ACHIEVEMENTS AND IMPACTS (2001-2008)

The Cooperative Research Centre for the Sustainable Aquaculture of Finfish






What the Aquafin CRC has done for Australian finfish aquaculture

Foreword

The Aquafin CRC was a research and education provider for the sustainable aquaculture of finfish in Australia. The main research emphasis was on Atlantic Salmon and Southern Bluefin Tuna.

This booklet is in its third and final edition. It reports the achievements of the CRC's programs, and indicates the impacts of our achievements on the Australian finfish aquaculture industry. It provides some key contacts for those who want to know more about the research and subsequent developments.

The Aquafin CRC was a joint venture of a large group of research institutions, universities, industry associations, companies and the Fisheries Research and Development Corporation. The work of the CRC is the output of the collaborative efforts of all our Participants.

Nothing useful would have happened without the enthusiasm and hard work of our project leaders, research staff, collaborating industry and regulatory staffs, and students. All the significant achievements of the research program are theirs. The CRC expresses its deep appreciation of their skill and commitment, and wishes them all a successful future.

The CRC owes a great debt to the leaders of the production, health, environment, education and training programs, who have contributed crucially to strategic development, provided program leadership, and led specific projects while still carrying out their many responsibilities to their own organisations. We also acknowledge the members of the current and former members of the SBT Aquaculture and the Atlantic Salmon Aquaculture Subprogram Steering Committees.

The CRC has been greatly strengthened by the support and guidance of the CRC Board chair and members, who have contributed much expertise and commitment despite their other many responsibilities.

We acknowledge and thank the CRC's own staff for their excellent and committed contributions.

We have endeavoured to list all of these people in this booklet, in their respective roles, and apologise for any omissions.

The Aquafin CRC was established and supported under the Australian Government's Cooperative Research Centres Program

Contents

Cost-Benefit Analysis of the Aquafin CRC

This is a rough estimate, drawn from several sources and not independently verified.

The Present Value of Benefits, from the first independent impacts review in 2006 and based on three research areas (salmon maturation, AGD management and Tuna quality), were the equivalent of $131M in 2007.

The mid-range estimated Present Value of Benefits, from the second independent impacts review and based on five key research areas (tuna feeds, tuna food safety, tuna farming zone environment, salmon farming zone environment and Striped Trumpeter), totalled $221M in 2007.

The total Present Value of Benefits in 2007, attributed to these projects by the two independent impacts reviews, was therefore $352M.

The total financial costs of the Aquafin CRC represent a Present Value in 2007, of $88M.

The mid-range NPV of the Aquafin CRC as a whole is then $256M, representing a benefit cost ratio of 3.9:1.

There are considerable uncertainties in the cost-benefit assessments of these projects, so that the calculated NPV ranges from $167M to $368M.

Some other potentially significant research areas have not yet been formally assessed – these include Long Term Holding of tuna, antifoulants for the tuna industry, vaccines for amoebic gill disease, and feed technologies for marine finfish.

Participants of Aquafin CRC (2001-2008)

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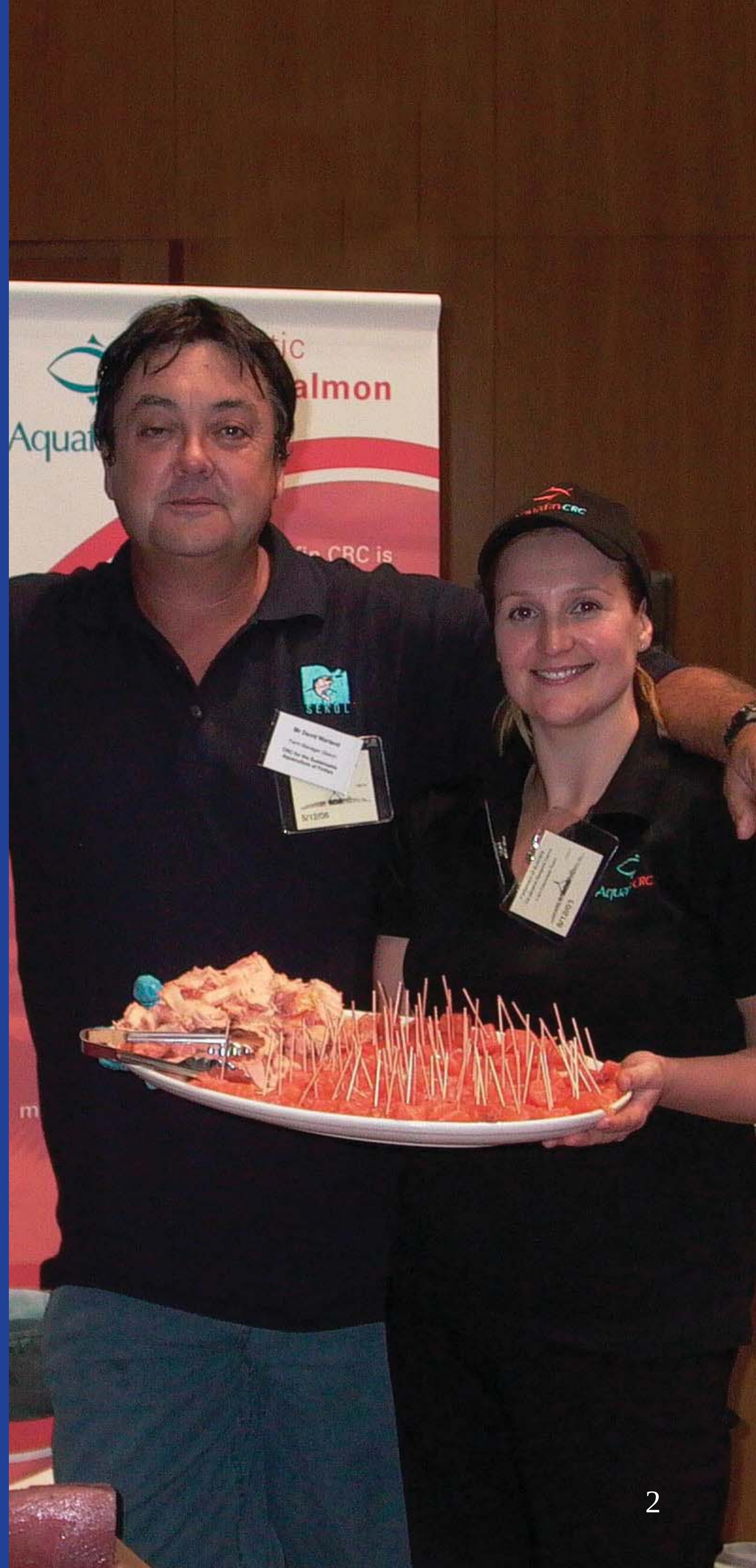

Feeding Southern Bluefin Tuna

Background

Southern Bluefin Tuna (SBT) are captured each summer and fattened in sea-cages for a period of 3-8 months. During the farming cycle, the water temperature and feeding behaviour vary and the nutrients required to achieve the best growth and marketable carcase composition also vary. These variations will become even more significant if the industry extends the culture cycle to increase overall production ("Long Term Holding").

As with most forms of aquaculture, feeds and feeding are the biggest factor in the cost-efficiency of the farming operation.

Farmed SBT are fed on baitfish (a range of small pelagic species such as sardines) which are mported from overseas as well as from the sardine fishery in the Great Australian Bight and Spencer Gulf.

There would be substantial advantages in using manufactured ("pelleted") feeds to supplement or replace baitfish. The feasibility of developing pelleted feeds for SBT was demonstrated by the CRC for Aquaculture (1994-2000) and developed further by Skretting Australia, but manufactured feeds are not yet cost-competitive with baitfish.

Baitfish – Achievements

The composition and quality of baitfish have major effects on the performance of farmed SBT. We have measured the nutritional composition of a wide range of commercially-used baitfish species over several years. The composition of baitfish varies widely between species and also according to season. In addition, the availability and prices of baitfish species vary throughout the year.

The results have been collected into a handbook and a database which has been designed as a decision-making tool (Formubait©). Farmers use both of these to fine-tune the levels of key nutrients supplied to their tuna, and to minimise their feed costs.

Baitfish quality is greatly affected by catching, storage and thawing practices – vitamins and nucleotides decline to low levels, rancidity increases and freshness declines significantly. Our research shows that baitfish, particularly sardines, should be thawed in refrigerated seawater, not air, to minimise vitamin losses. Baitfish should also be kept on ice in transit from jetty to freezer and frozen-storage times should be limited. In order to minimise loss of quality, tuna should be fed frozen baitfish blocks at-sea.

Australian baitfish, provided they are fresh caught or well stored and handled, have a high vitamin content (and hence enhance the shelf life of products from tuna fed on these baitfish), but they usually have a low fat content (around 2%). Availability, quality and fat content of baitfish will be important factors in the success of Long Term Holding.

While Formubait can help to predict the composition of baitfish, and to select types of baitfish accordingly, it would also be valuable for tuna farms to be able to confirm the expected proximate composition immediately before use as feed. Near InfraRed spectroscopy (NIR) and automated chemistry systems have been investigated and calibrations provided to industry.

The effects of using different feeding strategies (different mixes of baitfish types at different stages of the farming cycle) have been assessed in one trial under semi-commercial conditions. The preliminary conclusion is that feeding a consistent balance of fat and protein is most efficient, but this needs to be confirmed.

Baitfish – Impact

Feed accounts for about half the costs of production of SBT. **Based on discussions with industry, independent consultants estimated the NPV of the baitfish database and software, as at July 2006, at between $10.0M and $16.0M.**

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Pelleted feeds – Achievements

Two years of commercial trials confirmed that pelleted feeds could be used and would achieve growth, condition and market price for SBT comparable to those fed on baitfish. Problems of weaning SBT onto pellets were largely overcome. However, maximum growth and condition were achieved later in the season and mortalities were consistently slightly higher than when using baitfish. There were also difficulties in producing a shelf-stable pellet acceptable to the fish.

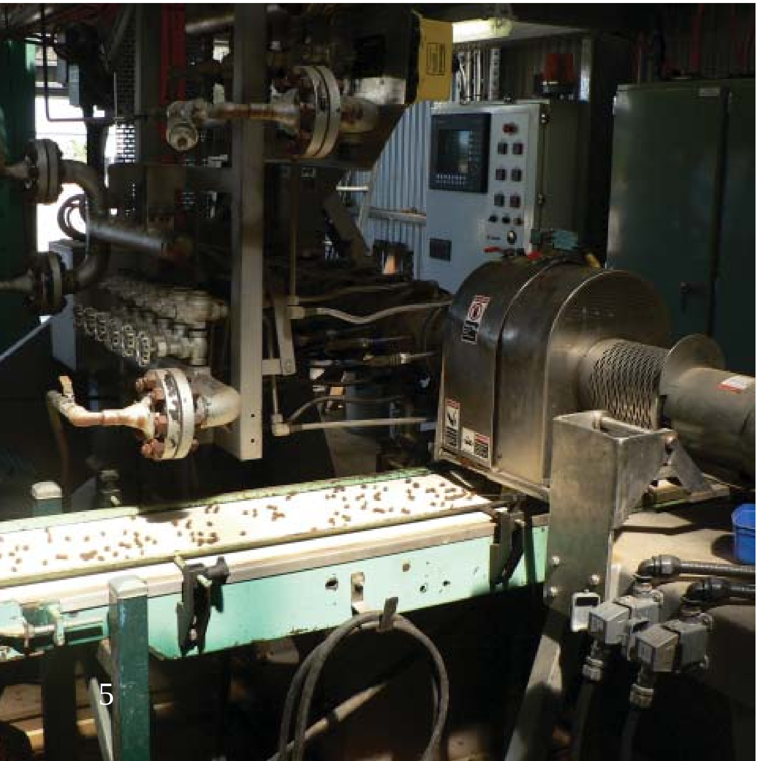
We have produced customised extruded feeds on the SARDI experimental extruder, including high-vitamin pellets and pellets with a high fat content and a texture more acceptable to SBT. We have refined the size and shape of pellets to increase their acceptability to SBT.

Some data have been accumulated on the assimilation by SBT of major nutrients from a range of potential ingredients of pelleted feeds. Estimates of assimilation and wastage of nitrogen from feeds (*CRC environment program*) have demonstrated that there is substantial scope to increase feeding efficiency.

We have identified an additive which keeps these relatively moist pellets stable at ambient temperature, and which did not significantly reduce feed uptake and growth in yellowtail kingfish. Its acceptability has not yet been confirmed by feeding to SBT, however.

We have distributed a nutrition manual to industry, which gathers together information on SBT nutrition and will assist farmers in devising better strategies for feeding SBT in order to achieve desired growth, quality and efficiency.

Nutritional research in SBT is very challenging. We have produced a cost-benefit analysis of a range of SBT research platforms, that should help to maximise the cost-efficiency of future research, especially nutrition. In addition, a new design of cage liner has been tested and provides a methodology for feed preference and feed conversion studies with small numbers of SBT.



Pelleted feeds – Impact

This research will only have an economic impact if baitfish become much less readily available or more expensive (so that pellets are widely adopted). Its principal value at present is providing a risk management strategy.

A stabilised moist pellet will have a big impact in reducing the costs (labour and frozen storage) and in making such feeds competitive with baitfish.

A pelleted feed, if it had improved storage and handling properties, could be used for delivery of supplementary nutrients, or to feed captured fish while they are towed to farming sites. It would facilitate the supply of feed and the use of automated feeders at sites remote from shore facilities.

In the longer term this technology presents the opportunity to reduce the demand of SBT farming for not only baitfish but also fishmeal and fish oil.

Independent consultants estimated the impact of the combined baitfish and pelleted feeds research at an NPV of $15M in 2008. This recognises the risk management value of pellets but also that there would be a trade-off between the use of these two forms of feed.

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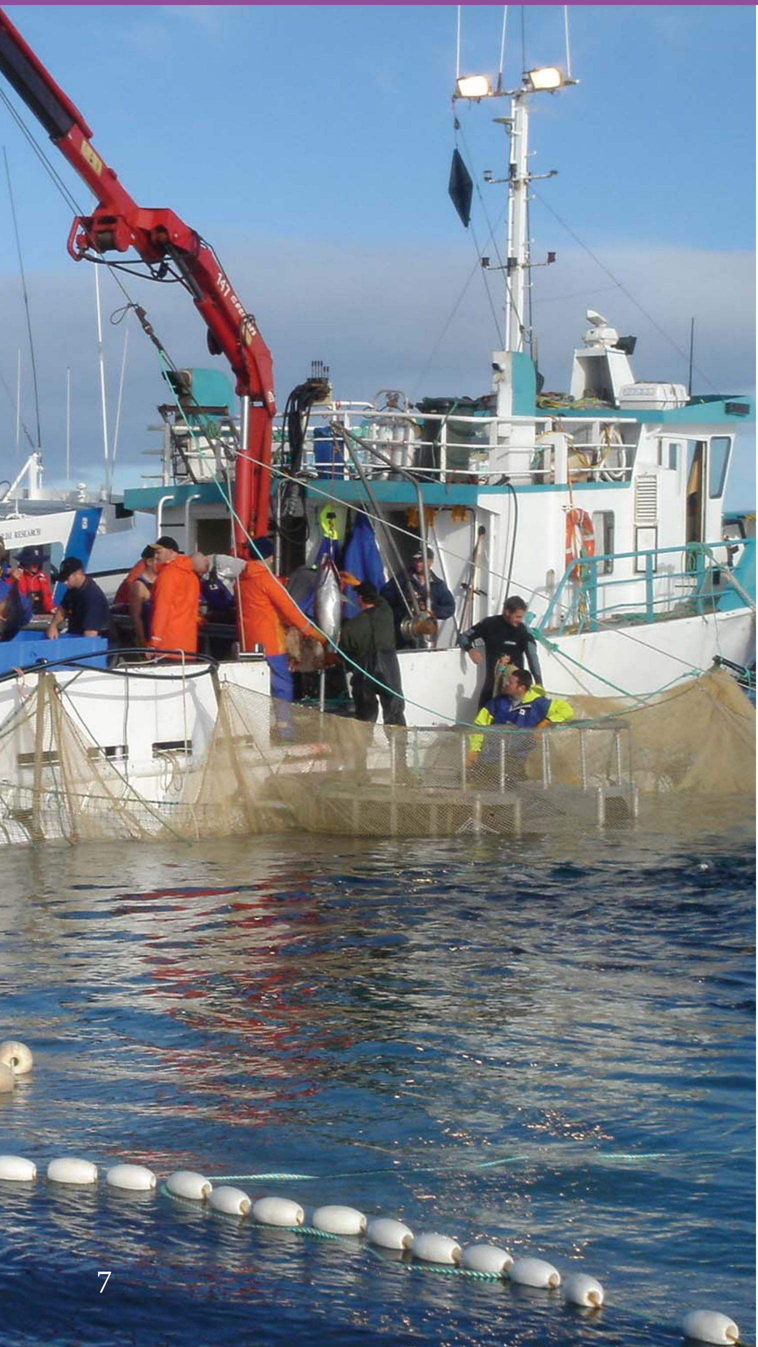
Long Term Holding of Southern Bluefin Tuna



Background

The tuna farming industry could achieve a major increase in the volume of product by holding its fish for two successive growing seasons (18 months) rather than one season (up to 8 months) as at present.

There are considerable risks in undertaking Long Term Holding, and the industry has not yet taken this course owing to many uncertainties: the implications for tuna health; predation by sharks and seals; nutrition, growth rates and feed costs; bioaccumulation of chemical residues from feeds; changes in product quality; net fouling and environmental impact. These are not significant problems with short-term ranching, but because of the climatic and seasonal variations involved we cannot simply extrapolate from current industry experience.

Long Term Holding of SBT – Achievements

The CRC's various scientific programs all addressed aspects of Long Term Holding, but we also completed a formal multidisciplinary trial, holding commercial fish over a period of 17 months. The survival, health and residue status of the fish were all encouraging, but the feed intakes, growth rates and condition were disappointing, particularly in older fish, during spring and early summer.

Feed intake appears to be directly related to body condition index. This has major implications for how to feed tuna in commercial production systems on both a short and long term basis, and could significantly improve overall FCR's.

Long Term Holding of SBT – Impact

This project included an economic assessment of Long Term Holding. There was a clear economic benefit in having fresh tuna available for sale in all seasons. If generally and successfully adopted, Long Term Holding could double the yield and the profitability of the industry.

The impacts would come from:-

- Greater production from limited wild-harvest quota
- Ability to supply the market at times of producers' choice
- Increased proportion of larger fish with higher price/kg and yield
- Fuller use of infrastructure and workforce

However this impact will not be realised unless the problem of year-round growth and carcase condition can be solved. Further research on feeding strategies will be necessary to see if hoped-for growth rates and product quality can be achieved outside the normal season.

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Athletic Tuna

Background

Owing to their size, speed and value, experimentation with large tuna species like SBT is very challenging, and therefore remarkably little is yet known about their nutrition and physiology, or about how they may differ from more familiar farmed fish species.

Physiology and metabolism of SBT – Achievements

We designed and trialled a mesocosm respirometer installed in a sea pontoon, which proved effective in measuring repeatably the oxygen consumption of free large swimming tuna – a world first.

We subsequently made the first recording of the metabolic cost of food ingestion and digestion (specific dynamic action; SDA) of a tuna species. The metabolic cost of SDA is approximately double that of other fish species.

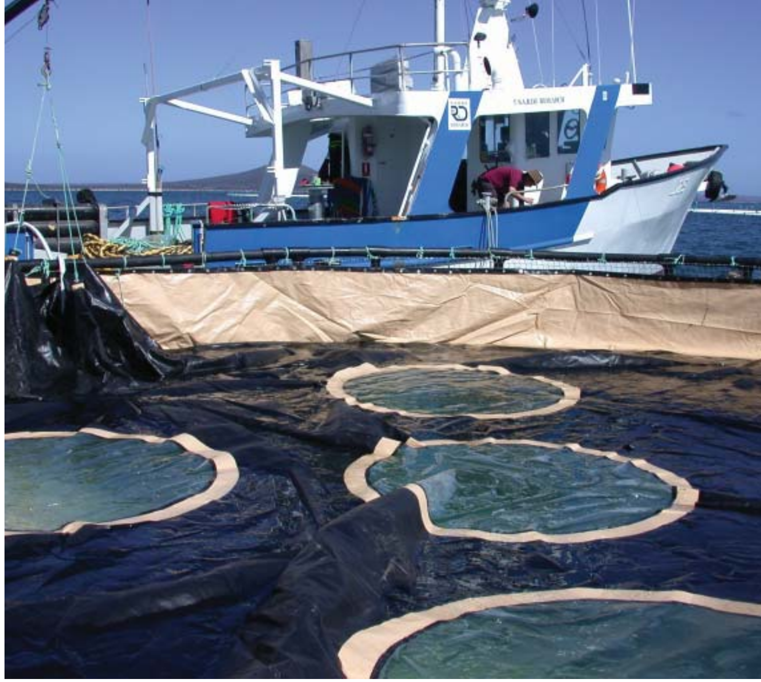
The energy content of the diet had little effect on SDA. This confirms that the high energetic cost of SDA is ecologically relevant and unavoidable. We think that the majority of the high cost of SDA is due to high rates of protein synthesis, and represents the energetic costs of the fast growth rates of tuna. Therefore, it does not necessarily mean that bluefin tuna dietary energy utilisation is less efficient than that of other teleosts.

We found that, both when fasted and after feeding, SBT could survive surprisingly low dissolved oxygen levels (down to 1.6 mg l^{-1}). Furthermore, at dissolved oxygen levels as low as 3 mg l^{-1} they continue to digest at a similar rate as at normal oxygen levels. This shows how remarkably well-adapted SBT are to low oxygen conditions when compared to other marine fish species. Adaptations which support the large metabolic scope of tuna (large gill surface area and high cardiac output) are also likely to be beneficial for the extraction and delivery of oxygen when it is in short supply.

We conclude that acute dissolved oxygen fluctuations in SBT aquaculture are unlikely to cause immediate mortality. While the chronic effects of low dissolved oxygen are still largely unknown, metabolic rate and routine swimming speed increased when dissolved oxygen fell to 4.5 mg l^{-1} (60% saturation) or less. Because of this increased routine energy demand, mild hypoxia will tend to reduce growth and production.

We collected simultaneous recordings of SBT metabolic rate and visceral temperature, under a variety of conditions (including 14 feeding events, capture stress and hypoxic episodes), showing that visceral warming is directly proportional to metabolic rate, adding value to the information that can be extracted from SBT archival tagging programs.

In field trials of a newly-developed SBT heart rate tag, the first recordings of free-swimming tuna heart rate were made. Monitoring heart rate and swimming activity will show the effects of falling oxygen levels in the water, enabling farmers to optimize feeding regimes in response to environmental conditions.



Physiology and metabolism of SBT – Impact:

This research has provided a remarkable leap forward in understanding the energetic and nutritional physiology of large tuna. It will have long-term implications for feeds and feeding practices, fish health and environmental management on tuna farms.

It has allowed us to model oxygen concentration in pens (Oxytuna model, below) to predict when critical levels for SBT may be reached.

Ultimately, the use of 'tagged' SBT carrying implants that measure physiological variables, coupled with real-time transmission of the data, could act as bio-monitors of the conditions being experienced by the fish and enable real-time decisions that govern farm management.

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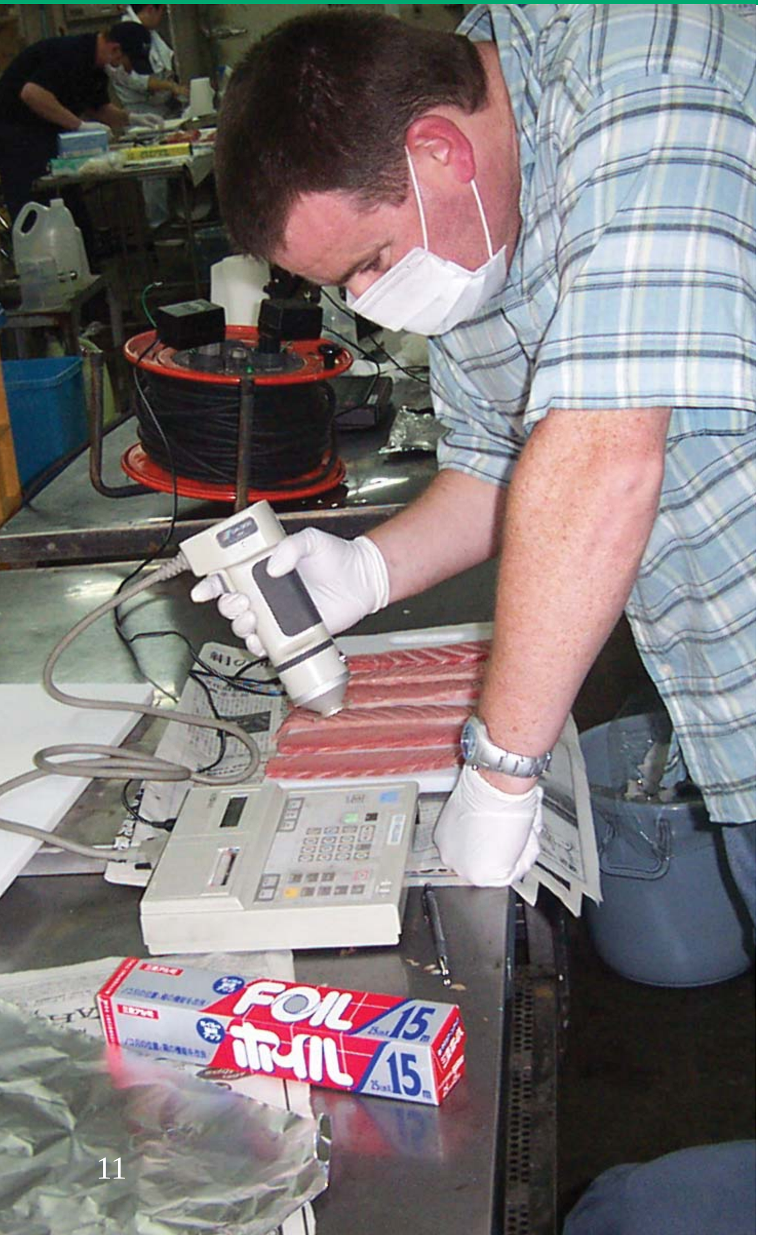
Quality and Safety of Products from Farmed Southern Bluefin Tuna



Background

Seafood markets increasingly demand products which have consistent sensory appeal and useful shelf life, are safe to eat, and are produced in an ecologically sustainable way. Producers who can meet or exceed these demands should have a competitive advantage.

To secure this advantage, producers need to be able to trace their product to the point of sale, so as to relate price signals to the quality of their product. Tracing the product and communicating with the customer are also critical to providing assurances of safety and sustainability. Producers need to be sure that the quality parameters they measure are relevant to the market, so they want to know what farming methods will achieve the desired qualities.

Product quality – Achievements

We have successfully traced chilled SBT to the marketplace in Japan on several occasions. Thermal recorders have identified points of risk due to elevated temperature, which industry has acted on. The tracing exercises have consolidated a useful collaborative network including Japanese researchers and companies. Objective measures and sensory analysis of quality have been carried out by Japanese and Australian researchers. Correlations between Japanese and Australian assessments of quality have been achieved, and observations of Japanese practice have enabled sensory analysis of tuna flesh to be carried out in Port Lincoln.

Preliminary objective colour measurement using digital camera technology provided a good correlation with Japanese market price and quality grading. This technique has potential for broader application.

The role of vitamins in flesh quality and shelf life has been established. Levels of vitamins C and E and selenium in wild and farmed fish have been determined. Significant increases in tuna flesh content of vitamin C (but not vitamin E) were achieved using the industry practice of sprinkling a vitamin mix onto baitfish. In trials using pellets, increased levels of both vitamins C and E were achieved and consistently resulted in a significantly longer shelf life for tuna flesh, and did not adversely affect objective or sensory qualities.

We have shown that the extension of colour shelf life, achieved by the feeding to SBT of natural antioxidants, applies to both fresh and frozen/thawed SBT sashimi. This is valuable information as the frozen product is currently approximately 80% of the total product exported to Japan.

However, using pellets as a supplement to baitfish (the approach initially preferred by industry) is not effective in practice. A technology has been developed for mass injection of baitfish with vitamin concentrates, and has proven to be a highly successful method of transferring the vitamins to SBT. This same method could be used to introduce other feed supplements, in order to enhance tuna health and flesh quality.

We used immortal fish cell lines to explore the mechanisms of protection of tuna flesh lipids against oxidation, and as a rapid system for discovery of new antioxidants (they were also expected to be useful for detection of viruses of tuna).

Commercial harvest stress was assessed by comparing objective and sensory quality of fish from the start and end of harvest; there was no difference, which suggests that stress is not a significant factor in current best harvest practice. (However we do recommend that stress during culture and harvest be minimised in the interest of farm production efficiency and to maintain desirable quality attributes during storage.) Similarly tuna shipped on the day of harvest and shipped the following day did not differ significantly in quality.

We have mapped the distributions of fat, myoglobin and vitamins in tuna carcases, and measured the changes in a range of quality attributes through the farming season. For example, vitamin C, and selenium decline during the capture and tow period (Feb-March), drip loss increases during the farming season, and the fat content is static between May and August. This information should prove useful in optimising husbandry and harvesting strategies, particularly if the farm cycle is extended.

NIR has been assessed for in-line measurement of carcase fat, as a major tool in quality grading. Direct on-flesh calibration was good, but accuracy and reliability declined when the probe was placed on the intact scales and skin. Nevertheless, with minor equipment modification and careful operator training this method should prove useful.

Product quality – Impact

Based on their discussions with industry, the independent consultants have estimated the NPV of the vitamin/shelf-life outcome only, as at July 2006, at $10.0M.

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Product Safety – Achievements

We have compiled a chemical residues guide for industry, gathering data from our projects as well as from other studies.

Our SBT residue data are formally recognised by Japanese import agencies, and demonstrate that Australian SBT comply with Japanese standards.

Residue levels were measured for each of the baitfish species used in our experimental trials and found to be low compared with international standards. The residues included metals, metalloids, pesticides, herbicides, polychlorinated biphenyls (PCBs), dioxins and furans.

The majority of the body burden of mercury is already present in SBT at the start of the farming season, and is greater for 3-year-old than for 2-year-old captured SBT. Mercury concentrations drop rapidly during the first 12 weeks of farming (this is related to the increase in the body weight of the SBT, a process known as growth dilution), and then remain constant for the remainder of the farming season.

Dioxins, furans and PCBs are lipid-soluble environmental contaminants, and we have shown a correlation between the dioxin concentration and the lipid content of each tissue of SBT.

Metals, organochlorine, organophosphate, dioxin and PCB levels have been measured in SBT under Long Term Holding, and our results show that extending the farming period is unlikely to create residue issues for the industry, provided that it continues to select baitfish appropriately.

Two PhD students have developed predictive models of the relationships between residues in the wild SBT at transfer, in baitfish and in SBT during the farming season. These provide the basis of a decision-support system for farmers to manage and minimise residues and gain a market advantage.

Product safety – Impact

Based on our data, Food Standards Australia New Zealand removed SBT from the Australian public advisory statement on mercury, and Japan issued a health advisory which differentiated between Australian SBT and Northen Bluefin Tuna, giving a less strict dietary advisory for SBT that benefits marketing.

Collaborative links with research institutes and government regulators around the world have assisted the industry's moves into new markets, including China and the European Community.

Our work has supported harmonisation of analytical methods and changes to national standards in importing countries, creating a favourable market climate for Australian SBT.

Technical advice has been provided to the TBOASA for use during bilateral negotiations with Japan and the Commission for the Conservation of SBT.

We produced technical reports for industry, including: a market access guide for seafood exporters: international residue standards (2005); and a report reviewing residues in Australian commercially farmed and wild caught Southern Bluefin Tuna (2005 - published in English, Chinese and Japanese).

Independent consultants have estimated the NPV of the food safety research at about $112M.

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Health Management for the Southern Bluefin Tuna industry

Background

The SBT farming industry has enjoyed a remarkably low level of overt disease in its first 14 years, which may in part reflect the fact that it uses only healthy fish that have already survived several years in the wild. Nevertheless mortalities do occur, some from uncertain causes possibly linked to stress, and a few that are clearly correlated with pathogens, such as the ciliate causing "swimmer syndrome".

Aquaculture precedents suggest that the further growth of the industry, a longer duration of the farming cycle, and the possible introduction of tuna hatcheries are all factors likely to increase the threats to tuna health. Accordingly, we have developed a strategic health management program for SBT.

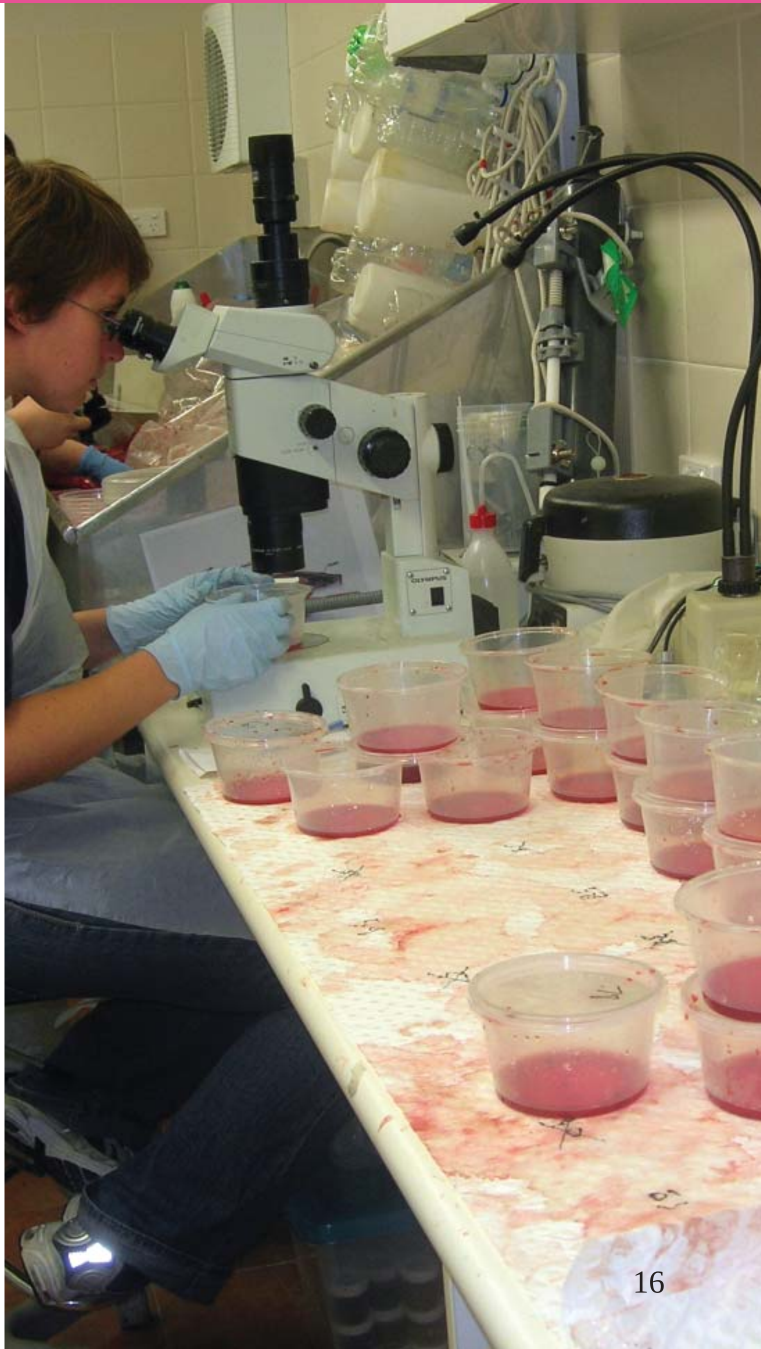
Health Management - Achievements

All the available information on SBT health was collected from the literature and from research agencies and industry sources. On the basis of this information, and through workshops with industry and scientists, a risk assessment was conducted, areas of highest risk identified and corresponding research priorities proposed.

A pilot industry surveillance and monitoring system was set up, and all available information gathered onto a health database accessible by industry and researchers via the internet. We provided administrator training and manuals to the companies to support the use of this site. Best practice sampling methods have been established for tuna health surveillance and monitoring programs.

Parasites (which had been identified as the highest health risk category) were monitored through two farming seasons, and distinctive patterns of increase and/or decrease over the farming cycle were observed. One copepod species, which affects the gills of SBT, was observed to increase throughout the cycle. There are indications of major differences between years, notably of the ciliate causing swimmer syndrome.

A major project, which will continue beyond the CRC, is addressing the question whether specific practices relating to capture, tow, transfer and on-farm husbandry significantly correlate with the health, performance or mortality of SBT. If they do, the researchers will try to determine whether "stress" and



immunosuppression are a causal link. There are preliminary indications that specific tow conditions do influence subsequent mortality on-farm.

Long Term Holding showed no indications of increased parasite problems, and there is some evidence of the development of immunity to the blood fluke, *Cardicola forsteri,* during the farming cycle.

We have developed PCR-based assays for the blood fluke, *Cardicola forsteri*, the gill fluke, *Hexostoma thynni*, and the swimmer syndrome pathogen *Uronema nigricans*, that can detect and quantify traces of parasite DNA in environmental samples.

C. forsteri and *H. thynni* were detected from net fouling samples taken from SBT aquaculture sites. The intermediate host of *C. forsteri* is at present unknown but is likely to be either a bivalve or a polychaete, however extensive efforts have so far failed to track this down.

Molecular analysis showed that both *Cardicola forsteri* and *Hexostoma thynni* are also found in Northern bluefin tuna in the Mediterranean, showing that both parasite species have an exceptionally wide range. Work has also been carried out on the species of sea lice that infest SBT and the host range of these parasites has been revealed.

Health Management –Impact

As no major pathogenic threats against farmed SBT have yet emerged, the knowledge, tools and surveillance system provide a risk management strategy for the industry, but it is not possible to measure an economic impact with any precision.

The industry and researchers are planning to exploit and expand these studies to minimise the impact and effects of blood fluke and copepods. Likely components include identifying the intermediate host of the blood fluke, adapting husbandry procedures, administering immunostimulants and likely parasiticides through baitfish injection, and feeding during the tow from capture to farm sites and soon after stocking on the farms.

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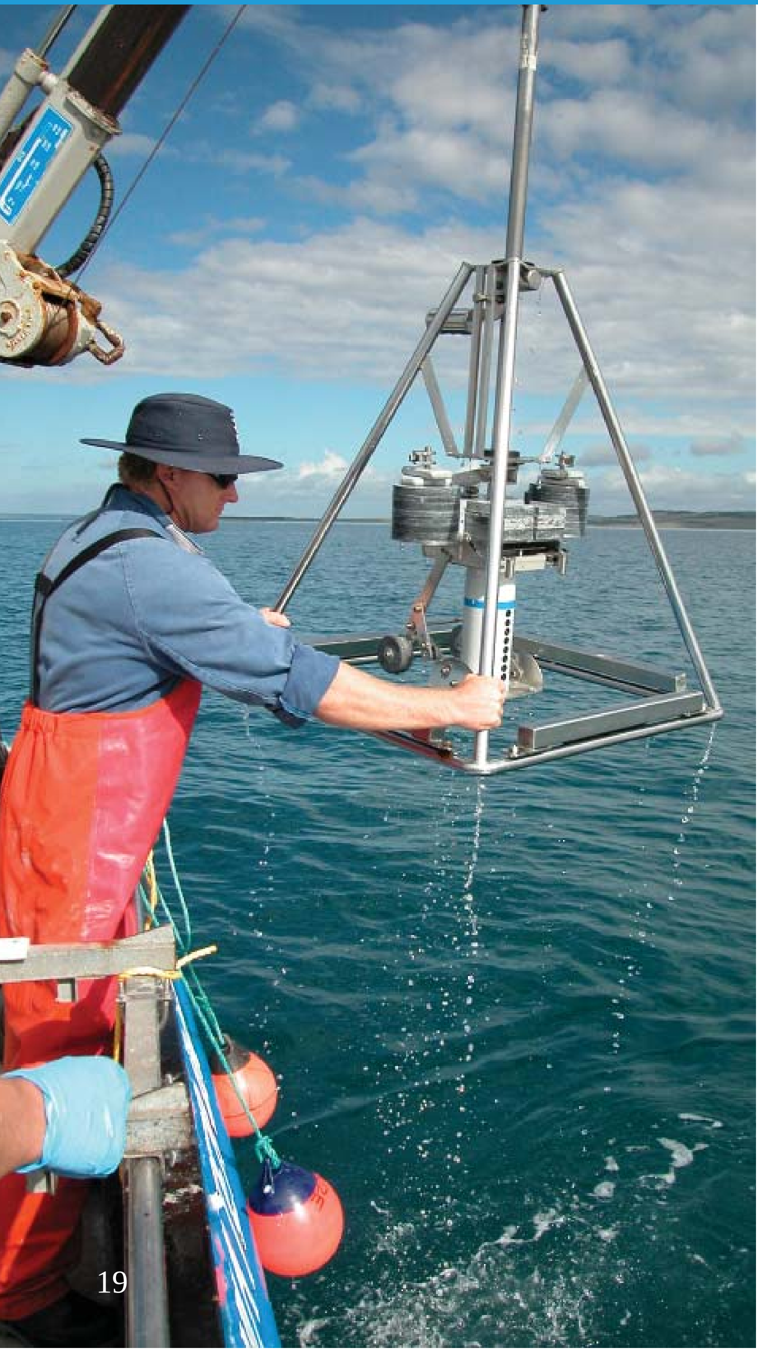
Environmental Management and Tuna Farming



Background

Licensing of tuna farming in South Australia requires the demonstration that there are no substantial or long term changes to the environment outside the boundaries of farm leases. This has been addressed to date by an expensive and time-consuming benthic monitoring process. However this routine monitoring does not provide much additional information to the farmer or the regulator, and does not enable them to comprehensively assess the margin for error or the implications of changes in farming practice or growth and intensification of the industry, nor does it meet potential concerns about more subtle and long term changes in the wider ecosystem.

Our environmental program addresses all of these issues, and examined and model the wider ecosystem in ways that will enhance the industry's capacity to manage or avoid environmental events that are adverse to the health and productivity of their fish – events such as blooms of harmful species of algae, resuspension of sediments, contaminant spills or incursion of pathogens.

Environmental Management – Achievements

A new working system was put into practice in 2005 for the SA Government's Tuna Environmental Monitoring Program, which measures changes in targeted benthic invertebrate species as a means of detecting environmental changes around tuna farms. Our new system uses DNA assays in real-time PCR to quantify the biomass of each of 9 indicator species. These results are then analysed statistically and reported in an Environmental Compliance Scorecard system. This has provided a more cost-effective and much faster method than used previously, and can also provide farm managers with much more detailed information about changes in and around farm sites if required.

We have gathered a considerable amount of information that contributes to a comprehensive understanding of the impact of tuna farming on the local and regional environment. This information has been integrated in a form that industry and regulators can use to assist their planning and decision-making. Initially, a suite of preliminary models was used to (1) indicate that there is scope for substantial improvements in efficiency of feed use, (2) integrate the factors influencing carbon deposition on the seabed near pontoons and (3) integrate the factors influencing nutrient dispersion into the water column.

The information gathered includes (a) *environmental background*: mapping of the varied sediment types in the farming zone; measurement of sedimentation rates, physical and chemical properties of the water masses and their seasonal variations; (b) *characterisation of farm wastes*: physical and chemical properties of feeds and faeces, sedimentation rates, fluxes of phosphorus and ammonia and oxygen uptake rates in the sediments; (c) *mitigating processes*: uptake of wastes by scavengers and effects of fallowing.

A pilot telemetric monitoring system was developed and was set up to provide near real-time data on water quality and environmental conditions inside and outside a farm pontoon. The data include water temperature, pH, conductivity (salinity) and dissolved oxygen as well as wind speed and direction.

Trials on environmentally acceptable anti-fouling treatments have measured the efficacy of the treatment and also the practical benefits (including increased water flow and oxygen levels, reduced net weight, reduced substrate for pathogens, reduced diving effort, improved net handling and longevity, and reduced deposition of waste). Final analysis of these data will determine the cost-effectiveness of anti-fouling practices, and are expected to lead to a full commercial-scale trial.

Our tuna environment work has also adapted the modelling methods that we developed for the Tasmanian salmon industry, and included additional sediment modelling and field studies of specific biogeochemical processes. This provided a clear understanding of the oceanography of the tuna farming region, and provided a means of integrating wide ranging environmental data and identifying knowledge gaps.

Hydrodynamic, sediment and biogeochemical models of the SBT farming zone have been completed. The composite model can assess how various water-borne disturbances can propagate across the tuna farming zone, and allows for response strategies to be developed.

As the model is not yet fully validated, the only scenario analysis undertaken was a comparison between "farming" and "no farming". This suggested that the tuna industry is not currently causing major phytoplankton blooms in the region, although it is increasing phytoplankton biomass.

Environmental Management –Impact

The environmental research to date has played a key role in establishing and disseminating the tuna industry's good environmental performance. The economic impact of the new DNA-based monitoring system is marginal at present, but the costs of monitoring using this system will fall considerably if it can be applied to a wider range of environmental situations – this is because the set-up costs are high while the incremental costs for additional samples are very low. A project is well on the way to adapting the system to the yellowtail kingfish farming zone in Spencer Gulf, but will be finished after the CRC closes.

When the tuna zone modelling suite is fully validated, it will be a very useful tool in managing environmental hazards, ensuring the sustainability of the SBT farming industry. The model will predict the incidence, movements and effects of environmental threats such as plankton blooms and sediment suspension, and identify safe areas for pontoon re-location to avoid such threats. It could also be adjusted to predict the effects on the industry of climate change.

The models will also facilitate prediction of the environmental effects of changes to industry practices (such as increases in stocking density or period of farming and locations of farms) and indicate whether they are within the assimilative capacity of the ecosystem.

Another benefit will be the ability to design a comprehensive regional environmental monitoring program. This monitoring program will specify what to monitor, where to monitor to pick up the largest impacts, and how often to monitor.

We expect that the ecological data and a validated model will provide confidence in the industry's future expansion, whether through Long Term Holding, hatchery production or increased quota.

An independent consultant estimated the NPV of the tuna environment research at $27M.

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Enhancing Production of Atlantic Salmon

Salmon Production – Background

Farmed salmon is a global commodity, so the success of the Tasmanian industry depends on continually increasing productive efficiency. Salmon are capable of maturing from an early age, and when they do so the loss of flesh condition renders them unsaleable. Tasmanian conditions and high quality feeds permit rapid growth, but this advantage is accompanied by earlier maturation, compromising the industry's ability to market fish year-round.

Salmon Production – Achievements

By a combination of better understanding of salmon reproductive physiology and a series of trials in close collaboration with industry, we have developed methods using artificial lighting to delay maturation by 2 months and correspondingly extend the harvesting season, to accelerate growth to market size, to accelerate recovery of marketable condition in mature females, and to inhibit maturation of out-of-season smolts. These methods give the farmer a range of strategies to maximise production and optimise timing of marketable fish.

The methods developed so far have given variable results from year to year, and it seems likely that the control of maturation is a more complex function of growth, photoperiod and temperature. The more recent work, investigating the interacting effects of photoperiod and mild winter temperatures on maturation rates, will provide a more comprehensive model to help farmers to design lighting strategies that work consistently in the prevailing conditions (and that are consistent with husbandry strategies to reduce amoebic gill disease). However, it appears that farming companies have already largely overcome the problem of variation from year to year.

Ultrasound was shown to be a useful non-destructive technique for distinguishing between mature male and female Atlantic Salmon. Furthermore the characteristic shape of developing gonads in relatively immature female fish was readily detectable. This is a tool that addresses an important need of industry.

Salmon Production –Impact

Based on their discussions with industry, independent consultants have estimated the NPV of these combined outcomes in July 2006 at between $45.0M and $64.0M.

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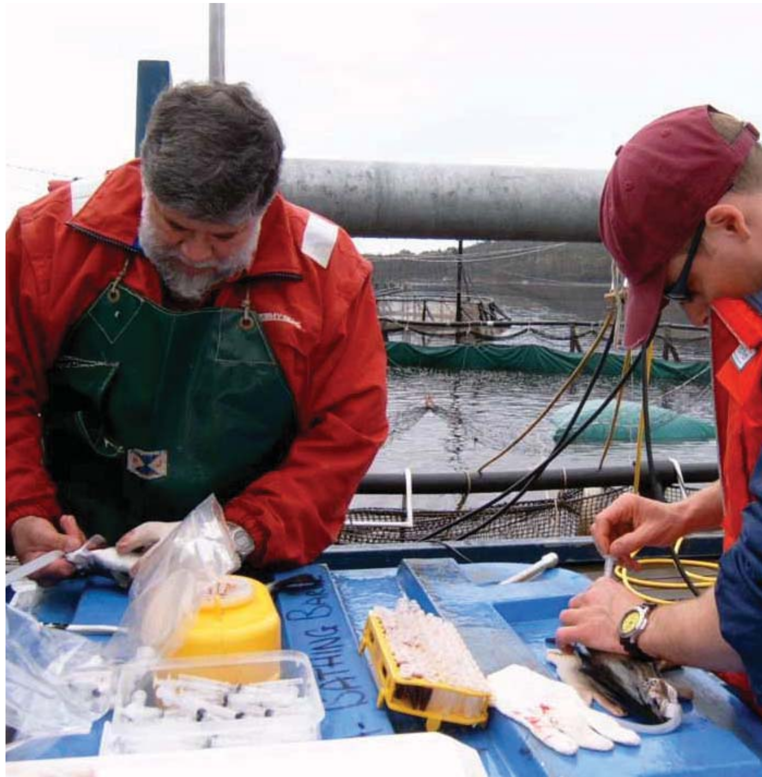
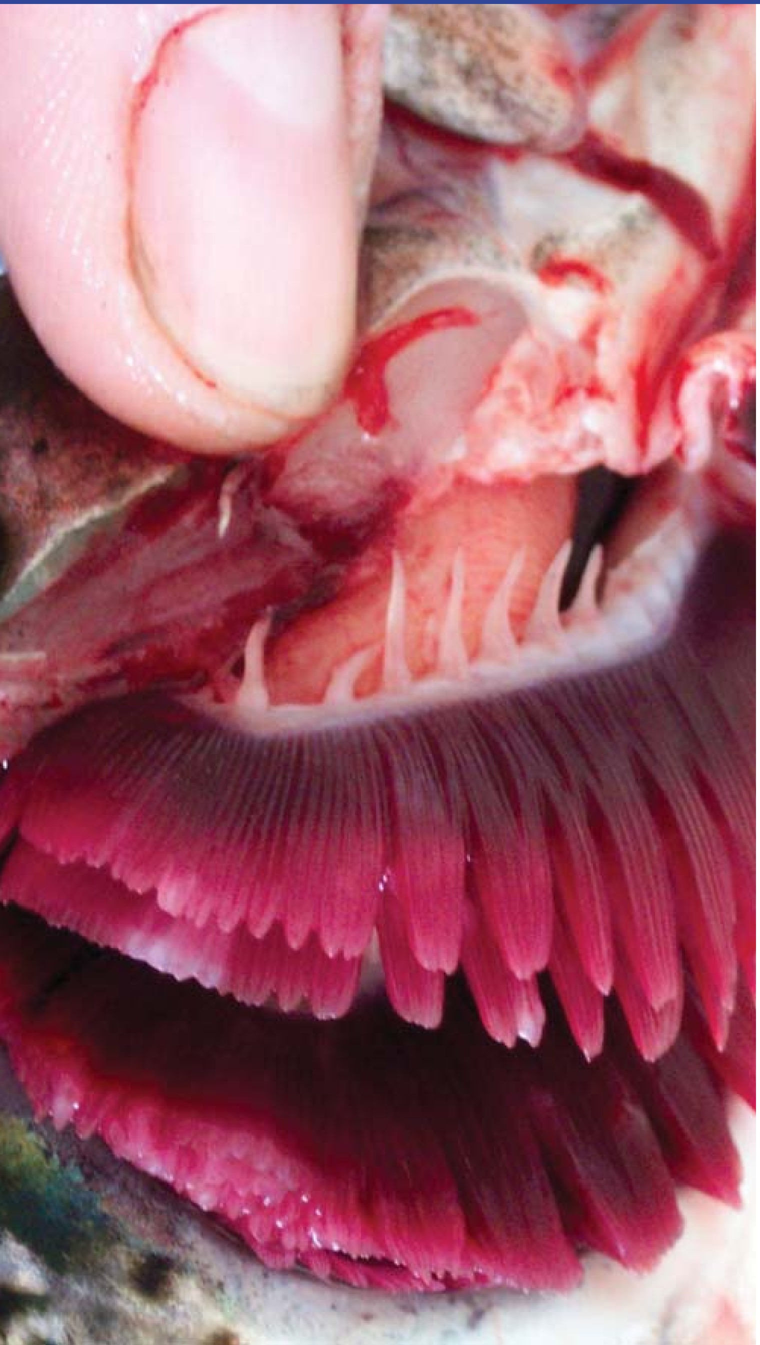


Control of Amoebic Gill Disease (AGD) in Atlantic Salmon



AGD Control - Background

The need to control gill amoebae in Tasmanian salmon is the biggest cost factor limiting the industry's productivity. The current method of control, bathing in freshwater is environmentally friendly, but it is costly in time and labour, limited by supplies of freshwater, and apparently less effective in hot dry years (which it is feared may become more frequent). Frequent bathing may also reduce productivity by stressing the fish and reducing their growth.

Early work provided little confidence in any one potential new control strategy, so our AGD control program was a broad campaign, ranging from the tactical (e.g. epidemiology and incremental improvements in husbandry) to the "Long term" and higher-risk (including novel therapeutics, vaccine development and selective breeding).

AGD Control - Achievements

The pathogen of AGD

Part way through the CRC program, molecular studies showed convincing evidence that the only amoeba directly associated with AGD lesions was a previously unknown species, which we named *Neoparamoeba perurans*. This was also confirmed in material from AGD cases around the world. Fortunately, the other AGD research in the CRC program consistently used infective amoebae harvested from carrier fish, which also proved to be *N. perurans*. A PCR based diagnostic method was developed for this pathogen.

Therapeutic treatments

The quality of the freshwater used for bathing is important, with softwater (low calcium and magnesium) giving better control and a longer interval between baths. The cost of artificial softening of poor quality water is too high to be attractive, however.

A disinfectant, Chloramine-T, could be used to kill residual amoebae in freshwater using bathing treatments, permitting re-use of the water where this is logistically practicable.

A number of other chemical agents have been assessed experimentally, including several parasiticides, ionophores, nutritional supplements and a mucolytic. However, while several have displayed some efficacy none have yet shown sufficient potency against AGD to be considered for commercial development.

Epidemiology and husbandry

The main risk factors for AGD have been identified as high salinity, high temperature and farms located upstream. High copper levels in water reduce parasite survival *in vitro*. More parasites were isolated from nets treated with antifouling paints, but disease levels were not affected.

Moving of sea-cages to a new fallowed site, immediately after freshwater bathing, reduced the rate of re-infection.

Surveys showed that the then presumed agent of AGD (*Neoparamoeba pemaquidensis*) is generally ubiquitous in marine and estuarine sediments and in cage netting, but there was little correlation between its presence and the incidence of AGD – once the disease has occurred, the salmon appeared to be the main source of further infection. Since the pathogen has now been shown to be a different species, and an appropriate diagnostic has been prepared, this study can and should be repeated.

The use of artificial lighting was shown to increase AGD infection rates, probably because of effects on schooling behaviour, but lighting is used to inhibit salmon maturation, and this in turn reduces susceptibility to AGD.

A draft protocol was written for best husbandry practices to minimise AGD.

Vaccine

An experimental DNA vaccine, containing 6 clones from *N. perurans,* provided consistent and significant reduction of mortality of salmon in three trials using controlled AGD challenges in a tank system. Vaccination was shown to be associated with *in vivo* transcription of the corresponding RNAs and translation of at least one of the polypeptides. (The first attempt to vaccinate with the corresponding polypeptide antigens was not successful, however.)

The prototype DNA vaccine elicited a comparable protective effect in sea-cage conditions under natural challenge, and could potentially reduce the number of freshwater baths required during summer.

The vaccine has been further advanced by reducing the number of clones to 3 without loss of efficacy (which would reduce vaccine production costs) and by confirming efficacy using the likely preferred commercial DNA vector.

The level of efficacy is probably not yet sufficient for commercial use, but the project, continuing after the close of the CRC, is aimed at refining and improving the current vaccine and, if successful, implementing a plan for commercial development.

Immunology

We have identified a number of monoclonal antibodies (Mabs) that recognise surface antigens which are unique to infective amoebae. Several of these Mabs were shown to inhibit the attachment of amoebae to gill explants *in vitro*.

A high molecular weight fraction from wild-type (infectious) parasites was identified as another possible target for a vaccine, as the antigens are localized predominantly on the surface of the parasite and are recognised by many of the Mabs that also showed inhibition in an *in vitro* amoeba-gill attachment assay. However in a vaccination trial this antigen had no protective effect and may even have been immunosuppressive.

So far no immunostimulant has shown a consistent effect against AGD, although occasional interesting results have been found with oligonucleotides and with Freunds adjuvants (without immunogen). A comprehensive review was written on the use and prospects of immunomodulation in aquaculture.

A number of immunisation protocols have been compared for effectively stimulating antibody production in the gill mucus.

Genetic selection

We have shown that there is genetic control of AGD resistance, and that this is a highly complex and polygenic trait. Marker assisted selection for AGD resistance is possible, but it has to be undertaken from a whole genome perspective rather than a single target gene approach. These findings, together with developments in the industry's selective breeding program, should lead to greater efficiency in breeding for AGD resistance.

General

Research in this field has been greatly facilitated by (1) the characterisation of the pathogenic species and development of methods for diagnosis, large-scale production, and purification of the amoebae, (2) development of a library of strains of the amoeba species, (3) standardisation of methods for challenging fish with amoebae to test therapies, vaccines and resistance to AGD of selected salmon strains, (4) techniques for studying attachment of amoebae to gill tissue and fish cells, (5) development of gene libraries from infectious and non-infectious parasites and (6) analysis of the pathogenesis and immune responses using salmon DNA expression arrays.

AGD Control –Impact

The first tangible outcome was from the epidemiology project. Compilation of best husbandry practices has helped farmers to fine-tune their approaches to farm management and the treatment of infection. This in turn has had a positive effect on production, with higher numbers of fish in peak condition through lower prevalence or intensity of AGD, and lower production costs, mainly because less freshwater bathing of infected fish is required.

While receiving different responses from different farms, the independent assessor estimated the NPV of the outcomes from the epidemiology project at $21 M in July 2006.

A vaccine, or breeding program, if it substantially eliminated the use of freshwater bathing, would have a very much greater economic impact on the industry. AGD currently costs the Tasmanian salmon industry some $20-25M *per annum*.

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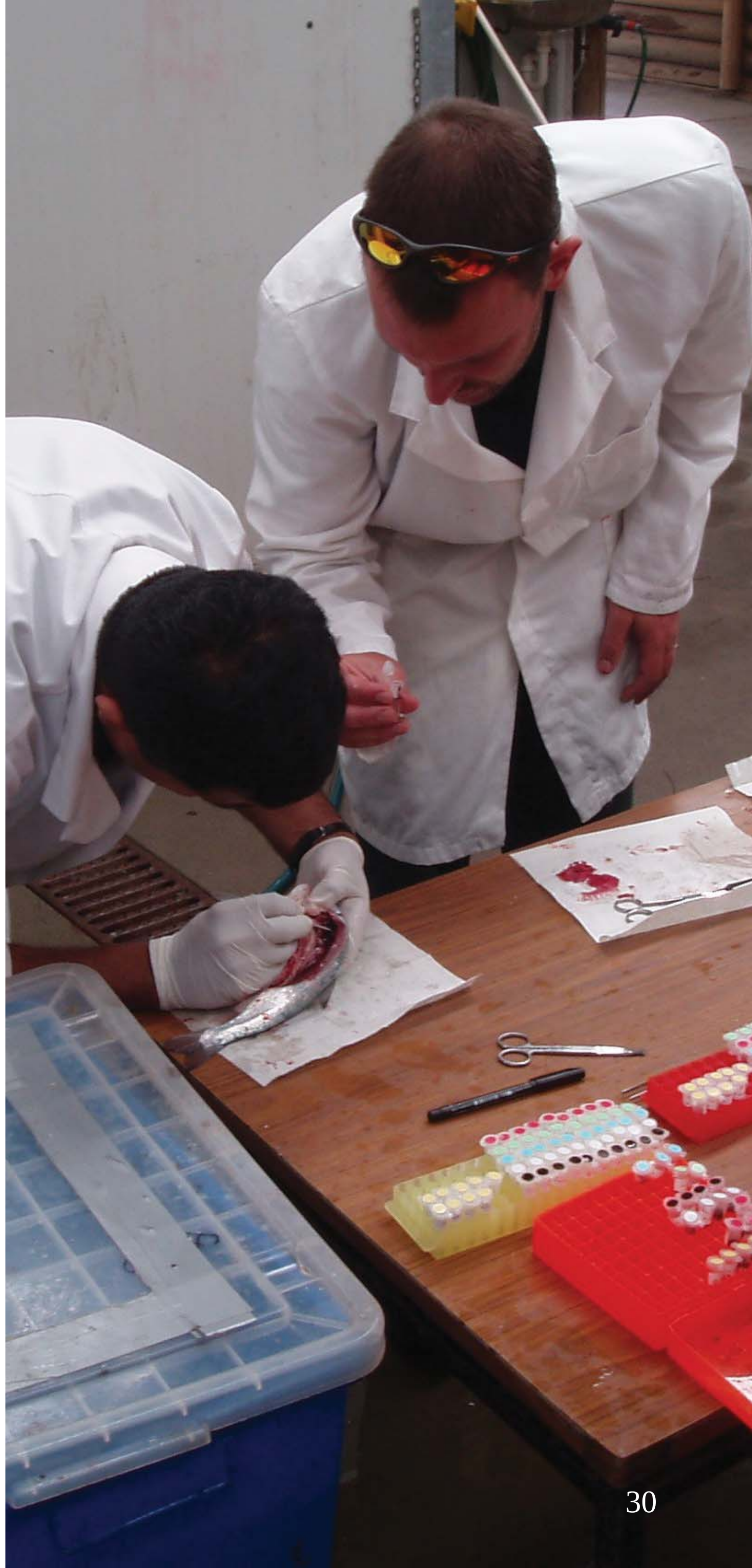

Other Salmon Health Research

Bacterial diagnostics for salmon

Salmon Health - Achievements

We developed a practical system for the detection of covert infections in salmonid fish, that was not reliant on the use of stress testing live fish.

The test format can be used for high-throughput testing, an essential pre-requisite for population assessment of disease status. While optimised for the known major bacterial pathogens of salmonids, it is a generic platform that can be applied to a wide range of other bacterial pathogens associated with finfish, crustacea and shellfish.

Salmon Health - Impact

This system provides farms, for the first time, with a practical basis with which to assess the level of infection either prior to, or immediately after, a disease outbreak. The data generated enable the farmer, health care provider and government regulator to judge the severity of a disease and forecast the impact of the outbreak.

Determination of pathogen carriage levels provides a rational basis on which to consider treatment and controls on stock movement. Stock testing prior to movement is a major contributor to establishing zones of freedom from disease.

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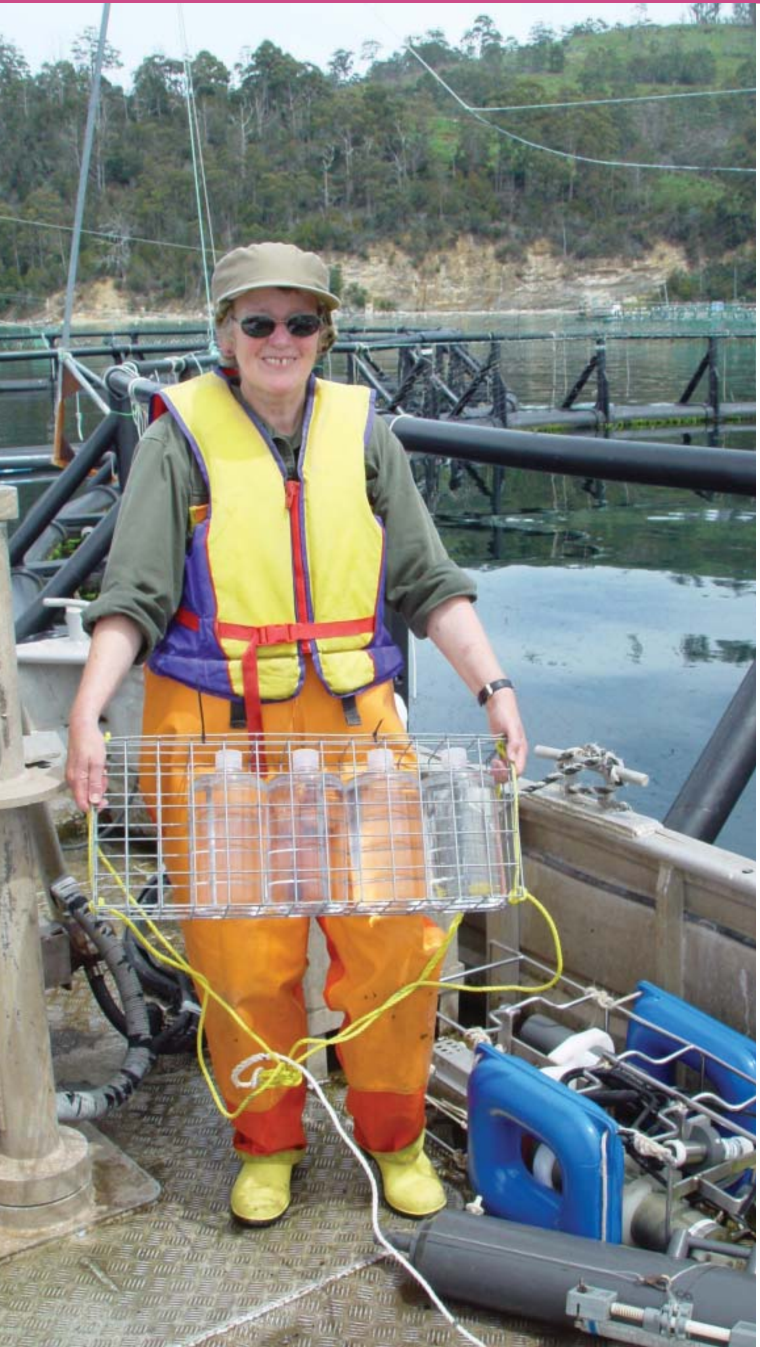
Environmental Management and Salmon Farming



Salmon Environment - Background

There is world-wide controversy over the alleged impacts of large-scale salmon farming on the environment. Both industry and regulators therefore need good scientific information so that they can ensure and demonstrate that salmon farming in Tasmania is sustainable at current and future levels. The science needs to cover the measurement of real impacts and rates of recovery in the immediate vicinity of farms, the broader impact and assimilation of waste nutrients from farms, and the dynamics of the ecosystem to enable us to predict the effects of environmental and industry changes and take necessary corrective action.

Salmon Environment - Achievements

We demonstrated the effects of farms on the nearby marine sediments and showed that recovery (or progressive deterioration) is dependent on salmon stocking levels and the background environment. We developed practical techniques to assess the process of impact and recovery, and provided a field guide, data analysis package and training workshops to enable farmers to monitor their farms and adaptively manage their operations to ensure sustainability.

We developed a three-dimensional coupled hydrodynamic, sediment and biogeochemical model of the Huon Estuary and D'Entrecasteaux Channel, which simulates the seasonal cycling of organic and inorganic carbon, nitrogen, phosphorus and oxygen through multiple phytoplankton, zooplankton, nutrient and detrital pools, and which was validated against field observations collected in 2002.

Model analysis of scenario simulations, parameterised without fish farm inputs, with fish farm inputs for 2002 and with projected inputs for 2009, allowed us to identify the system-wide spatial and temporal environmental footprint of the industry.

We designed a long-term monitoring strategy for the industry in the D'Entrecasteaux Channel and Huon Estuary to ensure the sustainability of the salmonid industry at the whole-of-ecosystem level. It will provide knowledge of how well the ecosystem is functioning with an increased nutrient load and allow any significant temporal trends in ecological indicators to be detected.

A major challenge was converting indicators of ecological condition into recommended quantitative performance measures that can be used in a regulatory manner to adaptively manage the ecosystem. These recommendations have been agreed in principle with government regulators and industry.

Salmon Environment – Impact

The quality and detail of the models enable managers to accurately gauge the scale of industry growth that can be sustainably accommodated within the region, and for industry to anticipate and respond effectively to transient or progressive environmental events and threats. Recent decisions by the marine farming planning review board were informed in part by the likely effects on phytoplankton populations projected by our environmental models.

Benefits will flow to industry, regional communities, and other users of the zones.

An independent consultant estimated the NPV of the salmon environment research at $30M.

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Erika Laws (2003-2005)
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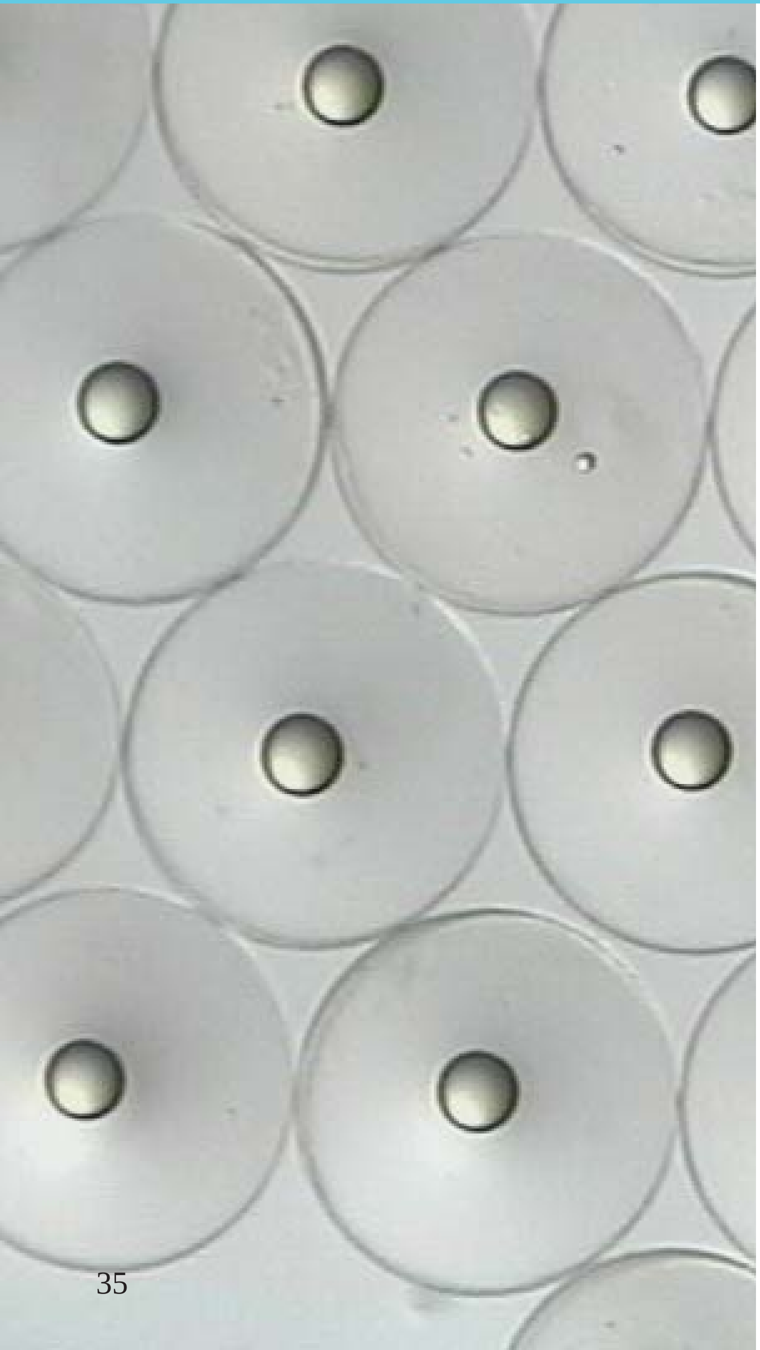
New Finfish Species for Aquaculture



New Species – Background

The Aquafin CRC's interest in new and emerging species is focussed on temperate marine finfish therefore primarily in New South Wales, Tasmania and South Australia. Snapper, mulloway and Yellowtail Kingfish are all species that have seen various levels of commercial investment and success in very recent years, which will benefit from new technology to increase the reliability and cost-efficiency of these operations. Striped Trumpeter is a species which has been identified by the Tasmanian government as having great market potential, but for which no commercially feasible hatchery technology had been developed, and past commercial investment had been limited to research support.

CRC research was therefore directed at new hatchery technology for Striped Trumpeter, and improved hatchery methods and feeds for snapper, mulloway and Yellowtail Kingfish.

Striped trumpeter – Achievements

We published extensive new information about the nutritional biochemistry of Striped Trumpeter larvae, providing a better scientific basis for work on this species.

Our increased understanding of the behaviour of Striped Trumpeter larvae in culture prompted a number of changes to the culture environment that improved larval rearing.

Similarly, observations on larval health and increased attention to water quality and potential pathogens also contributed to larval performance.

Dramatic and increasingly consistent improvements were achieved in terms of survival and reduction in malformations in the larvae, and successful mass cultures made commercial grow-out trials possible.

By optimising tank design and environmental conditions, better control of microbial communities, and improved weaning, we developed methods that enabled the production of juveniles with sufficient reliability for interested companies to undertake hatchery development.

The first sea-cage trials of cultured fingerlings of Striped Trumpeter were carried out with considerable success by a commercial company. This has moved the Tasmanian salmonid industry significantly closer to diversification into a new species, which should strengthen the industry's profitability and long term sustainability.

Striped Trumpeter – Impact

The present state of the art in rearing striped trumpeter fingerlings is the result of many years meticulous research also involving the CRC for Aquaculture (1993-2000), although the key advances in the difficult area of larval rearing have been achieved by the Aquafin CRC.

It creates a real opening for a new aquaculture sector in Tasmania. It may be an opportunity for the salmon industry to diversify, or for a new sector to emerge. This species is already prized as a "white cloth" table fish and recognized by the Japanese as a sashimi product. Some 10 years ago the Tasmanian government estimated the potential value of such an industry at $40M p.a.

We transferred techniques developed during the striped trumpeter project (such as ozonation of seawater and eggs) to other hatcheries, enabling them to improve the survival and quality of juveniles of other emerging species, particularly those experiencing similar problems with malformations.

The sustained program of work has nurtured major growth in marine hatchery skills and capability in Tasmania and Australia more widely.

Independent consultants valued the direct industry impact only. There are major uncertainties in the inception of a new industry sector, and these are reflected in a NPV range from $0 - $20M.

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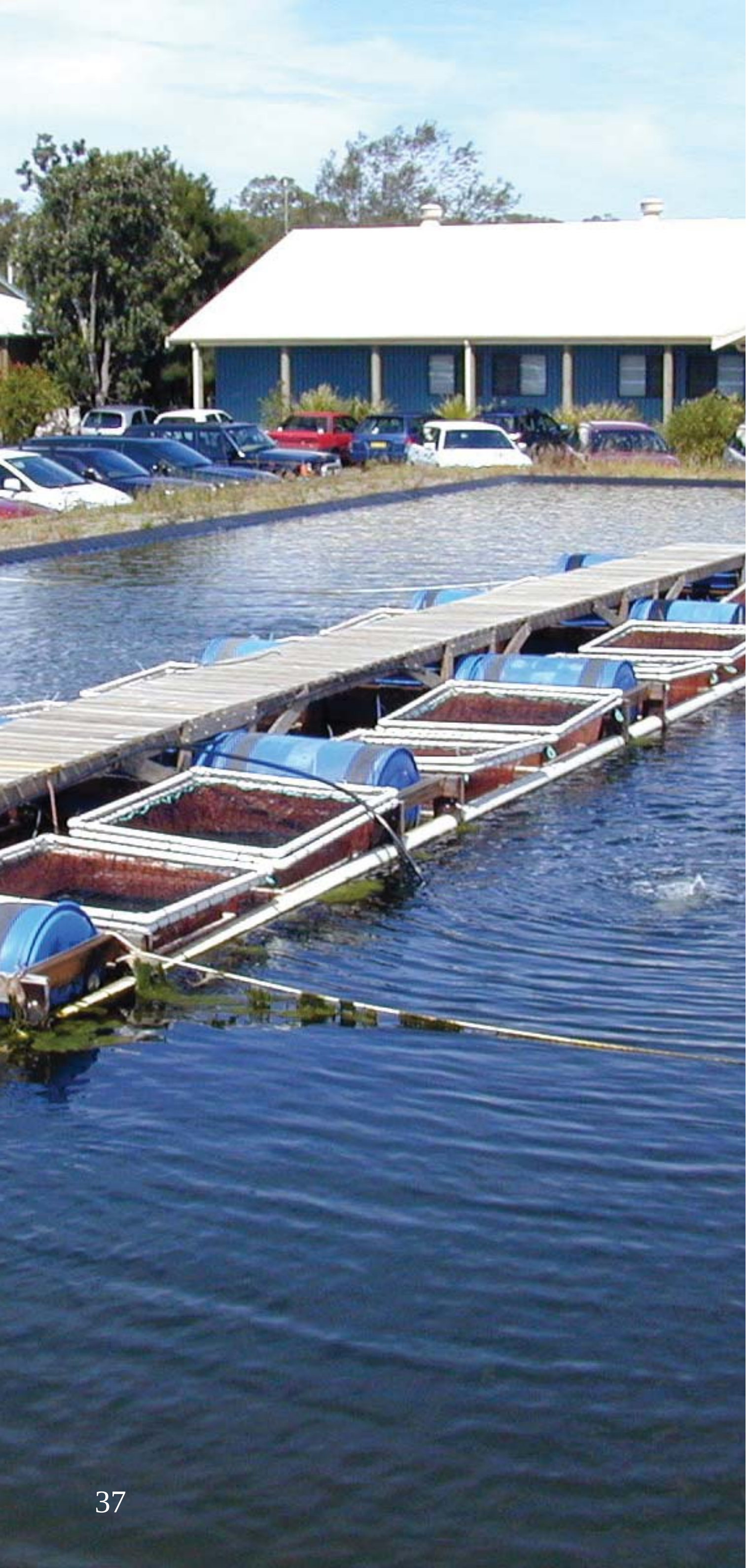

Snapper – Achievements

We developed methods for successfully rearing snapper larvae in extensive outdoor ponds.

In intensive snapper larval culture, we replaced *Artemia* as live feed by using low-cost weaning diets.

Carbohydrates and alternative protein materials were used to reduce the fishmeal content of snapper grow-out feeds. Our digestibility data for carbohydrates, and for protein sources as alternatives to fishmeal, will help feed manufacturers to adapt their formulations according to the availability and prices of ingredients.

We developed methods for rapidly altering the skin colour of farmed snapper to meet market requirements.

Snapper – Impacts

Snapper farming developed but then declined in Australia with operators moving to faster growing species such as mulloway and yellowtail kingfish. However the project has made substantial generic contributions to marine finfish aquaculture.

Feed manufacturers have been given greater confidence to use alternative ingredients in response to reductions in availability and/or increases in price of fishmeal. Diets developed for snapper have helped form the basis for formulations for other marine carnivorous species (e.g. mulloway and Yellowtail Kingfish).

Hatchery practices and nursery technology have gained clearer understanding of the importance of abiotic factors, larval feeding strategies and diets on the cost-effective production of fingerlings. Low-cost technology for extensive production of snapper larvae in fertilised ponds has also been developed. The new technology provided an excellent starting point from which to refine larval rearing techniques for other species.

Mulloway and Yellowtail Kingfish – Achievements

For mulloway larvae, experiments have been completed to determine optimal photoperiod for growth and survival, techniques for ozonation of eggs and early weaning strategies.

Optimal salinity, temperature, photoperiod, light intensity, feeding frequency and stocking density in tanks have been identified for mulloway between 2 and 20g.

Information on feeding behaviour and the development of sensory organs in mulloway was provided giving hatchery managers a physiological basis for new feeding strategies.

Similar information will be produced for yellowtail kingfish by the time the project concludes.

Low-cost technology for extensive production of snapper larvae in fertilised ponds has also been adapted for mulloway, and will also be evaluated for Yellowtail Kingfish.

We have measured the growth of juvenile mulloway when fed a range of non-species specific commercial diets made for marine fish.

Information on ingredient digestibility and nutritional requirements has helped to achieve least-cost formulations for mulloway diets. Similar work will be completed for Yellowtail Kingfish by mid 2009.

Mulloway and Yellowtail Kingfish – Impacts

By carefully optimising hatchery feeds and feeding strategies, including alternative live feeds and replacement with formulated feeds, we aim to reduce the operational costs of fingerling production by half.

Hatchery techniques have been shared with other hatchery managers and technicians during Aquafin CRC workshops and conferences, Australasian Aquaculture conferences and during specific meetings of marine finfish hatchery managers and technicians.

By developing a database of ingredients and their digestibilities, and bioenergetic models for mulloway and yellowtail kingfish (kingfish still to be completed), we will assist farmers to plan feeding strategies, accurately estimate feed requirements, predict nutrient outflows from their farming operations, model their growth and production for marketing purposes and populate farm financial models. The bioenergetic models will assist feed manufacturers to formulate diets to meet requirements for digestible protein and digestible energy (for fish at different phases of the growth cycle).

With our new information, both on nutritional requirements and on feed ingredients, we aimed to increase the cost-effectiveness of grow-out diets by 25%.

Together, these advances should substantially strengthen the prospects for temperate marine finfish aquaculture in Australia.

Key Contact for Snapper, Mulloway and Yellowtail Kingfish

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Education and Training within the CRC

The Importance of Education and Training

The Aquafin CRC's education and training program was designed to support innovation in Australian aquaculture by applying scientific and commercial skills in an entrepreneurial way, and by enhancing educational opportunities for graduate students in aquaculture-related disciplines.

Our PhD program gave students the opportunity to develop both excellent scientific skills and a strong business affinity for the Australian aquaculture industry. We linked most students to an individual industry mentor to maximise the student's knowledge of the industry and employment opportunities.

The Aquafin CRC supported and encouraged industry training activities for its industry partners. Students, industry and research participants were also encouraged to apply for training support to assist their professional development.

Education And Training Achievements

The Aquafin CRC had a total of 18 PhD students supported by CRC scholarships and 23 adopted PhD candidates who held scholarships from other sources, and also 3 adopted Masters students and 17 Honours students. 15 of our PhD students have now completed and 15 are currently finishing their thesis. Of these students, 20 have already secured meaningful employment in the field of aquaculture or related disciplines.

Training sessions for PhD students included two media and presentation skills workshops (2003 and 2006), grant writing (2003), vocational development (2003), two IP and commercialisation workshops (2004 and 2007), and an interview techniques workshop (2005). Students made extensive use of the training support program.

For PhD supervisors, workshops were developed and facilitated in 2002 and 2007.

Aquafin CRC researchers delivered a large number of industry workshops. For the tuna industry there has been the Colour Chip Workshop, Product Quality (2001); The Harmful Micro-algae Workshop (2003); FORMU-BAIT Training (2003); Shark Workshop as part of Aquafin 2003 conference (2003); Sensory

Evaluation and Chemical Analysis Workshop (2003); a Practical SBT Health Workshop (2003); Tagging Workshop (2004); Health Workshop (2004); Sensory Evaluation Workshop (2004); Tuna Quality Project Workshop (2004); SBT Health Workshop (2005); Biostatistics refresher course (2005); Carbon Deposition Model Workshop (2007); a Mortality Sampling Workshop (2007); as well as the annual SBT Aquaculture Subprogram Industry Workshops (2001-2008), and a final Wrap-up Workshop held in May 2008.

For the Atlantic salmon industry, workshops included epidemiology for aquaculture (2003), introduction to epidemiology (2003), advanced epidemiology (2003), disease investigation (2003), AGD case definition (2003), harmful micro-algae (2004), SEA-BASE training (2004) and bio-informatics for PhDs, postdocs and researchers (2005). Regular workshops were presented to keep industry fully informd of the progress of all projects, and a final Wrap-Up Workshop was held in April 2008.

The training support initiative, since its development in 2002, has supported 45 students, 18 Post Doctoral Fellows and 20 researchers to participate in a variety of activities such as presenting at international and national conferences, laboratory visits and exchanges and training in areas such as new methodologies and techniques.

Education and Training - Impacts

It is now widely recognised that, particularly in the primary industries sector, the most effective contribution made to industry development by research agencies is often the nurturing of graduates and others who will work in the industry in the future. In fact, in this sector, the most effective transfer of new technology is through this movement of skilled people, particularly since much technology is embodied in their professional know-how.

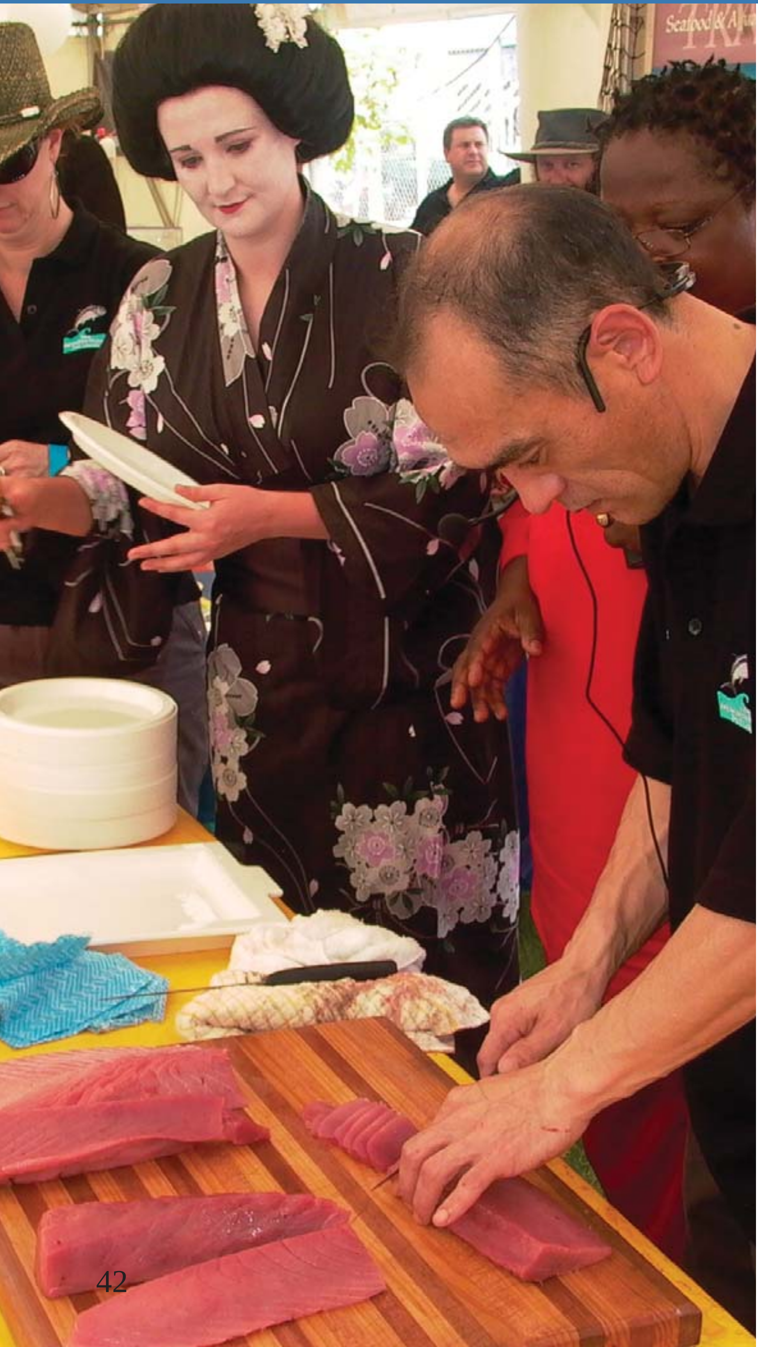
Therefore the education and training program's ultimate expected impact is to provide more well-trained and qualified people who want to work in and for Australian aquaculture. The program's support of visits to establish collaboration with other research organizations and universities in Australia and overseas has had a positive impact on the quality and credibility of our research.

Our efforts to train industry personnel in the latest research developments should help to provide skills and techniques that will give the Australian finfish industry a leading edge in managing their farms and producing a premium product.

Education and Training Staff

Prof Chris Carter (University of Tasmania) - Program Leader, Education and Training
Ms Emily Downes (Aquafin CRC) - Education and Communication Manager
Ms Jane Ham (from Sept 2007)

Communications and Public Relations



The Importance of Communicating Our Research

As our research underpined a clean, green, sustainable and productive industry, communicating our findings to the public was important for ensuring this image was maintained. The communications program worked steadily towards raising the Aquafin CRC's profile and informing end users and the general public of our research results.

In addition, we made communicating effectively to our participants a priority, in particular with industry participants.

Communication and Public Relations Achievements

The Aquafin CRC has widely published its research results. In total we have produced 918 publications (160 scientific papers; 698 conference/workshop presentations, including posters; 35 final reports; 37 handbooks, manuals, technical reports and workshop proceedings; 20 theses; 6 book or book chapters; as well as130 non-CRC newsletters, newspapers, media releases and interviews.

An Atlantic salmon industry publication "Salmon Snapshot" was distributed by the Tasmanian Salmonid Growers Association as a tool for communicating research progress to the industry. Three editions were prepared and distributed. An industry specific publication for the South Australian southern bluefin tuna industry (Tuna-brief) was prepared and distributed by the SBT Aquaculture Subprogram on Aquafin CRC research (33 issues in total). An SBT Aquaculture Subprogram website was also developed, providing a depository of all Aquafin CRC SBT research. The website had three areas, including two password protected areas (one for the tuna industry and one for the SBT Aquaculture Subprogram Steering Committee), providing the public with information and research outputs from SBT research, as well as providing the tuna industry members with ready access to research outputs that had limited circulation. An SBT Industry Micro-algal Database was developed for the website, providing the tuna industry with access to both historical and current micro-algal data collected in the Port Lincoln region.

The SBT Aquaculture Subprogram, in addition to communicating research results with the tuna industry, established an orderly and transparent process of increasing industry ownership of SBT research.

The CRC had major presence at a number of well recognised conferences. At the 2004 Australasian Aquaculture Conference, an exhibition booth was organised and in 2006, a tuna research session was sponsored. A trade exhibition booth was organised at Seafood Directions and at the International Association of Fish Inspectors (IAFI) 6th World Congress on Seafood Safety, Quality and Trade Conferences during 2005 to draw attention to our research portfolio. CRC research was presented at Australasian Aquaculture 2008.

We have ran four conferences specifically for our participants. These conferences were used to cement relationships, encourage cooperation and provide more opportunities for exposure of the research.

The Aquafin CRC also presented to 80 members of the CSIRO Double Helix club. The aim was to give the children (and their parents) an appreciation of the industry and the process behind getting a farmed product to the consumer. The CRC donated a copy of "The Story of Seafood" book as a prize.

The Aquafin CRC participated in "Questacon" (National Science and Technology Centre, Canberra) for the exhibition "Innovation: A Showcase of Australia-Japan cooperation". This consisted of a small travelling exhibition and complementary website, featuring stories of Australia-Japan cooperation in science, technology, engineering and innovation. The CRC highlighted its research work to strengthen the link between tuna product quality and the Japanese consumer and the residue research.

The Aquafin CRC was also part of a travelling photographic exhibition in 2006 to celebrate the history of Australian-Japanese relations. This exhibition was the major event in celebrating 'The Year of Exchange' and the launch was held in the High Court of Canberra to mark the 30th anniversary of the signing of the Australian-Japanese Basic Treaty of Friendship and Co-operation. The Aquafin CRC showcased its research and demonstrated Australian and Japanese co-operation in science, which is leading to a successful business initiative through CRC research. The exhibition toured all the state capitals. The Japanese Consulate-General has also made the exhibition available to universities, high schools and other institutions. A book will be published showcasing the exhibition stories.

Two PhD students were involved with the "Young Tassie Scientists" initiative in 2004 and 2005. The program is aimed at increasing awareness of the role undertaken by young scientists in different area of scientific research in Tasmania and raises awareness of the value and relevance of science. Ms Renee Florent was voted most popular Young Tasmanian Scientist for 2005.

In 2007, the Aquafin CRC formed a consortium with other food CRCs (Dairy, Sheep, Poultry and Molecular Plant Breeding) to participate in the National Youth Science Forum (NYSF) with 282 Year 12 science students from all over Australia. The purpose of the NYSF is to promote as many different facets of science to students interested in science as possible to help them choose their future career path. The participating CRCs wanted to promote research in agriculture/aquaculture as a fantastic career option.

Aquafin CRC participated in "Tunarama" a large rural public festival held in February each year in Port Lincoln (2005-2007). In 2005, the tuna health project entered the festival parade. The aim was to raise awareness of CRC health research. In 2006 and 2007, the Aquafin CRC attended to educate the general community about the CRC and its research with industry. A traditional Japanese tuna filleting display with an authentic Japanese tuna filleter was organised as part of the festival's seafood and wine expo. The audience were offered free tuna sashimi tasting plates. A stand with give aways and information was also on display which gave the CRC valuable exposure to the local community as well as many interstate and overseas tourists. The

Aquafin CRC donated prizes for children's competitions.

During 2006, SARDI Aquatic Sciences invited the Aquafin CRC to do a repeat performance of the traditional Japanese tuna filleting display for their open day. The open day offers a chance for the community to learn and discover marine science research. At the end of the session, the Aquafin CRC offered free tuna sashimi tasting plates and gave out tuna recipe cards. A number of books were also donated as prizes.

In 2007, the Aquafin CRC together with Sekol Farmed Tuna did a CRC research display at Parliament House in Canberra after an invitation from DEST to join the very few selected CRCs to participate in a showcasing evening extravaganza event.

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Book compiled by: Peter Montague, Emily Downes and Jane Ham

Editing: Steven Clarke

Design: Jane Ham

Photographs:
Front cover (far left) and Page 35: Tasmanian Aquaculture and Fisheries Institute (University of Tasmania)
Front cover (second and third from the left) and Page 31: Huon Aquaculture
Front cover (fourth from the left): istock photograph
Front cover (fifth from the left), Pages 3, 5, 6, 10, 14, 15, 19, 22 and 39: SARDI
Front cover (far right) and Page 37: NSW Department of Primary Industries
Foreword and Page 8: Adam Watkins
Pages 7 and 9: ASBTIA
Pages 11 and 12: Flinders University
Pages 16, 24 and 25: University of Tasmania
Page 26: James Harris
Pages 30 and 32: CSIRO

ISBN No: 978-0-7308-5399-2

Printing: Stallard and Potter (Adelaide)

This report is published by the Aquafin CRC, October 2008.

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Aquafin CRC Achievements and Impacts (2001-2008)
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