in hatchery procedures for Australian bass, snapper, mulloway and yellowtail kingfish, and in the live feed production procedures developed by PSFI. During this period I assisted PSRI staff in undertaking an induced spawning of Australian bass, larval-rearing of Australian bass for stock enhancement, live feed production of rotifers and *Artemia*, as well as assisting with broodstock management. Both PSRI and BIRC play a leading role in research, development and extension to the aquaculture industry in NSW and QLD respectively, improving methods for hatchery production for sustainable aquaculture and business profitability and success. Broodstock management, live feed production and larval rearing are similar at both research facilities, with only minor differences in system design and hatchery protocols.

**OUTCOMES ACHIEVED TO DATE**

- Improved operation of the BIRC hatchery which may lead to more efficient achievement of production milestones within the cobia project.
- A more broadly based approach to training of PRF staff, encompassing a wider range of larval-rearing and live feed production techniques.
- Closer links and greater information transfer with PSRI, BIRC and PRF on developing improved methods for hatchery production of marine finfish and live feed production

**(PROJECT) OUTPUTS DEVELOPED AS RESULT OF TRAVEL GRANT/ INDUSTRY BURSARY:**

- Expanded knowledge of marine finfish hatchery practices and their application to species other than cobia
- A broader base on which to work with PRF to develop their marine finfish hatchery.
- A report on operations at Port Stephens Research Institute, highlighting differences in operation between PSRI and BIRC hatcheries.
- Maintenance of currency in best-practice methods of hatchery and live feed production to enable evaluation and improvement of practices at the BIRC finfish production facility.
- Development of stronger collaborative links between PSRI, BIRC and PRF through staff transfers.

## ABOUT THE PROJECT/ACTIVITY

### BACKGROUND AND NEED

I have been working at the Bribie Island Research Centre for 8 years. I am held in high regard and carry significant responsibility as one of the senior technicians on site. BIRC is a multi-functional aquaculture research centre, with commercial scale production facilities enabling scientists to conduct research that can have direct, industry-wide application. Current projects that I am involved with include cobia aquaculture for prawn farm diversification, developing jungle perch fingerling production to improve fishing opportunities, and polychaete-assisted sand filters for marine wastewater treatment. As a Fisheries Technician, I occupy a crucial role in the finfish research team with responsibilities including hatchery operation and live feed production. I have been earmarked to play a key role in training hatchery staff from Pacific Reef Fisheries (PRF) as they develop their finfish hatchery capability, under the Seafood CRC project number 2011/724 “The development of an Australian Cobia aquaculture industry”.

This grant provided me with the opportunity to broaden both knowledge and practical skills through gaining experience with new species in a different hatchery setting as well as the chance to work with one of the premiere aquaculture research groups in Australia. It will benefit me and DAFF through applying these new skills and knowledge directly to the finfish hatchery operations at the centre. In addition, the experience will have considerable benefits for my training role.

## RESULTS

## INDUSTRY IMPACT

### PROJECT OUTCOMES (THAT INITIATED CHANGE IN INDUSTRY)

- Improved operation of the BIRC hatchery which may lead to more efficient achievement of production within the cobia project and other research projects.
- A more broadly based approach training of PRF staff, encompassing a wider range of larval-rearing and live feed production techniques.
- Staff exchanges encourage development of strong collaborative links between research facilities and industry hatcheries, allowing direct transfer of best-practice methods used at host and visitor hatcheries, leading to greater production and profit.

### SUMMARY OF CHANGE IN INDUSTRY

Knowledge, skills and experience gained at PSRI will enhance progress of the cobia project in two main areas. Firstly, it will improve the capability in hatchery operation and live feed production for BIRC finfish production facility through the application of new knowledge and/or approaches to hatchery activities. Secondly, experience with a greater breadth of hatchery practices will facilitate my role as a trainer of PRF staff during staff exchanges at BIRC and in working with PRF staff to develop hatchery capability at PRF's existing prawn hatchery.

### WHAT FUTURE AND ONGOING CHANGES ARE EXPECTED?

This grant provided me with the opportunity to broaden both knowledge and practical skills through gaining experience with new species in a different hatchery setting. This will lead to:

- Improved operation of the BIRC marine finfish hatchery which may lead to more efficient achievement of production milestones within research projects.
- Benefits for myself and DAFF through applying these new skills and knowledge directly to the hatchery operations for cobia and other marine finfish species, including jungle perch, at BIRC. In addition, the experience will have considerable benefits for my role to develop hatchery capability in PRF staff as part of Seafood CRC project *2011/724 The development of an Australian Cobia aquaculture industry.*
- Stronger collaborative links between PSRI, BIRC and PRF through staff transfers.

### WHAT BARRIERS ARE THERE FOR CHANGES TO OCCUR?

There are a number of barriers for these changes to occur. These include:

- Funding availability at BIRC (site and research project funding) to improve/upgrade aspects of marine finfish hatchery operations.
- The availability of staff and resources to evaluate, establish and maintain these changes.
- Maintaining collaborative links open between research centres and industry partners regarding research developments and industry needs.

## IF NOT ALREADY HAPPENING, WHEN WILL THE CHANGES OCCUR?

There are a number of project findings that are being adopted or expected to be adopted in the near future. These include:

- Currently evaluating and improving operation of the BIRC marine finfish hatchery. This may lead to more efficient achievement of production milestones within the cobia project.
- As part of the capability development element of project *2011/724 The development of an Australian Cobia aquaculture industry*, ongoing training of PRF staff, so that they maintain currency in best-practice in hatchery operation. By developing a broader knowledge of the hatchery practices and live feed production methods of cobia will better equip PRF hatchery staff to develop finfish hatchery capability at PRF's existing prawn hatchery, leading to successful operations.

## WHAT IS THE LIKELIHOOD THAT THESE CHANGES WILL OCCUR?

This project has strengthened further the links between research at PSFI and BIRC, and will also increase ties with industry partners such as PRF. This closer contact will enable direct benchmarking of best-practice methods used at host and visitor hatcheries and increase the opportunities for project findings and recommendations to be adopted by research centres such as BIRC and PSFI, and commercial stakeholders such as PRF. This will be further facilitated by planned visits to BIRC by PRF hatchery staff using the most current cost effective and labour efficient techniques are paramount in successful hatchery operations, leading to the longevity of the aquaculture industry with increases in output and profit.

## WHAT BARRIERS ARE THERE TO ADOPTION OF THESE CHANGES AND WHAT ACTION COULD BE TAKEN TO OVERCOME THESE?

There are a number of key aspects for successful adoption of project findings. These include:

- Additional funding and capital for improvements in BIRC's finfish marine hatchery. This will be address through appropriate internal DAFF channels such as applications for Capital Works, Infrastructure Development and/or Scientific Equipment.
- Information transfer of best-practice methods via hands-on operational training and experience. This will be facilitated by ensuring regular and open communication (through reports, seminars, telephone and email correspondence etc.) and by future site visits by staff.
- Maintaining collaborative links between PSRI, BIRC and PRF through staff transfers.

# COMMUNICATION OF PROJECT/EXTENSION ACTIVITIES

## WHAT IS THE OUTPUT THAT NEEDS TO BE COMMUNICATED?

There are a number of outputs from the hands-on operational experience and training at PSRI marine finfish hatchery. These include:

- Expanded knowledge of marine finfish hatchery practices and their application, including best-practice techniques on larval-rearing and live feed production.

- A broader base on which to work with PRF to develop their marine finfish hatchery to maximize production and profit.
- A report on operations at PSRI, highlighting differences in operations between PSRI and BIRC hatcheries, so as to evaluate and improve practices at BIRC (see Appendix).
- Stronger links with PSRI and industry stakeholders such as PRF.

**WHO IS/ARE THE TARGET AUDIENCE/S?**

There are a number of target audiences from this experience. They include:

- The Australian Seafood CRC.
- Hatchery and other staff at BIRC.
- NSW fisheries staff at PSFI.
- Hatchery and other staff at PRF.
- Other stakeholders, including commercial hatcheries and farms.

**WHAT ARE THE KEY MESSAGES?**

The knowledge, skills and experience gained from this training at PSFI allows direct benchmarking of best-practice hatchery methods used at host and visitor hatcheries, including BIRC. This in turn will lead to a broader base on which to work with commercial operators such as PRF to develop their marine finfish hatchery. The transfer of staff between R&D hatcheries also encourages the development of strong collaborative links between research facilities and industry, highlighting research developments and industry needs.

**WHAT IS THE CALL TO ACTION?**

This grant provided an expanded knowledge of marine finfish hatchery practices and their application to species other than cobia. This broader knowledge base can then be used to improve operation of the BIRC hatchery which may lead to more efficient achievement of production milestones within the cobia project and other research projects conducted at BIRC. Examples include:

- Evaluate and if possible improve practices at BIRC finfish production facility.
- Use best-practice methods on hatchery (larval-rearing) and live feed production.

As part of the capability development element of project *2011/724 The development of an Australian Cobia aquaculture industry*, PRF hatchery staff will be trained, so that they maintain currency in best practice in hatchery operation. By developing a broader knowledge of the hatchery practices and live feed production methods of cobia will better equip PRF hatchery staff to develop finfish hatchery capability at PRF's existing prawn hatchery, leading to successful operations.

**COMMUNICATION CHANNELS**

| *Channel* | *Who by* | *When* |
|---|---|---|
| • A report distributed among interested parties on operations at PSFI, highlighting differences in operation between PSFI and BIRC hatcheries. | • Myself | • Immediately |
| • Workshops and practical demonstrations | • Research facility | • Immediately |
| • Seminars | • Research facility | • Immediately |
| • Internet | • Everyone | • Immediately |
| • By email and telephone correspondence | • Everyone | • Immediately |

## LESSONS LEARNED AND RECOMMENDED IMPROVEMENTS

**WHAT IS YOUR FEEDBACK?**

This grant provided me with the opportunity to broaden both knowledge and practical skills through gaining experience with new species at a different research hatchery. Gaining a wider variety of approaches to marine finfish hatchery production has allowed me to better evaluate and improve practices at BIRC finfish production facility and hatchery training of PRF hatchery staff. This experience was also an excellent mechanism for my professional and personal development, and a mechanism for stronger collaborative links between PSRI and BIRC.

Improvements for future research projects include:

- A longer time spent (greater than 1 week) at a research centre or commercial hatchery to gain a greater insight into live feed production and hatchery operation.
- Staff exchanges between PSRI, BIRC and commercial operators such as PRF, where researches and technical staff rotate over a 2 week period to gain experience at all facilities, allowing direct benchmarking of best-practice methods used at host and visitor hatcheries. It also allows an exchange of research developments and industry needs.
- Due to work commitments, a hatchery staff member from PRF was not able to undertake the training in conjunction with myself at PSRI. This would have impacted on information transfer to develop hatchery capability in PRF's staff. This could be overcome by staff transfers in less busy periods.

## FURTHER ACTION REQUIRED IN REGARDS TO COMMERCIALISATION?

The knowledge and skills gained during this staff transfer will be shared directly through ongoing dealings and staff exchanges with PFR hatchery staff to develop finfish hatchery capability at PRF's existing prawn hatchery. This is part of the capability development element of project 2011/724 *The development of an Australian Cobia aquaculture industry*.

## ACKNOWLEDGEMENTS

I wish to thank the Australian Seafood Cooperative Research Centre for giving me the opportunity to participate in hands-on operational experience and training at the Port Stephens Research Institute marine finfish hatchery, Taylors Beach, NSW.

I would also like to thank NSW fisheries staff, including Luke Cheviot, for their guidance and training in hatchery operation and live feed production at PSRI.

Thanks also to Dr Peter Lee, Principal Scientist (Aquaculture) at BIRC, and Dr Stewart Fielder, Senior Research Scientist at PSFI for their written endorsements.

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## APPENDIX (See below)

# Operations at Port Stephens Fisheries Research Institute (PSRI) marine finfish hatchery, highlighting differences in operation between PSRI and Bribie Island Research Centre (BIRC) hatcheries

*Trevor Borchert*

This publication has been compiled by Trevor Borchert of Agri-Science Queensland, Department of Agriculture, Fisheries and Forestry.

**Broodstock Management**

Broodstock at PSRI marine finfish hatchery are housed in twelve recirculating aquaculture systems (20 000 L each). Each system has a heater/chiller unit, mechanical drum filter and suspended bead biological filter (Figure 1). The systems are also equipped with lights for full photothermal control. Research is centred on improving methods for hatchery production of mulloway (*Argyrosomus japonicus*), yellowtail kingfish (*Seriola lalandi*), and southern bluefin tuna (*Thunnus maccoyii*), and for the production of Australian bass (*Macquaria novemaculeata*), for stock enhancement. Australian bass are a highly prized light-tackle sport fish, and due to large public demand, juvenile fish are stocked into lakes and impoundments for recreational fishing purposes (Fielder and Heasman, 2011).

Figure 1. PSRI broodstock tank.

Similar to PSRI, broodstock at BIRC are kept in four recirculating aquaculture system tanks (35 000 L each), allowing full environmental control. This enables finfish broodstock to be maintained for research purposes all year round (Figure 2). Each system includes a heater/chiller unit, u-v steriliser, foam fractionator, and mechanical and biological filtration. Photoperiod is controlled by fluorescent lights on a timer. Broodfish housed within these recirculating systems include marine finfish species such as cobia *(Rachycentron canadum)*. A further 4 x 10 000 L tanks are used for quarantine and for housing immature fish selected as future broodfish.

Figure 2. BIRC finfish broodstock facility.

Water quality parameters such as temperature, salinity, dissolved oxygen and pH are checked daily (am) at both PSRI and BIRC and adjusted accordingly. The feeding of broodstock is carried out similarly, with fish fed every day or every second day (depending on spawning season) with fresh food such as squid and pilchards. Pellets are given to the smaller fish every day. Formalin treatments at 150 to 200 ppm (prophylactic parasite treatment) are carried out every month on the broodstock at BIRC, less frequent treatments at PSFI.

**Live Feed Production**

***Algae***

Microalgae is an essential food source in the rearing of all stages of marine bivalve molluscs (clams, oysters, scallops), and the larval stages of many marine finfish species. PSFI produces live algae for hatchery (predominately their mollusc hatchery) and industry, mass culturing 7-12 algal species (Figure 3).

Figure 3. Algae lab at PSFI mollusc hatchery.

In recent years, PSRI marine hatchery has shifted from using these mass cultures to a microalgal concentrate, while BIRC's marine finfish hatchery uses outdoor mass cultures of microalgae. Chlorella (freshwater *Nannochloropsis sp.*) paste is used at PSFI marine fish hatchery as a substitute for live algae in the production of rotifers. Algal pastes are a super concentrated liquid microalgae feed for live feed and larval fish. Concentrates are used to supplement or replace live algae grown on-site at the hatchery, and some benefits include reducing live feed production space, easy to use, and relatively long shelf life. There are a number of benefits for using microalgal concentrate such as Chlorella paste, including reducing power and labour costs. The production of microalgae at BIRC involves the scaling up of pure seed cultures in the lab to outdoor mass cultures of the green microalgae *Nannochloropsis oculata*). New mass cultures are started every 3-4 days, with capacity of 8 x 5000 L tanks (Figure 4).

Figure 4. BIRC outdoor mass algal cultures with larval tanks in background.

Tanks are filled with filtered seawater (1 µm) and sterilised overnight with liquid sodium hypochlorite (100 mL per 1000 L). The next day tanks are de-chlorinated with sodium thiosulphate anhydrous (5 g per 1000 L), fertilised with a fertiliser regime developed by DAFF, and inoculated with 20% of 7 to 10 day old microalgae (Palmer *et al*. 2007). Aquasol (35 g per 1000 L), a commercially available soluble fertiliser is also used. Established *N. oculata* culture is then used for rotifer production and larval fish cultures. Other algal species cultured at BIRC include *Isochrysis galbana* (T-Iso), *Chaetoceros muelleri*, and *Tetraselmis sp*.

***Rotifers***

Rotifers (*Brachionus plicatilis)* are microscopic organisms that are routinely mass cultured in the aquaculture industry as food for fish larvae. Rotifers are of vital importance for the fish larvae as they are the first live prey, and are regarded as living food capsules for transferring nutrients to fish larvae. The production techniques of the rotifer *B. plicatilis* differ substantially between PSRI and BIRC, although with broadly similar outcomes.

Rotifers (large strain) at PSRI are cultured in a 300 L recirculating system, designed to culture a continuous supply of rotifers at high densities of between 1000 to 2000 $mL^{-1}$. The system involves two conical tanks, a foam fractionator and a peristaltic pump to deliver the correct dose of microalgae concentrate (Figure 5).

Figure 5. Rotifer recirculating system at PSFI.

Management of the culture includes daily water exchanges, cleaning of screens and scouring pads, and feeding microalgae concentrate (Marine Chlorella) to the system. This culture system is a labour efficient method of producing high numbers of rotifers for fish larval-rearing and could be incorporated into BIRC live feed production systems.

The production of rotifers at BIRC (large strain) uses a more extensive approach, involving weekly batch cultures, with capacity of 6 x 4000 L tanks. Cultures are inoculated at a rate of 40 $mL^{-1}$, fed live microalgae *N. oculata*, and attain rotifer densities of 100 $mL^{-1}$ after 1 week (total capacity 2400 million rotifers) (Palmer *et al*. 2007). Small strain rotifers at BIRC are cultured the same way, although in 1000 L tanks. Rotifers used in larval-rearing at BIRC are enriched with S.presso™ (Inve Aquaculture, Belgium), a liquid enrichment high in PUFA. Rotifers added to larval cultures at PSRI are enriched on a combination of microalgal concentrates and artificial enrichment products such as Algamac-3050 (Aquafauna Bio-Marine, USA).

***Artemia***

*Artemia* (commonly known as brine shrimp) are cyst-forming aquatic crustaceans and are extensively used in research and commercial hatcheries as a convenient form of live feed for larval fish and prawns. Both PSRI and BIRC use the SEP-Art technology (Inve Aquaculture, Belgium) to produce *Artemia* as a food source for fish larvae. This new technology facilitates the harvesting of *Artemia*, with complete separation of nauplii and unhatched cysts. The SEP-Art separator tube has strong magnets which attract the iron coated shells leaving clean nauplii after harvesting from hatching tanks (Figure 6).

Figure 6. PSRI *Artemia* hatching tanks with blue SEP-Art separator tube in front.

This technology is highly efficient and fast, vital in any research and commercial hatchery. Once at nauplii stage, *Artemia* are enriched with a number of commercially available live feed enrichment products. BIRC uses S.presso (Inve Aquaculture, Belgium), a complete liquid enrichment with high nutritional benefits for fish larvae. PSRI enriches *Artemia* with Algamac-3050 (Aquafauna Bio-Marine, USA), a nutritionally balanced enrichment powder. These enriched *Artemia* nauplii are then fed to fish larvae, ensuring healthier larvae and increased production. PSRI also cold stores (4 - 5 ºC) enriched *Artemia* and rotifers for later use, which maintains the quality of the retained live feed. At BIRC live feeds are all fed to larvae immediately after enrichment.

**Broodstock spawning, egg incubation and hatching**

Similar protocols are used at both PSRI and BIRC for spawning of the broodstock, egg collection and hatching. Gonad biopsies (canulation) are taken using 1mm clear plastic tubing inserted through the gonopore of both male and female fish in order to measure gonad development and viability for spawning induction. Following hormone induction with hCG or LHRHa (Figure 7), fertilised eggs are harvested from the spawning tank (usually from broodstock tanks with egg collecting baskets) and transferred to incubation tanks (400 L to 1000 L at BIRC) (Figure 8). Broodstock cobia at BIRC are retained in the broodstock rearing tanks, whereas at PSRI, hormone induced Australian bass are transferred into 500 L to 1000 L tanks to await ovulation and spawning (Figure 9).


Figure 7. Hormone induction (hCG) of Australian Bass at PSRI.

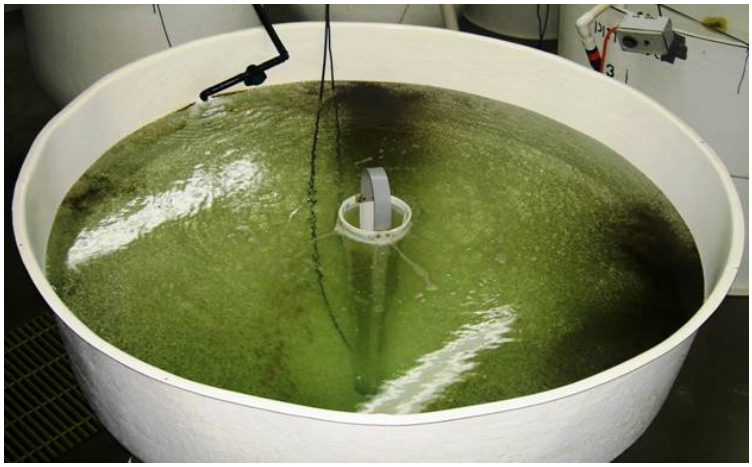

Figure 8. BIRC 1000 L hatching tank containing cobia larvae.

Figure 9. 1000 L spawning tanks at PSRI.

Regular samples are taken to monitor cell division and embryonic development. PSRI uses ozone for egg disinfection, which is an important practice to reduce the incidence of infection by pathogens in the hatchery. It is recommended that this protocol be incorporated into BIRC's finfish marine hatchery. After hatching, larvae are counted (volumetrically), and stocked into larval-rearing tanks.

**Larval-Rearing, Nursery and grow-out**

Marine finfish hatchery techniques are similar between PSRI and BIRC. Larval-rearing protocols at PSRI for Australian bass, mulloway and yellowtail kingfish involve intensive clear-water phase and/or extensive green-water in large outdoor ponds. Intensive larviculture tanks range from 500 L to 2000 L conical fibreglass tanks. These indoor tanks are controlled under optimised temperature, salinity and light regimes and the larvae stocked are fed enriched live feeds of rotifers at 10 to 20 $mL^{-1}$ and *Artemia* at 0.2 to 3.2 *Artemia* $mL^{-1}$ per feed (Fielder and Heasman, 2011). For Australian bass, after the initial clear-water phase, culture tanks are continued on clear water or intensive green-water systems where microalgae is added (microalgae concentrate) (Figure 10).

Figure 10. Harvesting Australian bass at PSRI for stock enhancement.

For yellowtail kingfish and mulloway, culture tanks are conditioned with algae concentrate (Rotifer Diet 3600) and aerated lightly to reduce the incidence of early mortalities and deformities. PSRI also uses an upwelling system in their larval-rearing tanks as an alternative to aeration to reduce larval mortalities. Seawater is pushed through a pvc pipe with holes at a rate of 24 to 25 L minute$^{-1}$ in a 2000 L tank, saturating the recirculating system with oxygen (Figure 11).

Figure 11. PSRI 2000 L larval tank with an upwelling system.

It is recommended that this innovation be considered for adoption at BIRC to increase survival and production. Surface skimmers are also fitted to the tanks at PSRI and are essential to ensure normal swim bladder inflation.

PSRI also have 6 x 10 000 L covered larval-rearing tanks used for larval and juvenile fish rearing (Figure 12). Large outdoor ponds are also used for larval-rearing at PSRI, where the larvae feed on phytoplankton and zooplankton before being weaned onto commercial diets. These ponds are also used for holding broodstock such as mulloway (Figure 13).

Figure 12. PSRI 10 000 L larval-rearing tanks.

Figure 13. Grow-out ponds at PSRI.

At BIRC, larvae are stocked into larval-rearing tanks ranging in size from 1000 to 20 000 L. The most common approach to rear larvae at BIRC is the green-water culture method, where tanks are seeded with live microalgae (*N. oculata*) and the larvae first feed on enriched rotifers at 5 to 20 $mL^{-1}$, followed by enriched *Artemia* at 1 to 5 $mL^{-1}$. After 2 weeks, the larvae are harvested and stocked into ponds for grow-out.

The nursery and grow-out ponds are an integral part of fingerling production at BIRC. Ponds are filled and fertilised 2 weeks before broodstock spawning to maximise phytoplankton and copepod production in the ponds. Larvae are stocked and feed on the zooplankton for about 1 week before being weened onto a commercially available diet. Not long after stocking (4 to 6 weeks), juveniles are harvested from the pond and transported to industry (PRF) for grow-out and evaluation (Figure 14).

Figue 14. Juvenile cobia ready for harvest at BIRC.