

HATCHERY

Volume 14 Issue 2 MARCH/APRIL 2013

INTERNATIONAL

BETTER BREEDING

Right: An easy way to measure egg volume is to collect it in a graduated container.
Inset: A 4-year old hen that will be spawned and placed back on continuous light to spawn again in the spring out of season.



Optimize photoperiod to maximize spawning performance

BY TRISTAN ROBBINS AND JIM POWELL FFSBC | PHOTOS BY MARLA ZARELLI AND JIM POWELL

A Canadian restocking hatchery maximizes rainbow trout production with three successive spawning seasons over 18 months

Two of the most popular programmes offered by the Freshwater Fisheries Society of British Columbia, Canada (FFSBC) are *Learn to Fish* and *Fishing in the City*. These programmes involve stocking urban lakes with catchable rainbow trout from March to October. This means a constant supply of 225-250g trout over an extended period.

Complicating matters is that the five FFSBC hatcheries that stock out the fish are located in different regions of the province and they each have distinct thermal profiles to their water supplies. This means holding fish back or accelerating growth to meet the stocking demands, which is not cost effective. The solution seemed to be in moving the spawning season.

CAPTIVE BROOD

The captive brood are reared at the Vancouver Island Trout Hatchery in Duncan, British

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NEW SPECIES

Breeding longfin yellowtail jack: Is it a candidate for European aquaculture diversification?

BY JAVIER ROO AND HIPÓLITO FERNÁNDEZ-PALACIOS

The longfin yellowtail jack (*Seriola rivoliana*), also known as almaco jack, is suitable for aquaculture owing to its fast growth, excellent flesh quality and wide international markets. In the Atlantic region, research into the breeding and early rearing has been conducted by the Grupo de Investigación en Acuicultura in the Canary Islands, Spain.

BROODSTOCK MANAGEMENT

Broodstock development has been underway for several years and started when fifteen sub-adult almaco jack (*S. rivoliana*) were captured by local fisherman off the south coast of Gran Canaria in July 2007.



Longfin yellowtail jack broodstock at the Grupo de Investigación en Acuicultura in the Canary Islands, Spain.

They were transported to on-land facilities at the Instituto Canario de Ciencias Marinas (ICCM) where they were placed in a 10m³ tank under natural photoperiod, and supplied with natural sea water at 37‰ salinity and temperature ranging seasonally between 18 and 24°C. The fish (future broodstock) were fed twice a week with commercial pellets supplemented once a week with frozen squid and fish.

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HATCHERY PROFILE

Selective breeding pays dividends for Australian barramundi producer

R&D paves way for Mainstream hatchery expansion

BY JOHN MOSIG

While Australia has a relatively compact aquaculture industry, it punches well above its weight, particularly with technology, stock domestication and genetic improvement.

Unlike the emerging world, where operating efficiencies are derived from low labour costs, compliance, and in many cases subsidised utilities, Australian businesses like Mainstream must increase productivity through research and development. Mainstream Aquaculture Pty. Ltd. is leading the way in barramundi (*Lates calcarifer*) through its selective breeding program and custom-designed recirculating technology.

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Technician Ken Chow preparing a female fish for hormone injection.

COVER

Selective breeding pays dividends for Australian barramundi producer

continued from cover

ESTABLISHED BUSINESS

Mainstream has been providing barramundi to markets in Australia and overseas for a number of years. They cleverly established a recirculating aquaculture system (RAS) about 30 minutes drive from a major market in Melbourne and have the further advantage of a limitless supply of heated water from a deep geothermal aquifer. The company is managed professionally and has grown rapidly: it is now investing in a new hatchery to take advantage of recent advancements in breeding technology.

Mainstream's Head of Aquaculture, Paul Harrison said, "We aim for continuous supply of high quality barramundi



Technician Valentine Thepot siphoning a larval tank.



Two of Mainstream's holding tanks showing the oxygenation cones and the biofilters.

products. For the first five years we focused our efforts on the engineering side of the business to improve stability and operational efficiency. We are comfortable with that, but are continually assessing new technology in an effort to improve."

About seven years ago the company took on a new focus around hatchery operations. "We identified that the biggest impact on production efficiency was variable growth, and presumed this to be due to underlying genetics," Paul noted. "For us to operate our RAS as a continuous manufacturing line we needed a really good, continuous supply of barramundi seedstock. Barramundi available to us were just one generation removed from the wild; both timing of delivery and quality were highly variable. So we decided to focus heavily on the supply side of the business by developing a hatchery operation."

STRATEGIC LOCATION

Their current hatchery is located on the grounds of James Cook University in Townsville (Queensland). Again,

strategically positioned, it allows for both commercial and R&D activity.

"Commercially it has outperformed our expectations with fish produced every month for the past two years and over 5 million 21-DAH (days after hatch) weaned fingerlings produced in the 2012 financial year," Paul said. R&D activity is performed in collaboration with geneticist Dr. Dean Jerry.

BROODSTOCK DEVELOPMENT

Over the last five years, Mainstream has been assessing and refining its broodstock population. All broodstock are genotyped and the performance of hundreds of family combinations has been tracked on the Melbourne farm. Being able to establish the genetic background of high performing fish has enabled them to decide on which fish to pair to produce seedstock that deliver the best results.

Paul went on to say, "We've benefited enormously from this program. It has allowed us to make informed decisions on pairing and thereby produce certain cohorts



Geneticist Jose Domingos inserts a PIT tag into a selected brood-fish (note rounded body shape).



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COVER

Golden Barramundi

In addition to building a population of high performance Australian barramundi, Mainstream has also been able to produce a population of fourteen 'Golden' barramundi. These 'goldens' appear to produce no pigment but otherwise grow normally. "They come out with pure golden scales, red tinged fins and whiter flesh," according to Mainstream Manager Paul Harrison. With a new hatchery planned for the Melbourne site, one of Mainstream's first projects will be to investigate whether a strain of golden barramundi can be established with the same performance and conformation traits they seek in their standard fish.

that will run through the production line in predictable ways. At the same time we are selecting the best performing individuals for selective breeding. By shaping this population we eliminate broodstock pairings that produce poor performing seedstock and thereby improve the genetic basis of the stock with respect to farming... In fact if you're looking for the biggest gains we've had so far from the program it's been the elimination of poor performing stock, and improved conformation. We've estimated that output has improved by 30% from this."

HAPPY CLIENTS

He also pointed out that clients are happy with the product: they had to do much less grading, and were getting better fillet yields. "These sorts of things mightn't seem like much, but at the end of the day they all add value of the business," said Paul.

"We are now at a stage where we have an optimised breeding program and simply need more space to take full advantage of this. What's coming in now is the ability to selectively breed from performance-recorded pairings, and we are seeing some amazing results. The 'stand out' individual so far achieved 1.6kg in only six months, however, the focus is on improving mean growth rate of the entire population and narrowing the cohort growth variation."

BEST IN SHOW

The company owns an impressive population of 78 broodstock that provide hundreds of potential pairing combinations. In their effort to domesticate this species, they select for multiple traits simultaneously by running large numbers of family pairings and identifying the best performing offspring. Paul calls these individuals "best in show" and they are characterised by rapid growth, clean health history, and a thicker body shape (barramundi come in all shapes and sizes from long and slender to short and thick).

ADMINISTRATIVE CHANGES

To support all of this activity, Mainstream has recently undergone a business transformation. Paul, who founded the business in 2001 and served as CEO for 11 years, has handed over the reins to a newly appointed CEO, Boris Musa, who has spent the last five years as an executive with the Macquarie Group. Boris said "I'm privileged to have joined the business at this stage of its life cycle, after over a decade of intensive R&D effort. Mainstream, with its deep operating expertise in recirculating technology and a leading position in the selective breeding of Barramundi, is ready to be commercialised."

In talking about the opportunities for Mainstream, Boris said, "The world confronts an inescapable fact, we are feeding more people, with changing diets, using finite resources and we need a solution. Capture fisheries contribution to human fish consumption has barely changed in over 20 years as many wild stocks of fish are fully exploited and yet, consumer demand over this period has been increasing at over twice the rate of global GDP growth. Aquaculture ... is the sustainable solution... With the successful commissioning of our Barramundi hatchery, we'll be in the position to scale up our business significantly to meet burgeoning consumer demand."

IP PROTECTION

When asked about the intellectual property considerations of selling fingerlings, Boris said, "We are pleased to be able to help the global Barramundi industry by providing our customers with upper quartile fish. The longevity and strength of our existing client relationships validates that our fish grow quickly and are resilient. We are afforded some



Planning the week ahead - Monday morning staff meeting.



Standard and Golden Barramundi.



Mainstream's Head of Aquaculture, Paul Harrison hard at work.



Barramundi fingerlings.

IP protection as it is the combinations that are most important, not the genetic profile of individual fish. Besides, a good deal of the benefit comes from the hybrid vigour generated by proven combinations. That heterosis is not only lost when trying to breed from the offspring, it can have an adverse effect, as breeders of terrestrial livestock found in the '60s and '70s."

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COVER

OLD ADAGE

There's an old farming adage: When is the best time to plant an orchard? The answer is yesterday. Genetics fits into that category. While the initial outlay and outgoing costs are large and not immediately recoverable, the benefits come later. Nevertheless, if carried out scientifically, a genetics program provides enormous and on-going rewards for those with the courage and foresight to embark on one. Mainstream has chosen to embark on this for barramundi and industry observers will be watching their progress with interest.

Paul Harrison can be contacted by email on paul@mainaqua.com.au



Mainstream Hatchery Protocol

The established breeding cycle for Mainstream Aquaculture's Melbourne growout operation starts over 2,500 kilometres away in Townsville, Queensland. The company leases facilities at James Cook University that they operate as a commercial hatchery/nursery. The location has the added benefit of being close to Dr. Dean Jerry, the geneticist working on their barramundi seedstock enhancement project, and Professor Rocky de Nys, one of Mainstream's founders.

THREE BREEDING POPULATIONS

Three separate breeding populations are maintained under controlled conditions to achieve a year-round breeding program. The broodstock are induced every four weeks: females receive 0.05 mg of LHRHa/kg, the males 0.025 mg. The usual procedure is to stock two males for each female in the spawning tanks. Ovulation takes 30-36 hours. An ingenious overflow screen connected to an airlift device collects the spawning mass, and a sensor, triggered by the clogging of the overflow, sets off an alarm to alert management that spawning has occurred. The eggs are given five hours to water-harden before being sterilized in a solution containing 0.01ppm active iodine, then shifted to the hatching tank.

The pelagic eggs hatch within 14 hours and after 1-2 days the larvae are transferred to the larval rearing tanks. By day 3 their mouths have developed and they commence feeding. Mainstream uses a green-water culture with fresh *Chlorella* as the preferred algae to enrich rotifers, followed by enriched *Artemia*.

At day 14 the larvae are weaned onto a commercial fry diet comprising a mix of Lucky Star, Otohime, and O.range. To emulate estuarine water, the fish are spawned at a salinity of 32%. Weaning is completed by day 21. They are then acclimated into freshwater and counted. Extensive data on each batch indicate losses to that point to range between 40% and 60%. Most losses occur in the first few days amongst larvae that don't develop properly.

Grading is a major part of rearing these high order predators. Farm Manager, Paul Harrison, said that one of the little-recognized benefits from the breeding program was the time saved in grading. Typically barramundi fry are graded every 2-3 days during the first 60 days to prevent attrition. He added, "the less variable growth has cut our need to grade during that phase by about 50%."

HEALTH CERTIFICATION

Mainstream is one of the major international suppliers of barramundi seedstock, and health certification is part of their stock-in-trade. Every batch is screened independently at 21 days for signs of bacterial, fungal or viral pathogens with a particular emphasis on BVNN - barramundi viral nervous necrosis. Developing a strict biosecurity and hygiene protocol, and making sure it was implemented, has ensured that the fish have been certified at every inspection.

Once cleared, the fish that are grown out on the farm are transferred to the farm's nursery tanks. Those destined for domestic and overseas clients are shipped out at the required sizes from day 25 to day 42. Those going to marine farms are re-transitioned to seawater. "We can omit the transition to freshwater in the first place," Dan said, "But this gives them a further sterilization step."

IMPROVEMENTS OVER TIME

The original hatchery was built on a plan that reflected knowledge at the time. The floor plan of the new facility was designed to allowed greater automation: fish pumps (Aqualife), graders (Favre & Fishtechnik) and counters (Vaki) have all made life easier for both fish and the workforce. They have also boosted their oxygen injection rates. While this hasn't actually increased growth rates in any significant way, it has allowed them to carry more stock, and to do so more reliably. Paul felt that reduced the fish space cost alone has more than paid for the cost of buying and delivering the oxygen to the system.

This had also allowed them to dedicate the original facility to the hatchery/nursery phase of the operation as well as incorporating commercially focussed R&D projects.

Because of this streamlining, plus the reliability of the seedstock supply and the predictability that has come from the breeding program, Paul has been able to "industrialize" the growing process through a data-based managed work system that has seen Mainstream more than quadruple the output of both fingerling and market-sized fish, and considerably reduce its costs.