Department of Primary Industries

Aquaculture Research Advisory Committee

Annual Report

July 2013 to June 2014

Professor Ian White (Chairperson)
Ms Jo Pickles (Executive Officer)

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Author: Jo Pickles, Aquaculture Research, Port Stephens Fisheries Institute.

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Chairpersons Report

The increasing recognition of the role that microbes within the human digestive system play in the health of individuals is generating a renewed focus on food nutrition. The seafood industry and aquaculture in particular are key contributors to maintaining the diversity and nourishment of the food we eat and supporting the general health of communities.

Science has made and continues to make important contributions to identifying the key nutrients, oils and minerals in our seafood and in finding conditions, culture techniques and production and delivery systems which promote healthy food, healthy fish, and increase productivity. We are singularly blessed in New South Wales aquaculture with innovative industries and scientists committed to enhancing the quality, nutrition and safety of the products produced in the State.

That commitment is none-the-more evident in the members of the Aquaculture Research Advisory Committee. Despite hardships faced by the industry, grower representatives continue to contribute positively the wealth of their experience and wisdom. The Department of Primary Industries representatives have a focus on a productive and profitable industry and are dedicated to providing the best, innovative research and development ideas to support the industry. Between them they make a formidable collaborative team. The contributions made over the past year are testament to the strength of the research advisory system the NSW Government and the industry have set up.

When it comes to budget cuts, research is often vulnerable because of the longer times often required for outcomes. The outcomes produced in aquaculture research over the past two decades have been vital for the survival of the industry. Continued investment in the long term is an investment not just in an important regional industry, which is a significant indigenous employer, it is also an investment community health through enhancing food nutrition.

I am extremely grateful to the farmer members for their outstanding, selfless and tireless contributions. I am also extremely grateful to NSW Primary Industry staff who have contributed to ARAC. Their professionalism, dedication, energy, commitment and organisational skills continue to be outstanding. I also want to thank the FRDC and the Seafood CRC for their support for the NSW aquaculture industry. Finally I am extremely grateful to the Minister and NSW Primary Industries for their strategic initiatives in and support for aquaculture.

ARAC is committed to increasing the sustainability, profitability and growth of the aquaculture in NSW and its contribution to human health through applicable, targeted research. I have great pleasure in presenting this report on activities of the NSW Aquaculture Research Advisory Committee.

Professor Ian White FTSE
CHAIR ARAC

Contents

Chairpersons Report iii

The Committee 6

Terms of Reference 6
Membership and Selection Process 7
Deputy Members 7
Committee Members in 2013/14 7
Meetings 8
Declaration of Pecuniary Interests 9

Trust Accounts for the 2013/14 Financial Year 10

Advice on Level of Contribution 10
Advice on Level of Expenditure 10
Expenditure Purpose and Level 11
Levy Collection 12
Forward Budget 13
Recommendation on Level of Contribution 14
Aquaculture Permit Holders in NSW 14

List of Activities 15

Aquaculture Research and Development currently being undertaken by NSW Department of Primary Industries 20

Oyster Research and Development currently being undertaken in Australia 21

Aquaculture Research and Development currently being undertaken in Australia 27

ARAC is operated from the Port Stephens Fisheries Institute
Taylors Beach Road, Taylors Beach, NSW, 2316
(Locked Bag 1, Nelson Bay, NSW, 2315)
Telephone: (02) 4982 1232 • Facsimile: (02) 4982 1107
Email: jo.pickles@dpi.nsw.gov.au

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Preamble

This is the seventh Annual Report for the Aquaculture Research and Advisory Committee (ARAC). The Minister for Primary Industries approved the formation of the Aquaculture Research Advisory committee in October 2005 to provide advice on industry contributions and R&D expenditure for all aquaculture industries in NSW. Confirmation for ARAC's establishment was confirmed in 2006 after the completion of a NSW Government review of Boards and Committees. ARAC has replaced the Oyster Research Advisory Committee (ORAC) and the former Advisory Council on Aquaculture (ACoA).

ORAC was formally disbanded after its meeting in December 2005.

The Committee

The Aquaculture Research Advisory Committee (ARAC) was established in October 2006 and held its inaugural meeting on 31 January 2007.

ARAC is a statutory committee that advises the Minister on the amount of contributions payable by the NSW aquaculture industries into trust accounts for aquaculture research and development and the expenditure of those trust funds. The NSW prawn aquaculture industry is not included as it pays research levies directly to the Commonwealth.

ARAC is established under Section 157 of the *Fisheries Management Act 1994.*

Terms of Reference

1 Investigate and evaluate the requirement for aquaculture research and development in NSW, after consultation with NSW aquaculture industries and with reference to NSW, Australian and overseas experience, and whether funded by the Fisheries Research and Development Corporation or otherwise;

2 Revise as appropriate research and development plans for NSW aquaculture research and development and promote it to the wider research community;

3 Advise the appropriate NSW Fisheries Research Advisory bodies and the Fisheries Research and Development Corporation on NSW aquaculture research and development matters and priorities;

4 Advise the NSW Minister for Primary Industries on the level of funding from industry required for aquaculture research and development in NSW and on its expenditure.

5 Oversee the management of annual contributions for aquaculture research collected under Section 156 of the *Fisheries Management Act 1994*, and placed in separate trust accounts under Section 157 of the *Fisheries Management Act 1994.*

6 Report on a regular basis, including an Annual Report based on a financial year, to the NSW aquaculture industry, the NSW Minister for Primary Industries and NSW researchers on aquaculture research and development initiatives;

7 Facilitate the dissemination, adoption and commercialisation of the results of aquaculture research and development; and

8 Promote aquaculture research and development in NSW.

Membership and Selection Process

The *Fisheries Management (Aquaculture) Regulation 2012*, schedule 1 provisions relating to members and procedure of committee, section 2, states:

1 The Minister may convene a selection committee (including representatives of the aquaculture industry) for the purpose of recommending persons for appointment as members of a committee.
2 The Chairperson of a committee is to be the member of the committee for the time being appointed by the Minister as Chairperson.
3 Section 157 (7) of the Act requires the Minister to ensure that a majority of the members of the committee are representatives of the aquaculture industry.

Industry members of ARAC are appointed by the Minister through a competitive selection process from Aquaculture Permit holders who have submitted expressions of interest to join the committee. A selection committee is appointed, comprised of a representative from the NSW Farmers Association, one representative from the Seafood CRC and the NSW Department of Primary Industries (Fisheries Division). Industry members are selected on merit.

The Chairperson is appointed to the committee by the Minister.

To aid the committee with their function, NSW Department of Primary Industries personnel attend meetings and undertake the role of facilitator and secretariat.

Deputy Members

The *Fisheries Management (Aquaculture) Regulation 2012*, schedule 1 provisions relating to members and procedure of committee, section 3, states:

1 The Minister may, from time to time, appoint a person to be the deputy of a member, and at any time revoke any such appointment.

Committee Members in 2013/14

Member	Representing	Date of Appointment	Expiry Date
Prof. Ian White	Independent Chair	Oct 2006	Sept 2015
Ms Milada Safarik	Industry	Oct 2009	Sept 2015
Mr Tony Troup	Industry	Oct 2006	Sept 2015
Mr Ewan McAsh	Industry	Oct 2009	Sept 2015
Mr Russell Sydenham	Industry	Mar 2012	Sept 2015
Mr Matthew Wassnig	Industry	Sept 2012	Sept 2015
Ms Jessica Zealand	Industry	April 2014	Sept 2015

There are six members on ARAC, four lease-based (oyster) representatives and two land-based (non-oyster) representatives, which reflects the relative sizes of the industry sectors in NSW. All members of ARAC, including the independent Chairperson, are appointed for a term of three years.

In December 2013, an expression of interest was mailed to all lease-based permit holders, due to the resignation of Mr John Stubbs. A selection panel was convened to consider the applications and recommend a suitable candidate to the Minister for NSW Primary Industries. In April 2014, the Minister appointed Ms Jessica Zealand to the Aquaculture Research Advisory Committee. Ms Zealand is a third generation oyster farmer on the Shoalhaven River, involved in a well-established family business; Zealand Oysters. Ms Zealand has been involved in a range of industry, community and local government groups and is passionate about ensuring sustainable development of the oyster industry.

Dr Wayne O'Connor (A/Research Leader, Aquaculture), Mr Ian Lyall (Manager, Aquaculture) and Mr Ben Rampano (Aquatic Biosecurity Officer, Aquatic Biosecurity and Risk Management) from NSW Department of Primary Industries sat as observers on the Committee for 2013/14. Ms Jo Pickles from NSW Department of Primary Industries is the Executive Officer. Mr Anthony Zammit (NSW Food Authority) also sat as an observer.

Meetings

Three meetings were held during the financial year 2013/14:

Member	30 July 2013	21 November 2013	1 May 2014
Prof. Ian White	✓	✓	×
Mr Tony Troup	✓	✓	✓
Ms Milada Safarik	×	✓	×
Mr Ewan McAsh	✓	×	✓
Mr Russell Sydenham	✓	✓	×
Mr Matthew Wassnig	✓	✓	✓
Ms Jessica Zealand	n/a	n/a	✓
NSW Department of Primary Industries			
Dr Wayne O'Connor	✓	✓	✓
Mr Ian Lyall (or rep)	✓	✓	×
Ms Debra Doolan (or rep)	✓	✓	✓
Mr Anthony Zammit	✓	✓	✓
Ms Jo Pickles	✓	✓	✓

Disclosure of Pecuniary Interests

Schedule 1 of the *Fisheries Management (Aquaculture) Regulation 2012* sets out provisions relating to members and committee procedure. Clause 8, sub clause 1 states a member of a committee:

a who has a direct or indirect pecuniary interest in a matter being considered or about to be considered at a meeting of the committee, and

b whose interest appears to raise a conflict with the proper performance of the member's duties in relation to the consideration of the matter

must, as soon as possible after the relevant facts have come to member's knowledge, disclose the nature of the interest at a meeting of the committee.

No pecuniary interests were declared in this financial year.

Trust Accounts for the 2013/14 Financial Year

Advice on Level of Contribution

Section 156 of the *Fisheries Management Act 1994* states a permit holder is required to contribute to the cost of administration or research or to other industry costs. Under section 157(4) of the *Fisheries Management Act 1994* the Minister is to appoint a committee of persons to advise the Minister on the amount of contributions payable into any trust account. Research contributions made by the aquaculture community (excluding the prawn industry) are reported to the Minister by ARAC.

Research contributions from the oyster industry have been set at $37.00/ha/year. The amount of research contributions billed for 2013/14 was $124,320.00.

Research contributions from the non-oyster aquaculture industry have been set at $28/ha/year or $134 for a minimum of 5 ha/year. The amount of research contributions billed for 2013/14 was $23,034.00.

The required annual contribution to the Fisheries Research Development Corporation is calculated at 0.25% average gross value of production (AGVP), based on three year rolling calculations. The contribution from the oyster industry for 2013/14 was $75,597.00 ($85,766.00 less the fee waiver of $10,169.00). The contribution from the non-oyster aquaculture industry for 2013/14 was $18,697.00 ($19,209.00 less the fee waiver of $512.00).

Advice on Level of Expenditure

Section 156 of the *Fisheries Management Act 1994* states a permit holder is required to contribute to the cost of administration or research or to other industry costs. Under section 157(4) of the same Act the Minister is to appoint a committee of persons to advise the Minister on the expenditure of money in the trust account.

Expenditure Purpose and Level

The allocated expenditures for the 2013/14 financial year are outlined below:

ARAC REVENUE AND EXPENSES – 1 July 2013 to 30 June 2014 *Note: this is an accrual accounting report for WBS E116-1 (Oyster Research Levy)		
Revenue:	Credit	Debit
Balance carried forward 30.06.2013	$62,862.95	
Research Contributions billed 01.07.2013 to 30.06.2014 (with fee waivers deducted)	$112,933.72	
Oyster Conference Contribution	$1,004.00	
Total Revenue	**$176,800.67**	
Expenses: Internal Transfer to Committee Account		$0
FRDC Contribution (reduced by fee waivers for research)		$75,597.00
Total Expenses		**$75,597.00**
Balance of Cost Centre as at 30.06.2014	**$101,203.67**	

ARAC Committee expenses – 1 July 2013 to 30 June 2014 *Note: this is an accrual accounting report for WBS D2492-1		
Revenue:	Credit	Debit
Balance carried forward 30.06.2013	$0.00	
Transferred from NSW Department of Primary Industries funds	$5,013.45	
Total Revenue	**$5,013.45**	
Operating Expenses:		
Travel		$5,151.57
Committee Fees		$347.40
Consumables		$696.56
Total Expenditure		**$6,195.53**
Balance of Cost Centre as at 30.06.2014		**$1,182.08**

ARAC REVENUE AND EXPENSES – 1 July 2013 to 30 June 2014 *Note: this is an accrual accounting report for WBS E119-1 (Aquaculture [non-oyster] Research Levy)		
Revenue:	Credit	Debit
Balance carried forward 30.06.2013:	$44,681.98	
Research Contributions billed 01.07.2013 to 30.06.2014 (with fee waivers deducted)	$17,342.14	
Total Revenue	**$62,024.12**	
Expenses:		
Internal Transfer to Committee Account		$0
Bad Debts	$76.66	
FRDC Contribution (reduced by fee waivers for research)		$18,697.00
Total Expenses		**$18,620.34**
Balance of Cost Centre as at 30.06.2014	**$43,403.78**	

Levy Collection

Billing is conducted on the financial year and permit holders have the option of paying in full by 30 September or by quarterly instalments at 30 September, 31 December, 31 March and 30 June of that year.

Money held in the NSW Department of Primary Industries Crown Trust Account does not receive interest.

Forward Budget

ARAC REVENUE AND EXPENSES – 1 July 2014 to 30 June 2015 (Oyster Research Levy)		
Revenue:	Credit	Debit
Balance carried forward 30.06.2014	$101,203.67	
Research Contributions billed 01.07.2014 to 30.06.2015	$125,706.00	
Total Estimated Revenue	**$226,909.67**	
Expenses:		
FRDC Contribution (estimate)		$100,000.00
ARAC Committee Expenses (Internal transfer)		$8,000.00
Total Estimated Expenses		**$108,000.00**
Estimated Balance as at 30.06.2015	**$118,909.67**	

ARAC REVENUE AND EXPENSES – 1 July 2014 to 30 June 2015 (Aquaculture [non-oyster] Research levy)		
Revenue:	Credit	Debit
Balance carried forward 30.06.2014:	**$43,403.78**	
Research Contributions billed 01.07.2014 to 30.06.2015	$21,829.00	
Total Estimated Revenue	**$65,232.78**	
Expenses:		
FRDC Contribution (estimate)		$20,000.00
ARAC Committee Expenses (Internal transfer)		$4,000.00
Total Estimated Expenses		**$24,000.00**
Estimated Balance as at 30.06.2015	**$41,232.78**	

COMMITTEE REVENUE AND EXPENSES – 1 July 2014 to 30 June 2015		
Revenue:	Credit	Debit
Balance carried forward 30.06.2014	$0.00	$1,182.08
Internal transfers	$12,000.00	
Total Estimated Revenue	**$12,000.00**	
Expenses:		
Consumables		$1,500.00
Travel		$6,000.00
Committee fees		$4,500.00
Total Estimated Expenses		**$12,000.00**
Estimated Balance as at 30.06.2015	**$0.00**	

Recommendation on Level of Contribution

On 31 January 2007, the Committee agreed the oyster research levy should increase to $35.00/ha/yr from $29.00 as this amount was insufficient to maintain the contribution to FRDC at 0.25% of AGVP and operate ARAC. Letters were then written to lease-based farmers explaining the reasons for the increase. An amendment in the Regulation Review was prepared and approved to raise the levy which came into effect 2008/09. The Committee has agreed that levies be reviewed on an annual basis at the first meeting in the calendar year.

Aquaculture Permit Holders in NSW

In NSW, aquaculture occurs in fresh, estuarine and marine waters. There are several classes of aquaculture permits that are issued for the different types of aquaculture, with some farms having more than one permit. Most forms of aquaculture include Intensive farming; when the species being grown is given specially prepared feeds and Extensive farming; when the natural ecosystem of the water provides feed for the species grown.

As at June 2014 there were 310 lease-based permits (primarily involved in oyster production) and 138 land-based aquaculture businesses that have 206 permits between them authorising extensive and intensive (leases), fishout, hatchery and intensive land based activities.

List of Activities

- The NSW Oyster Conference, Catch-Up and Tradeshow 2013 was an initiative of NSW DPI, NSW Farmers Association and Oysters Australia. It was held at Port Stephens over 31 July and 1 August 2013. Over 300 participants were involved and it was a great way to promote the industry, get farmers together and display the trades. Three chefs from local restaurants presented oyster tastings to all delegates during the afternoon of the first day. A large social evening was held during the Conference for oyster farmers and their partners bringing together delegates from New South Wales, Tasmania, South Australia, Queensland and New Zealand – thoroughly enjoyed by all who attended. The whole event further strengthened the rapport between industry, NSW DPI and the NSW Food Authority.

- 'Funding win ensures the future of oyster hatcheries in NSW' was a media release (dated 9-7-13) highlighting the Select Oyster Company (SOCo), NSW Farmers, Oysters Australia and NSW DPI had secured funding to support the appointment of a business manager at SOCo. Dr Emma Wilkie has now been appointed as the Operations Manager who is tasked with improving the availability, properties and management of hatchery-raised Sydney rock oysters. An important development for SOCo.

- The NSW DPI Aquatic Biosecurity team updated the Committee on a number of items, namely:
  a) A new risk-based management option proposed to replace the existing Section 8 Pacific oyster Fishing Closure by December 2013. It aims to simplify management rules, reflect current levels of risk and also current oyster culture techniques used by industry. The Pacific Oyster Management System has now gone through the approvals process and was approved by the NSW Minister for Primary Industries as Aquaculture Permit Conditions specified in the *Fisheries Management (Aquaculture) Regulation 2012*. This has replaced the Section 8 Fishing Closures and the new system is now in effect. An advisory poster has been developed that includes a map with all NSW estuaries and the estuary classifications and a succinct description of the new provisions. This was distributed to industry in April 2014.
  b) Mortalities of Pacific oysters in Port Stephens have been reported since January 2013. Investigations took place into the unexplained Pacific Oyster mortalities and samples were tested at the EMAI Laboratory – PCR testing excluded POMS as a causative agent and histopathology tests were also carried out. No disease agent has been detected and a NSW DPI Technical Working Group is continuing to investigate possible causes. EMAI carried out an experimental transmission trial between February and April 2014, however, the experiment did not detect any evidence of a causative transmissible agent. The samples are being archived and over time NSW DPI will gather more data.
  c) The IVR (interactive voice response) telephone reporting system is in the final stages of development and will be trialled in the Hastings River with the state-wide rollout expected in the second half of 2014.
  d) Undertaking POMS preparedness activities, for more efficient emergency response activities in the event of another POMS outbreak in a previously unaffected estuary. This work has included the development of a Policy, that outlines what steps the Minister and the Department may take in response to another outbreak in a new estuary. This Policy was provided to the NSW Shellfish Committee for comment at their November 2013 meeting.

- NSW DPI received approval from the Department of Planning and Infrastructure for the Marine Aquaculture Research Lease off Port Stephens. The project will run for five years to extend the successful research work undertaken at PSFI. Floating sea cages can be used to culture a number of species including Yellowtail Kingfish and Mulloway. Key research outcomes will include proving species suitability, diet development work, validating equipment and technology, and conducting environmental monitoring. An EOI to secure a research partner was advertised in Australasian Aquaculture Magazine. A selection committee was convened to assess applications and negotiations are underway with the successful applicant regarding species, operation and structure of the site, etc.

- In July 2010, Steve McOrrie prepared an invitation and registration form that was mailed to all oyster farmers in NSW seeking historical material. ARAC has created a register and is collating this information. It is hoped items such as photos, oral histories or equipment will be used to document the History of the NSW Oyster Industry. Some of the photos and information has been used by a Port Stephens local identity John 'Stinker' Clarke who has written a book titled 'Oysterman' that was released in 2013. John was a dinner speaker at the NSW Oyster Conference, 'Catch-up' and Tradeshow 2013 and talked about his book on the history of the Port Stephens Oyster Industry. This epic task took John two years to research and collate the information just for Port Stephens alone. NSW DPI continues to encourage farmers to reply and follow-up with articles in the Aquaculture Newsletters etc.

- In 2013, the incorporation of Oysters Australia replaced the Oyster Consortium. ARAC were asked to review and provide comments on the Oysters Australia Constitution and the Fisheries Research and Development Corporation (FRDC) Partnership Agreement an ‘Independent Partnership Agreement between Oysters Australia and the FRDC for the implementation of an Australian edible oyster research, development and extension program’. With the Seafood CRC ending in 2015, Oysters Australia will continue to oversee research priorities for available FRDC funds. NSW DPI has prepared a brief recommending to the Minister that funds be made available to Oysters Australia through FRDC and under the agreement, FRDC will continue its existing leveraging arrangements at a rate of 1:1. Oysters Australia agreed to prepare a flyer explaining Oysters Australia and t the benefits for the industry. More information on Oysters Australia can be found at http://oystersaustralia.org.au/ and http://oystersaustraliablog.org.au/

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- The SARDI proposal 'Survey of foodbourne viruses in Australian oysters' was approved by FRDC in early 2014. The purpose of this study is to gather baseline data. Committee members reported a concern among some growers that the collection/volunteering of samples could lead to closure irrespective of absence of previous illness events if positive results are found. SARDI have confirmed that samples will be stockpiled and results will not be available until the end of the study - this data collection is for a research project independent of the industry.

- An update on the LBACG and the NSW Shellfish Committee is provided for the information of ARAC members at each meeting. When ARAC met in July 2013, it was suggested to refer to the case study between the Kalang and Camden Haven to show the difference in how responsive NSW councils can be and how pollution issues impacted each estuary and its reopening. It was agreed this is a management issue and not a research issue and the ARAC forwarded the above suggestion to the Shellfish Committee for their information/action.

- Russell Sydenham raised the issue of a benchmarking project on finfish (particularly after reading about the work done on oysters). Russell would like to see the development of a benchmarking model for finfish (particularly land based) either NSW or Australia wide and believes more effort should be placed on existing farmers. NSW DPI is happy to look at what information and funding sources are available and Russell is happy to talk to the NSW Aquaculture Association and the LBACG. There are valuable steps to be done and valuable information to be gained from a benchmarking model. The industry perspective is we need to start looking at making the land based industry more productive and cost-effective.

- NSW DPI submitted a State Significant Infrastructure application to develop commercial shellfish aquaculture within Jervis Bay. Native species such as mussels, scallops and oysters would be grown. This work was initiated by investor interest and a request to develop an aquaculture management plan by the Marine Parks Authority under the zoning review process. The application is for three lease locations within the bay. A 10 hectare site 0.7 km off Vincentia over an area previously leased for mussel aquaculture, and two areas of 20 hectares located 1.5 and 1.9km off Callala Beach. If approved, leases would be tendered to commercial shellfish enterprises. The EIS and draft Environmental Management Plan were on public exhibition during Oct-Nov 2013. 133 submissions were received; 109 objections, 10 comments and 14 report submissions. NSW DPI has prepared a Response to Submissions Report and a visual amenity study of the proposed lease infrastructure. A decision will be determined by the Minister or referred to a Planning Assessment Commission.

- The second edition of the NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS) was released in early 2014. The need for OISAS arose from concerns of both the NSW Government and the NSW oyster aquaculture industry, as to the existing and potential impact on the oyster aquaculture industry associated with the rapid development of the NSW coastline. The strategy has been developed by the government in partnership with the NSW oyster aquaculture industry and local community and other key stakeholders. The strategy sets out best practice in the identification and use by the oyster aquaculture industry of those estuarine areas suitable as priority oyster aquaculture areas and provides for the protection of water quality in these areas. The strategy is one of a suite of strategies initiated by the NSW Government for the management and development of aquaculture in NSW. The 2014 second edition of the NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS) retains all the essential elements of the first edition with several updates, amendments, additions and a new format. It can be found at: http://www.dpi.nsw.gov.au/fisheries/aquaculture/publications/oysters/industry/industry-strategy.

- ARAC representatives are asked to review the ARAC RD&E Plan annually and revise or update the priorities. To streamline the process the Committee introduced the ARAC Research Initiative - an annual call for research priorities across all farmers. A letter to all permit holders and the form 'Submission to ARAC for a Research Initiative' was mailed to all Aquaculture permit holders in mid-December (with the Aquaculture Newsletter). Several responses were received and the Committee agreed it was time to act on the issue of stocking rate of oysters and how it relates to growth and mortality. Industry (and the Committee) would like to see a set of guidelines (estuary specific) re stocking densities (particularly if you're new to the industry) relating to the different types of infrastructure ie. trays, bags etc. The issue of profitability and the SRO industry was also raised and the Committee would like to see an Economist review outcomes of the Benchmarking program, compare

NSW production figures to that of SA and TAS and determine the barriers to profitability in NSW.

- Registration of Aquaculture Chemicals, targeted to Land-based farmers, was discussed at ARAC. The issue of Minor Use Permits will affect trade and the registration of aquaculture chemicals has been identified in the AquaPlan review and is one of the five key priorities. Currently MUPs for formalin and hydrogen peroxide are only approved for National Aquaculture Council members. Whereas MUPs for copper sulphate and potassium permanganate were renewed by the NSW Silver Perch Growers Association and the NSW Aquaculture Association for all aquaculturists in Australia. Registration, renewal and reporting issues are ongoing and a meeting has been scheduled by the National Aquaculture Council (NAC), FRDC and the Australian Pesticides Veterinary Medicines Authority (APVMA) to discuss the issues.

- In developing the EIS's for the Marine Finfish Research Lease off Port Stephens and Commercial Shellfish Aquaculture Leases in Jervis Bay there was a shortfall in socio-economic data for the NSW aquaculture industry. Aquaculture Research and Management have had discussions with Rural Development Solutions to develop a plan that will provide definitive data. Unfortunately the plan put forward is out of our affordability at present. Further discussions will be held with Rural Development Solutions to find a more affordable option and may involve R&D partners. ARAC agreed more information on socio-economic data for the NSW aquaculture industry is needed.

- The FRDC Contribution for 2013/14 was discussed ie. the research levies that had been calculated for oysters and non-oyster aquaculture in NSW that are due to the FRDC. The money collected from these levies goes primarily to the Seafood CRC, via FRDC to support aquaculture research in NSW. A small portion of the levy contributes to the running of ARAC and to fund other small research activities. The contribution to FRDC is calculated at 0.25% average gross value of production (AGVP), based on three year rolling averages. ARAC approved the dispersal of these funds to FRDC.

- NSW DPI is continuing to support a range of post-graduate students investigating Aquaculture related questions in 2013. Projects include:
  a) Stephan O'Connor (PhD UTAS) Improved rearing and settlement technology for flat oysters (Wayne O'Connor).
  b) John Wright (PhD UWS) climate change and predator prey interactions with Pacific oysters (Wayne O'Connor).
  c) Elliot Scanes (PhD UWS) The effects of multiple stressors including climate change on the oyster populations of Port Jackson NSW (Wayne O'Connor)
  d) Vu Van In (PhD USC) Transcriptomic changes during reproductive development of Sydney rock oysters (Wayne O'Connor).
  e) Nicole Ertyl (PhD USC) Transcritpomic responses to stress in Sydney rock oysters (Wayne O'Connor).
  f) Thanvapon Yingprasertchai (PhD UNewc) Metals impacts on Sydney rock oysters (Wayne O'Connor)
  g) Kim Ahn Tran Thi (PhD Newcastle University), Reproductive responses to estradiol exposure of Sydney rock oysters (Wayne O'Connor)
  h) Veronica Taber (PhD Newcastle University) The effects of zinc exposure on Sydney rock oysters (Wayne O'Connor).

i) Olivia Goncalves (PhD MqU) Adapting to climate change: Identification of molecular markers associated with ocean acidification in oysters (Wayne O'Connor).

Information on any of these projects can be obtained by contacting the appropriate supervisor at the PSFI.

Aquaculture Research and Development currently being undertaken by NSW Department of Primary Industries

For the most up-to-date information on oyster research and development currently being undertaken by NSW Department of Primary Industries, please refer to its web site: www.dpi.nsw.gov.au/research/areas/production-research/aquaculture. The web site contains non-technical summaries of all research projects, scientific outputs and final reports.

Oyster Research and Development currently being undertaken in Australia

1	Project Title	Australian Oyster Industry Benchmarking Program Development
	Principal Investigator	Shane Comiskey/Rachel King
	Time Frame	2009 – 2013
	Funding Sources	Seafood CRC (2009/701)
2	Project Title	Differential accumulation of algal biotoxins within diploid and triploid Pacific oysters and Sydney rock oysters
	Principal Investigator	Dr Shauna Murray
	Time Frame	2011
	Funding Sources	UNSW, NSW DPI, ARC (LP110100516)
3	Project Title	Translating genomic discoveries into improved commercial outcomes for the South Sea Pearl Industry
	Principal Investigator	Degnan, B.
	Time Frame	2009-2014
	Funding Sources	UQ, ARC, Autore Pearling Pty Ltd, Pearl Oyster Propagators (LP130100086)
4	Project Title	Reproductive condition, marketability and survival in oyster breeding strategies
	Principal Investigator	Graham Mair
	Time Frame	2009-2013
	Funding Sources	Seafood CRC (2009/743)
5	Project Title	PhD. Development of tools for the sustainable management of genetics in polypoid Pacific oysters, *Crassostrea gigas*
	Principal Investigator	Anthony Koutoulis
	Time Frame	2010 - 2013
	Funding Sources	University of Tasmania and Seafood CRC (2010/724)
6	Project Title	Aquatic Animal Health Subprogram: understanding and planning for the potential impacts of OHsV1 on the Australian Pacific oyster industry
	Principal Investigator	Dr Tom Lewis
	Time Frame	2011 - 2014
	Funding Sources	RDS Partners Pty Ltd and FRDC (2011/043)
7	Project Title	Adapting to climate change: does enhanced metabolism provide heritable protection against ocean acidification and increasing temperature in oysters?
	Principal Investigator	Prof Hans O. Portner
	Time Frame	2012 - 2014
	Funding Sources	ARC (DP120101946) and Macquarie University
8	Project Title	Pearl Consortium IPA: Control of reproduction of the silver-lip pearl oyster, *Pinctada maxima*.
	Principal Investigator	David Mills
	Time Frame	2012 - 2016
	Funding Sources	FRDC (2011/248) and Paspaley Pearling Company

9	Project Title	Aquatic Animal Health Subprogram: Development of a DNA microarray to identify markers of disease in pearl oysters (*Pinctada maxima*) and to assess overall oyster health
	Principal Investigator	Brian Jones
	Time Frame	2008 - 2014
	Funding Sources	FRDC (2008/030) and Fisheries WA
10	Project Title	Aquatic Animal Health Subprogram: Investigation of Chlamydiales-like organisms in pearl oysters, Pinctada maxima
	Principal Investigator	Brian Jones
	Time Frame	2008 - 2014
	Funding Sources	FRDC (2008/031) and Fisheries WA
11	Project Title	PIRSA Initiative II: carrying capacity of Spencer Gulf: hydrodynamic and biogeochemical measurement modelling and performance monitoring
	Principal Investigator	John Middleton
	Time Frame	2009 - 2013
	Funding Sources	FRDC (2009/046), PIRSA, Flinders University, UNSW, CSIRO
12	Project Title	FRDC-DCCEE: ensuring that the Australian Oyster Industry adapts to a changing climate: a natural resource and industry spatial information portal for knowledge action and informed adaptation frameworks
	Principal Investigator	Pia Winberg
	Time Frame	2011 - 2014
	Funding Sources	FRDC (2010/534), University of Wollongong, Bega Valley Shire Council, Hornsby Council, Hastings Council, Shoalhaven City Council, UTAS and NCCARF
13	Project Title	Aquatic Animal Health Subprogram: development of improved molecular diagnostic tests for *Perkinsus olseni* in Australian molluscs
	Principal Investigator	Nick Gudkovs
	Time Frame	2011 - 2014
	Funding Sources	FRDC (2011/004) and Fisheries WA
14	Project Title	Tactical Research Fund: Developing a dynamic regional brand – focus on flavour
	Principal Investigator	Heather Smyth
	Time Frame	2011 - 2013
	Funding Sources	FRDC (2010/228), Uni of Qld, Eyre Peninsula Regional Development Board
15	Project Title	Aquatic Animal Health Subprogram: Pacific oyster mortality syndrome (POMS) - understanding biotic and abiotic environmental and husbandry effects to reduce economic losses
	Principal Investigator	Richard Whittington
	Time Frame	2011 - 2014
	Funding Sources	FRDC (2011/053), University of Sydney, Hornsby Shire Council, Sydney Metro CMA

16	Project Title	Pearl Consortium IPA: improving reliability and efficiency of spat nursery and growout for the silver-lip pearl oyster (Pinctada maxima)
	Principal Investigator	David Mills
	Time Frame	2011 - 2015
	Funding Sources	FRDC (2011/236) and Paspaley Pearling Company
17	Project Title	People Development Program: Aquatic Animal Health Training Scheme – KBBE workshop on diagnostics for mollusc diseases
	Principal Investigator	Mark Crane
	Time Frame	2009 - 2014
	Funding Sources	FRDC (2009/315.24) and CSIRO
18	Project Title	Aquatic Animal Health Subprogram: Pacific oyster mortality syndrome (POMS) risk mitigation, epidemiology and OsHV-1 biology
	Principal Investigator	Richard Whittington
	Time Frame	2012 - 2015
	Funding Sources	FRDC (2012/032) and University of Sydney
19	Project Title	Workshop to facilitate epidemiological analysis of unexplained mortality of South Australian Pacific oysters
	Principal Investigator	Charles Caraguel
	Time Frame	2012 - 2013
	Funding Sources	FRDC (2012/051) and SAORC
20	Project Title	Aquatic Animal Health Subprogram: Development of a laboratory model for infectious challenge of Pacific oysters (*Crassostrea gigas*) with ostreid herpesvirus type-1
	Principal Investigator	Peter Kirkland
	Time Frame	2012 - 2014
	Funding Sources	FRDC (2012/052) and NSW DPI
21	Project Title	Tactical Research Fund: Assessment of heavy metals in tropical rock oysters (blacklip and milky) and implications for placement into the Australian seafood market and for Indigenous enterprise development in the NT
	Principal Investigator	Ann Fleming
	Time Frame	2013 - 2014
	Funding Sources	FRDC (2012/223) and NT Government
22	Project Title	Tactical Research Fund: Development and validation of effective and affordable oyster production systems in the face of POMS disease of Pacific oysters and QX disease of Sydney rock oysters – evaluation from a production, research and economic perspective
	Principal Investigator	Steven Jones
	Time Frame	2012 - 2013
	Funding Sources	FRDC (2012/229) and Aglign Consulting Pty Ltd

23	Project Title	PhD: Human enteric viruses in Australian bivalve molluscan shellfish
	Principal Investigator	Lynne Cobiac
	Time Frame	2008 - 2013
	Funding Sources	CRC (2008/741) and Flinders University
24	Project Title	National Oyster R&D – strategic R&D project commissioning, management and path to commercialisation
	Principal Investigator	Rachel King
	Time Frame	2012 - 2014
	Funding Sources	CRC (2010/747) and Oysters Australia Pty Ltd
25	Project Title	Oyster Product Development Innovation – Oyster Opening
	Principal Investigator	Karen McNaughton
	Time Frame	2011 - 2014
	Funding Sources	CRC (2011/727) and SARDI
26	Project Title	Development of an efficient diagnostic tool for assessing antiviral resistance in abalone and oysters
	Principal Investigator	Peter Speck
	Time Frame	2012 - 2014
	Funding Sources	CRC (2011/758) and Flinders University
27	Project Title	Masters: Impacts and predictive modelling of coastal upwelling on the SA Oyster Industry
	Principal Investigator	Clinton Wilkinson
	Time Frame	2012 - 2014
	Funding Sources	CRC (2011/772), University of Tasmania and Oysters Australia Pty Ltd
28	Project Title	Development and commercialisation of an oyster TTI system
	Principal Investigator	Mark Tamplin
	Time Frame	2012 - 2013
	Funding Sources	CRC (2012/703), University of Tasmania and Oysters Australia Pty Ltd
29	Project Title	Understanding how to condition the Sydney rock oyster
	Principal Investigator	Abigail Elizur
	Time Frame	2012 - 2013
	Funding Sources	CRC (2012/713), University of Sunshine Coast and Oysters Australia Pty Ltd
30	Project Title	Oysters Australia: Developing and facilitating regional grower groups to extend and build on SCRC outputs
	Principal Investigator	Tom Lewis
	Time Frame	2012 - 2014
	Funding Sources	CRC (2012/732), RDS Partners and Oysters Australia Pty Ltd

31	Project Title	Evaluating the impact of an improved retailing concept for oysters in Fishmongers
	Principal Investigator	Meredith Lawley
	Time Frame	2012 - 2013
	Funding Sources	CRC (2012/740), University of Sunshine Coast and Oysters Australia Pty Ltd
32	Project Title	Market development funding options for the Australian oyster industry
	Principal Investigator	Ewan Colquhuon
	Time Frame	2013
	Funding Sources	CRC (2012/757), Ridge Partners and Oysters Australia Pty Ltd
33	Project Title	Genetic selection for resistance to Pacific Oyster Mortality Syndrome
	Principal Investigator	Peter Kube
	Time Frame	2012 - 2014
	Funding Sources	CRC (2012/760) and CSIRO
34	Project Title	Oyster breeding program transition to full commercialisation
	Principal Investigator	Rachel King
	Time Frame	2012 - 2014
	Funding Sources	CRC (2012/773) and Oysters Australia Pty Ltd
35	Project Title	Safe spat rearing experiment
	Principal Investigator	Rachel King
	Time Frame	2013 - 2015
	Funding Sources	CRC (2013/708) and Oysters Australia Pty Ltd
36	Project Title	Piloting commercial scale supply of mass selected Sydney rock oysters
	Principal Investigator	Jane Clout
	Time Frame	2013
	Funding Sources	CRC (2013/709) and SOCo
37	Project Title	Tackling microbial related issues in cultured shellfish via integrated molecular and water chemistry approaches
	Principal Investigator	Sharon Appleyard
	Time Frame	2011 - 2014
	Funding Sources	CRC (2011/729), CSIRO and Oyster Consortium
38	Project Title	Enhancing bivalve production in northern Vietnam and Australia
	Principal Investigator	Wayne O'Connor
	Time Frame	2014 - 2018
	Funding Sources	ACIAR (FIS/2010/100)
39	Project Title	People development program: 2014 FRDC International Travel Award
	Principal Investigator	Jill Coates
	Time Frame	2014
	Funding Sources	FRDC (2008/314.40)

40	Project Title	People development program: 2014 FRDC Visiting Expert Award
	Principal Investigator	Associate Professor Dale Leavitt
	Time Frame	2014
	Funding Sources	FRDC (2008/328.20)
41	Project Title	Survey of foodborne viruses in Australian oysters
	Principal Investigator	Valerea Torok
	Time Frame	2013 - 2014
	Funding Sources	FRDC (2013/234)
42	Project Title	Identification workshop of marine invasive worm species. Such worms impact on the oyster industry, and other aquaculture activities as well as changing benthic habitats which can impact on wild stocks
	Principal Investigator	Pat Hutchings
	Time Frame	2013 - 2014
	Funding Sources	FRDC (2013/402)
43	Project Title	Australian edible oyster RD&E investment via Oysters Australia Strategic Plan 2014-2019
	Principal Investigator	Rachel King
	Time Frame	2014
	Funding Sources	FRDC (2014/405)
44	Project Title	PhD: Molecular analysis of the effects of stressors on oysters
	Principal Investigator	Abigail Elizur
	Time Frame	2011 - 2013
	Funding Sources	Seafood CRC (2011/718)

Aquaculture Research and Development currently being undertaken in Australia

Australian Centre for International Agriculture Research (ACIAR)

Active and Pipeline ACIAR Aquaculture Projects. NB. All ACIAR-funded Projects have an Australian component with the Commissioned Organisation [responsible for administering the funds] being an Australian University or State or Commonwealth Government Department or other Statutory Organisation. *More information visit* ***www.ACIAR.gov.au***

Active projects	
FIS/2013/015	Sustainable Management of Sport Fisheries for Communities in Papua New Guinea
FIS/2014/018	Understanding Pearl Oyster Mortality in Fiji
FIS/2011/069	Technical support for pearl culture in coastal Tanzania
FIS/2010/101	Improving fish health management and production protocols in marine finfish aquaculture in Indonesia and Australia
FIS/2011/038	Scoping study for fish health-mariculture and rabbitfish aquaculture development in Indonesia
FIS/2009/059	Developing research capacity for management of Indonesia's pelagic fisheries resources
FIS/2007/124	Diversification of smallholder coastal aquaculture in Indonesia
SMAR/2008/021	Spiny lobster aquaculture development in Indonesia, Vietnam and Australia
FIS/2011/031	Coral Reef Restoration using Mass Coral Larval Reseeding
FIS/2010/042	Expansion and diversification of production and management systems for sea cucumbers in the Philippines, Vietnam and northern Australia
SMCN/2010/083	Improving the sustainability of rice-shrimp farming systems in the Mekong Delta, Vietnam
FIS/2011-013	Culture-based fisheries development in Lao PDR and Cambodia
FIS/2009/041	Development of fish passage technology to increase fisheries production on floodplains in the lower Mekong and Murray-Darling River basins
FIS/2010/058	Assessing economic and welfare values of fish in the lower Mekong basin
FIS/2011/052	Improving research and development of Myanmar's inland and coastal fisheries
FIS/2010/055	Building research and project management skills in fisheries staff in PNG
FIS/2010/054	Mariculture development in New Ireland, PNG
FIS/2008/023	Increasing production from inland aquaculture in Papua New Guinea for food and income security
FIS/2010/057	Developing inland aquaculture in the Solomon Islands
FIS/2010/056	Scaling-up innovation in marine fisheries governance in Solomon Islands, Kiribati and Vanuatu
FIS/2012/074	Improving community-based fisheries management in Pacific Island countries
FIS/2009/057	Pearl industry development in the western Pacific
FIS/2010/097	Exploring options for improving livelihoods and resource management in Timor-Leste's coastal communities
FIS/2012/101	Developing technologies for giant grouper (*Epinephelus lanceolatus*) aquaculture in Vietnam, the Philippines and Australia

FIS/2010/100	Enhancing bivalve production in northern Vietnam and Australia
FIS/2012/100	Improving the design of irrigation infrastructure to increase fisheries production in floodplain wetlands of the Lower Mekong and Murray-Darling Basins
FIS/2012/102	Sustainable management of the shark resources of Papua New Guinea: socioeconomic and biological characteristics of the fishery
FIS/2012/076	Improving community-based aquaculture in Fiji, Kiribati, Samoa and Vanuatu
FIS/2010/098	Diversification of seaweed industries in Pacific Island countries
FIS/2010/096	Evaluating the impacts of improving postharvest processing of sea cucumbers in the Western Pacific
FIS/2011/030	Strategic plan for ACIAR engagement in developing Indonesia's marine fisheries research and management capacity
Recently completed projects	
FIS/2011/049	Evaluation of the potential for commercial aquaculture of the freshwater prawn Macrobrachium rosenbergii in PNG
FIS/2006/141	Improving feed sustainability for marine aquaculture in Vietnam and Australia
FIS/2011/068	Strategy for investment in fisheries in East Timor
FIS/2012/037	Preliminary trials on giant grouper maturation, spawning and juvenile production in Vietnam, the Philippines and Australia
FIS/2011/072	Pilot study for development of fish friendly irrigation and mini hydro design criteria for application in the Mekong and Murray-Darling Basins Laos
FIS/2011/071	Scoping potential livelihood benefits and costs of sport fisheries in PNG

Australian Government
Australian Research Council

Australian Research Council (ARC)

New and ongoing research projects and fellowships funded by the Australian Research Council. *For more information visit* ***www.arc.gov.au***

Project ID	Project Title
DE130101089	Understanding masculinity, the crustacean way
DP130102859	Understanding fish-killing mechanisms by harmful algal blooms: towards the design of effective mitigation strategies
DE120102459	The effects of sea-level rise on the feeding ecology of coral-reef fishes in shallow water, and the implications for reef-flat food webs
DE120102614	Monitoring coral reef health from space: how herbivore behaviour alters reef structure
DP120101946	Adapting to climate change: does enhanced metabolism provide heritable protection against ocean acidification and increasing temperature in oysters?
DP120101993	Warming up predator-prey interactions
DP120102415	What happens to coral reefs without cleaner fish?
DP120104133	Effects of invasive macrofauna on marine biodiversity and ecosystem function
IH120100032	Commercial development of rock lobster culture systems: the cutting edge of aquaculture
LP120100592	The trophic ecosystem of a purpose-built, offshore artificial reef: do coastal currents supply sufficient nutrients for the local production of fish?
LP120100652	Seascape genetics for shark management: an innovation in sustainable fisheries modelling
LP120200164	Understanding the stock-recruitment relationship to reverse the decline in the southern rock lobster
DP110100592	Stress transcriptomics: development of tests to reduce the incidence of summer mortality in abalone
DP110100695	Orientation in the pelagic environment: how do larval marine fish find their way home?
DP110100716	Changing perspective: using fish ear bones to counteract the shifting baseline syndrome
DP110104750	Can consistent individual differences in metabolic rate explain animal personality? Implications for fish and aquaculture in a warming climate
FT110100724	Understanding phenotypes: contributions from studying mutations in a model organism
FT110100990	Decoding the rules of fate, attraction and cell migration in perciform fish
LP110100516	Differential accumulation of algal biotoxins within diploid and triploid Pacific Oysters and Sydney Rock Oysters
LP110200017	Genomics for persistence of Australian freshwater fish
LP110200211	Assessing the impact of habitat restoration on the rates of recovery of four native fish species using advanced statistical models
LP110200572	Immediate and delayed changes to survival, physiology, reproduction and movement of chondrichthyans following capture stress
LP110200793	Genomic tools for the emerging tropical rock lobster aquaculture industry

LP110200825	Closing the loop: understanding the relationships between recreational fishing surveys, fishing regulations and fisheries management objectives
LP110201008	Automation of species recognition and size measurement of fish from underwater stereo-video imagery
DP1093444	More than mud: how will disruption of soft-sediments threaten coastal biodiversity?
DP1093570	Triggering the dormant capacity of fish to make omega 3 fatty acids
FT100100767	Using ancient fish ear bones to overcome the shifting baseline syndrome in freshwater fish populations
FL0992179	Adapting the sustainable exploitation of coral reef resources to provide for climate change
DE140100701	Coral communities of the Great Barrier Reef are facing multiple disturbances, in particular the coral-eating crown-of-thorns starfish Acanthaster planci (A. planci) that can occur as large-scale outbreaks. This project aims to provide innovative guidance in support of the management of A. planci, based on a metapopulation modelling framework broadly applicable to the control of marine pests. Expected outcomes include the identification of the environmental triggers of A. planci outbreaks; the identification of target reefs and critical thresholds of management intervention needed to limit the impact of A. planci under different climate and land use scenarios; and future forecasts of coral and fish biodiversity under these scenarios.
DP140100122	In a world where few intact reefs remain, the goal of this project is to find ways to restore degraded reefs. Recent research has identified the species responsible for removing harmful algae from coral reefs, while advances in mariculture provide us with the capacity to rear these critically important reef fish species. Combining captive rearing, experimental manipulations, and a global analysis of the functional capacity of herbivorous fishes, in intact, degraded and human-modified systems, the research will explore the potential for restoring, or boosting, the capacity of reefs to withstand disturbance. The goal is to provide the scientific knowledge required to directly modify the key processes operating on coral reefs.
DP140100431	The power to recognise individuals of a species requires significant image and pattern discrimination abilities. Yet, individual recognition has been found in a huge range of species, from humans to invertebrates demonstrating its importance for social interactions. The project will investigate this ability in lower vertebrates (fish, with no visual cortex), so as to understand the underlying mechanisms of pattern discrimination. The project will also test how robust this ability is during changes in water quality (elevated carbon dioxide levels and increased turbidity). The outcomes will further our knowledge base in lower vertebrate vision and evolution, and also have implications for human vision, image analysis, and artificial vision.
DP140101377	Seafood production is an important part of Australia's economy and future food security. In a dual relationship, fisheries are both vulnerable to and a cause of changes in the marine environment. This project will identify the maximum limits to Australian seafood production and will determine the impacts of future perturbations. To achieve this, the project will: combine existing rich historical data sources with state-of-the art ecosystem and fisheries models; analyse environmental impacts that will complement national fisheries stock assessments that are essential for future competitive exports; and determine our growing seafood imports and their role in Australia's and the world's food security.

DP140101537	This project is a multifaceted, innovative cultural analysis of the crucial role of fish and fishing in feeding a growing global population. Estimates are that the world's population will be nine billion by 2050. It is imperative that innovative research strategies are developed to explore how to best respond to questions of food security in a sustainable manner. This brings challenges across numerous scales, including: changing consumer tastes, new State, Commonwealth and international regimes of marine governance, and adapting fishing communities to new forms of livelihood. This project will provide the first in-depth cultural account of the complex entanglement of the economy, the environment and the humans involved in fish and fishing.
DP140101800	Preserving biodiversity in the face of environmental degradation and climate change is the greatest challenge of our time. Although habitat fragmentation is considered a key cause of the current extinction crisis, the effects of changing habitat configuration on species persistence and recovery is almost completely unknown. Coral reefs are among the most diverse and threatened ecosystems on the planet and this project will provide the first insights into how coral reef fish diversity responds to increased subdivision and isolation of reef habitat. It will identify critical aspects of habitat change that either enhance local diversity or threaten populations with extinction and provide new ecological data to refine conservation strategies.
FT130100202	Primary productivity by marine phytoplankton directly controls global climate, supports fisheries and is an indicator of marine ecosystem health. Successful management of the world's marine ecosystems rests on improving the accuracy with which primary productivity is measured and monitored. This internationally collaborative research program will develop a new sensor-based approach – fast repetition rate fluorometry – to measure different phytoplankton groups that regulate primary productivity in Australia's complex marine environments. Application of these measurements will enable more accurate monitoring of the status of Australia's marine systems to inform ocean resource management decisions in order to safeguard marine ecosystem heath.
FT130100505	The overarching aim of this project is to advance knowledge on the long-term impacts of ocean acidification on marine fish and fisheries. An interrelated set of projects will be developed that tests the capacity of marine fish to adapt to projected future rises in ocean carbon dioxide and will investigate the effects of ocean acidification on apex predators and key fisheries species. The research will address critical knowledge gaps in ocean acidification research and provide advice about the impacts of ocean acidification on marine biodiversity and fisheries productivity on time scales relevant to strategic management and policy decision-making in Australia and internationally.
FT130101068	This project will integrate comparative ecological genomics (in the wild and in the lab), phenotypic data and spatially-explicit modelling approaches to assess adaptation and vulnerability of aquatic biodiversity to environmental change. It focuses on a family of Australian freshwater fishes that evolved in response to hydrological disturbance and shows contemporary patterns of biodiversity shaped by hydroclimatic variation and anthropogenic pressures. The project expects to disclose a positive correlation between family-wide adaptive capacity and variance in ecological disturbance. This work will address fundamental and novel questions about factors shaping adaptation and resilience along naturally and anthropogenically disturbed ecosystems.

IH130200013	Project Seadragon will establish the world's largest black tiger prawn farm, significantly boosting the Australian aquaculture sector. To operate with maximum efficiency and maintain international competitiveness, Project Seadragon will require transformative technologies in advanced animal breeding to produce high-yielding, genetically improved, farm strains. The ARC ITRH will coalesce world-leading animal geneticists, research and service providers, and Australia's largest prawn farm, and gather the genomic resources, commercial phenotypic data, and apply cutting-edge genetic and genomic selection methodologies, leading to the most advanced and industry transformative improvement program for any aquaculture species globally.
LP130100007	Removing the impediment to large-scale selective breeding of Australian barramundi: deciphering and manipulating the genetic basis of sex change
LP130100040	Impacts of pharmaceuticals and personal care products on Australian aquatic ecosystems
LP130100118	Have we already lost the Australian lungfish?
LP130100242	A pan-genome reverse vaccinology approach to disease prevention in farmed fish
LP130100086	Translating genomic discoveries into improved commercial outcomes for the South Sea pearl industry

Notes

1. The information shown below is limited to that which was current at the time research proposals were approved for funding and accordingly excludes any post-award variations that may subsequently have been approved.
2. Data were retrieved from the ARC database using the research classification codes specified on 'code' sheet to match the projects that contain such codes, which were nominated by researchers at the time applying for ARC grants. Keywords 'fish' and 'oyster' were also used to search project title and abstract.
3. Projects were further vetted for relevance to aquaculture and fishery.

Australian Government
Fisheries Research and Development Corporation

Fisheries Research and Development Corporation (FRDC)

The Fisheries Research and Development Corporation plans, invests in and manages fisheries research and development throughout Australia. It is a federal statutory authority jointly funded by the Australian Government and the fishing industry. *For more information visit:* ***www.frdc.com.au***

Project ID	Project Title
2006/235	Rocklobster Propagation Subprogram: commercially viable production of temperate rocklobster (Jasus spp.) puerulus from eggs
2007/319	Implementation of FRDC People development program
2008/031	Aquatic Animal Health Subprogram: Investigation of Chlamydiales-like organisms in pearl oysters, Pinctada maxima
2008/039	Aquatic Animal Health Subprogram: Strategic planning, project management and adoption
2008/041	Aquatic Animal Health Subprogram: Tools for investigation of the nodavirus carrier state in marine, euryhaline and freshwater fish and control of NNV through integrated management
2008/202	Towards reliable hatchery-produced quality blue mussels: an integrated approach to optimising supply
2008/218	Atlantic Salmon Aquaculture Subprogram: extension funding application- AGD Vaccine phase III
2008/227	ASBTIA: SBT Research Program - Coordination, facilitation and administration
2008/228	ASBTIA: Maintaining SBT High Health Status - understanding SBT parasites and investigating ways to mitigate their influence on SBT production
2008/314.29	People development program: 2012 FRDC International Travel Bursaries - Dr Joy Becker
2008/318.15	People development program: 2012 FRDC governance scholarship for women - Claire Webber
2009/032	Aquatic Animal Health Subprogram: Characterisation of abalone herpes-like virus infections in abalone
2009/044	Aquatic Animal Health Subprogram: surveys of ornamental fish for pathogens of quarantine significance
2009/046	PIRSA Initiative II: carrying capacity of Spencer Gulf: hydrodynamic and biogeochemical measurement modelling and performance monitoring
2009/055	El-Nemo SE: adaptation of fishing and aquaculture sectors and fisheries management to climate change in South Eastern Australia Work Area 4, Project 1 Development and testing of a national integrated climate change adaptation assessment framework
2009/206	Development of octopus aquaculture
2009/208	Developing clam aquaculture in Australia: a feasibility study on culturing Donax deltoides and Katelysia sp on intertidal and subtidal leases in South Australia
2009/303	Australasian Aquaculture 2010 to 2014
2009/303.20	People Development Program: Australasian Aquaculture 2010 to 2014 (Bursary Sponsorships)

2009/315.12	People development program: 2011 Aquatic Animal Health Training Scheme - Cassandra Ypelaan
2009/315.15	People development program: Aquatic animal health training scheme - workshop on aquatic animal disease surveillance
2009/315.22	People development program: Aquatic Animal Health Training Scheme - Josiah Pit
2009/315.23	People development program: Aquatic animal health training scheme - Visiting Expert Dr Teruo Miyazaki
2009/322	People Development Program: Building seafood industry representational capacity
2010/036	Aquatic Animal Health Subprogram: Improved fish health management for integrated inland aquaculture through Better Management Practices (BMPs)
2010/051	PIRSA Innovative Solutions 3: biosecurity risk assessment and development of standardised mitigation for tuna and finfish aquaculture
2010/063	Atlantic Salmon Aquaculture Subprogram: evaluation of approaches to improve sediment remediation (rate & function) under salmonid fish cages
2010/201	Feasibility study for integrated multitrophic aquaculture in southern Australia
2010/202	Tackling a critical industry bottleneck: developing methods to avoid, prevent and treat biofouling on mussel farms
2010/212	Further development of commercialization of Artemia culture
2010/219	Tactical Research Fund: Establishing regional indicators of social sustainability in the Tasmanian aquaculture industry - a pilot study
2010/233	PIRSA Innovative Solutions: Investigations to address key policy gaps associated with the development of clam farming in South Australia: genetic and health issues aligned to translocation and stock identification
2010/234	PIRSA Innovative Solitions 3: Feasibility study on the establishment of harlequin fish (Othos dentex) aquaculture in South Australia
2010/305	Extension of OH&S and Quality Index project outputs to seafood industry across Australia
2011/003	Aquatic Animal Health Subprogram: Investigations into the genetic basis of resistance to infection of abalone by the abalone herpes-like virus
2011/005	Aquatic Animal Health Subprogram: Investigation of inclusions in Australian prawns
2011/041	Atlantic Salmon Aquaculture Subprogram: assessment of the environmental impacts & sediment remediation potential associated with copper contamination from antifouling paint and associated recommendations for management
2011/042	Atlantic Salmon Aquaculture Subprogram: clarifying the relationship between salmon farm nutrient loads and changes in macroalgal community structure/ distribution (Existing Student Support)
2011/046	Tactical Research Fund - Aquatic Animal Health Subprogram: Disease risk assessment for abalone stock enhancement program
2011/069	Atlantic Salmon Aquaculture Subprogram: The effects of AGD on gill function - use of a perfused gill model
2011/070	Atlantic Salmon Aquaculture Subprogram: Comparative susceptibility and host responses of endemic fishes and salmonids affected by amoebic gill disease in Tasmania
2011/071	Atlantic Salmon Aquaculture Subprogram: AGD resistance - learning from other species to bolster the natural Atlantic salmon response

2011/086	Atlantic Salmon Aquaculture Subprogram: macroalgal monitoring in Macquarie Harbour, Tasmania
2011/235	Atlantic Salmon Aquaculture Subprogram: design, testing and assessment of seal exclusion systems for salmon (Salmo salar) farm netpens and leases in Tasmania
2011/238	Feasibility study for establishing an APFA model prawn farm in Qld
2011/241	Tactical Research Fund: Development of a commercial control treatment for sepulid tube worm fouling at Port Phillip Bay mussel farms
2011/245	Tactical Tesearch Fund: Research methods to manage pathogenic microbiological and biological organisms within a redclaw (cherax quadricarinatus) egg incubator hatchery to improve survival and reliability
2011/246	Opportunities and constraints on Australian wild fishing and aquaculture under a carbon economy
2011/253	Innovative Solutions for Aquaculture: development of a sustainable South Australian macroalgal aquaculture industry
2012/001	Aquatic animal health subprogram: Strategic planning, project management and adoption
2012/002	Aquatic Animal Health Technical Forum
2012/024	INFORMD Stage 2: Risk-based tools supporting consultation, planning and adaptive management for aquaculture and other multiple-uses of the coastal waters of southern Tasmania
2012/030	Prawn Superpowers Summit - enhancing awareness of emergency aquatic animal disease response arrangements for the Australian prawn farming industry
2012/031	Australian abalone industry emergency disease response awareness workshop
2012/035	Bio-Security Awareness Workshop
2012/036	Revitalising estuaries and wetlands for carbon sequestration, biodiversity, fisheries and the community
2012/040	Tactical Research Fund: development of a risk management plan for marine biotoxins in Tasmanian abalone
2012/044	Aquatic Animal Health Subprogram: Exercise Sea Fox: testing aquatic animal disease emergency response capabilities within aquaculture
2012/047	Atlantic Salmon Aquaculture Subprogram: characterising benthic pelagic interactions in Macquarie Harbour - organic matter processing in sediments and the importance for nutrient dynamics
2012/048	Atlantic Salmon Aquaculture Subprogram: Culture and cryopreservation of Neoparamoeba perurans (AGD)
2012/053	Atlantic Salmon Aquaculture Subprogram: assessment of Orthomyxo-like virus pathogenicity in Atlantic salmon
2012/060	Review of the 2012 paralytic shellfish toxin non-compliance incident in Tasmania
2012/208	The Tasmanian Freshwater Eel Industry - an industry development and directions plan.
2012/213	Developing jungle perch fingerling production to improve fishing opportunities
2012/217	Atlantic Salmon Aquaculture Subprogram: trial of a stock protection system for flexible oceanic fish pens
2012/220	Tactical Research Fund: sea ranching trials for commercial production of greenlip (Haliotis Laevigata) abalone in Western Australia

2012/228	Atlantic Salmon Aquaculture Subprogram: UTAS Experimental Aquaculture Facility: Obtaining expert international governance, design and operational advice for the Atlantic salmon partners.
2013/004	Aquatic Animal Health Subprogram: the Neptune Project- a comprehensive database of Australian aquatic animal pathogens and diseases
2013/008	Movement, habitat utilisation and population status of the endangered Maugean skate and implications for fishing and aquaculture operations in Macquarie Harbour
2013/027	ASBTIA: Optimising the use of praziquantel to manage blood fluke infections in commercially ranched SBT
2013/222	Atlantic Salmon Aquaculture Subprogram: Innovative Seal Exclusion Technology
2013/410	RD&E capability audit and assessment for the Australian fishing and aquaculture industry 2013
2013/414	Aquatic Animal Health Subprogram: Review of vocational courses on aquatic animal health available to fisheries and aquaculture sectors in Australia
Oyster Projects	
2008/030	Aquatic Animal Health Subprogram: Development of a DNA microarray to identify markers of disease in pearl oysters (Pinctada maxima) and to assess overall oyster health
2008/314.40	People development program: 2014 FRDC International Travel Award - Jill Coates
2008/328.20	People development program: 2014 FRDC Visiting Expert Award - Associate Professor Dale Leavitt
2009/315.24	People development program: Aquatic animal health training scheme - KBBE workshop on diagnostics for mollusc diseases
2010/534	FRDC-DCCEE: ensuring that the Australian Oyster Industry adapts to a changing climate: a natural resource and industry spatial information portal for knowledge action and informed adaptation frameworks
2011/043	Aquatic Animal Health Subprogram: understanding and planning for the potential impacts of OsHV1 u Var on the Australian Pacific oyster industry
2011/053	Aquatic Animal Health Subprogram: Pacific oyster mortality syndrome (POMS) - understanding biotic and abiotic environmental and husbandry effects to reduce economic losses
2011/236	Pearl Consortium IPA: improving reliability and efficiency of spat nursery and growout for the silver-lip pearl oyster (Pinctada maxima)
2011/248	Pearl Consortium IPA: Control of Reproduction of the silver-lip pearl oyster, Pinctada maxima
2012/032	Aquatic Animal Health Subprogram: Pacific oyster mortality syndrome (POMS) - risk mitigation, epidemiology and OsHV-1 biology
2012/051	Workshop to facilitate epidemiological analysis of unexplained mortality of South Australian Pacific Oyster
2012/052	Aquatic Animal Health Subprogram: development of a laboratory model for infectious challenge of Pacific oysters (Crassostrea gigas) with ostreid herpesvirus type-1
2012/223	Tactical Research Fund: Assessment of heavy metals in tropical rock oysters (blacklip and milky) and implications for placement into the Australian seafood market and for Indigenous enterprise development in the NT.

2012/229	Tactical Research Fund: development and validation of effective and affordable oyster production systems in the face of POMS disease of Pacific Oysters and QX disease of Sydney Rock Oysters - evaluation from a production, research and economic perspective
2013/234	Survey of Foodborne Viruses in Australian Oysters
2013/402	Identification workshop of marine invasive worm species. Such worms impact on the oyster industry, and other aquaculture activities as well as changing benthic habitats which can impact on wild stocks
2014/405	Australian edible oyster RD&E investment via Oysters Australia strategic plan 2014-2019

Australian Seafood Cooperative Research Centre (Seafood CRC)

The Australian Seafood Cooperative Research Centre is Australia's first entity to stimulate and provide comprehensive seafood-related research and development and industry leadership on a national basis. *For more information visit:* ***www.seafoodcrc.com.au***

Project ID	Project Title
2008/741	PhD: Human enteric viruses in Australian bivalve molluscan shellfish
2008/749	PhD: Using the mucosal antibody response to recombinant Neoparamoeba perurans attachment proteins to design an experimental vaccine for amoebic gill disease
2008/772	Education and training exchange program with NOFIMA, a world leading aquaculture research institute
2008/793.10	Optimising quality within domestic prawn value chains
2009/701	Australian Oyster Industry Benchmarking Program Development
2009/724	Genetic technologies to support a transformation to profitability & competitiveness in F merguiensis and P Monodon
2009/725	PhD: Sustainable aquaculture development through effective policies
2009/730	Development of barramundi selective breeding entity II
2009/743	Reproductive condition marketability and survival in oyster breeding strategies
2009/775	Prevention of "muddy" taints in farmed Barramundi
2009/787	The Whole Prawn - Prawn Market Access Defenders
2010/704	Maximising the value by minimising stress in Abalone - Optimising Harvesting strategies
2010/722	PhD: Optimising prawn nutrition for growth performance under suboptimal conditions
2010/724	PhD: Development of tools for the sustainable management of genetics in polyploid Pacific Oysters, Crassostrea gigas
2010/727	PhD: Molecular assessment of spawning cues in temperate abalone
2010/728	PhD: Development and optimisation of anaesthetics for use in the abalone aquaculture industry
2010/736	Development of formulated diets for cultured abalone
2010/747	National Oyster R&D - strategic R&D project commissioning, management and path to commercialisation
2010/755	PhD: Development of sperm refrigeration and cryopreservation techniques in greenlip and blacklip abalone
2010/757	PhD: Reducing the taint in Barramundi farmed in recirculating freshwater systems
2010/767	Prevention and control of maturation to address multiple key abalone production constraints
2010/768	Broodstock and genetic management for SBT and YTK
2010/770	Australian Seafood Apprentice Chef and Commercial Cookery Online Training Series (Curtin University and West Coast Training Institute)
2010/771	Alleviation of Summer Gut Syndrome in Tasmanian Atlantic Syndrome
2010/779	The SCRC skills audit and articulation into the National Seafood Industry Training Package
2010/780	PhD: Molecular and quantitative genetics studies to improve breeding programs for key Australian aquaculture species

2011/701	PhD: Atlantic salmon gastrointestinal health and productivity
2011/718	PhD: Molecular analysis of the effects of stressors on oysters
2011/724	The development of an Australian Cobia aquaculture industry
2011/726	Wanted Dead or Alive: Novel Technologies for Measuring Infectious Norovirus Particles
2011/728	Enhancing survival in aquaculture (specifically P.monodon) by creating a Heterosigma algal identification unit
2011/730	Development of germ cell transplantation technology for the Australian aquaculture industry
2011/731	Optimising External Colour in Farmed Crustaceans, using Penaeus monodon as a model species.
2011/735	An evaluation of the options for expansion of salmonid aquaculture in Tasmanian Waters
2011/736	National Prawn Market Category Planning
2011/748	Time-temperature monitoring for maximising returns through the supply chain
2011/751	PhD: Improvement of abalone nutrition with macroalgae addition
2011/754	Development of finfish aquaculture in Western Australia: Removal of barriers to profitable production
2011/758	Development of an efficient diagnostic tool for assessing antiviral resistance in abalone and oysters
2011/761	Optimisation of viral clearance from broodstock prawns using targeted RNA interference
2011/771	Genetic selection for Amoebic Gill Disease (AGD) resilience in the Tasmanian Atlantic salmon (Salmo salar) breeding program
2011/772	Masters: Impacts and predictive modelling of coastal upwelling on the SA Oyster industry
2012/708	Quantifying physiological and behavioural responses of cultured abalone (molluscs) to stress events
2012/713	Understanding how to condition the Sydney Rock Oyster
2012/723	Performance of Barramundi from widespread genetic sources in diverse grow out environments
2012/729	Biofloc research extension project
2012/732	Oysters Australia: Developing and facilitating regional grower groups to extend and build on SCRC outputs
2012/738	Determination of the baseline levels of TPH and nutrient levels in a proposed aquaculture zone
2012/740	Evaluating the impact of an improved retailing concept for oysters in Fishmongers
2012/755	Visiting Expert: Dr John Taylor visit to Tasmania
2012/756	Aquaculture production innovation hub: Phase II - communication, extension and opportunities (formerlly 2008/902)
2012/760	Genetic selection for resistance to Pacific Oyster Mortality Syndrome
2012/767.10	Aquaculture Genetics Services Unit
2012/772	Ongoing Salmon research in the new Utas Aquaculture Research Facility
2012/773	Oyster breeding program transition to full commercialisation
2013/700	Yellowtail Kingfish genetics: commercialisation strategies
2013/701	Ninth International Conf on Mulluscan Shellfish Safety Sponsorship
2013/707.01	Oyster chain market strategy meeting 19 March 2013
2013/708	Safe spat rearing experiment
2013/709	Piloting Commercial Scale Supply of Mass Selected Sydney Rock Oysters
2013/710	Securing the future of SBT propagation R&D

2013/726	Utilisation of improved varieties of soybean meal and poultry offal meal by barramundi (*Lates calcarifer*)
2013/729	Promoting marine finfish aquaculture in NSW
2013/730	Refining Yellowtail Kingfish feed management and understanding their dietary requirements
2013/731	Improving Fluke control in YTK and reducing risk through better farm management practices
2013/732	Avoiding the pitfalls of modified atmosphere packaging
2013/733	Interactive seafood packaging Master Class
2013/735.01	SafeFish Website
2013/737	Propagation of South Bluefin Tuna - Addressing constraints to larval rearing
2013/744	Phase 2: Evaluation of the impact of TV and other forms of advertising and its effect on consumer behaviour for Tassal Tasmanian Atlantic Salmon
2013/752	Setting directions for the Australian Barramundi Farmers Association
2014/707	Evaluation of Atlantic salmon and brown trout hybrid as an experimental and/or commercial animal for reduction of impact of AGD
2014/708	Stamping quality across the Australian Farmed Barramundi Industry

Recently completed projects	
2008/763	PhD: Quality, shelf life and value adding of Australian Oysters (Tom Madigan)
2008/903	Understanding Yellowtail Kingfish
2008/904	Benefit-cost analysis marker assisted selection in Australian aquaculture species
2009/726	Southern Bluefin Tuna Larval/Juvenile Rearing
2009/728	Sustainable feeds and Feed Management for Yellowtail Kingfish
2009/738.01	Development of a business plan for Barramundi selective breeding entity - expenses
2009/749	Improvements in Yellowtail Kingfish larval and juvenile survival and quality
2009/752	Overseas Market Access for Shellfish
2009/759	Towards all female *P. monodon* populations using androgenic gland manipulations
2009/760	PhD: Development of vision and first feeding behaviour of Southern Bluefin Tuna and Yellowtail Kingfish (Pollyanna Hilder)
2009/786	The Whole Prawn - Prawn value chain analysis
2010/707	Loss minimisation in farmed prawns through improvements in shelf-life and colour
2010/715	Cobia Market Analysis
2010/725	PhD: Capturing and maintaining genetic variation when initiating selective breeding programs for aquaculture (Shannon Loughnan)
2010/731	Discovery and manipulation of Neoparamoeba perurans aquaporins as a means to treat amoebic gill disease (AGD)
2010/734	Oyster over catch: cold Shock Treatment
2010/741	Synopsis of AGD research to date and review/recommendation of future AGD related R&D directions including the development of a vaccine for AGD.
2010/750	Improving hatchery production of Southern Bluefin Tuna larvae and juveniles
2010/753	Improving hatchery production of Yellowtail Kingfish larvae and juveniles

2010/778	Optimising harvest practices for Yellowtail Kingfish
2011/702	PhD: An investigation of pathogenic bacterial populations in Atlantic Salmon (*Salmo salar L.*) (Eva Hatje)
2011/721	Understanding and Minimising 'Greying' of Farmed Barramundi fillets
2011/729	Tackling microbial related issues in cultured shellfish via integrated molecular and water chemistry approaches
2011/733	Evaluation of survival and pathology of juvenile yellowtail kingfish (Seriola lalandi) after injection with an autogenous, killed vaccine for Photobacterium damselae ssp. damselae at the Port Stephens Fisheries Institute
2011/734	Controlling biofouling of pond aerators on marine prawn farms
2011/740	Addressing the causes of early mortality in hatchery produced YTK larvae
2011/765	Masters: Investigating barriers to Yellowtail kingfish culture in WA: Parasites affecting flesh quality (Rowan Kleindeniest)
2012/703	Development and commercialisation of an oyster TTI system
2012/716	PhD Extension: RNA interference (RNAi) as a means to control Neoparamoeba perurans, the causative agent of amoebic gill disease (AGD) (Paula Lima)
2012/731	Optimising industry adoption: Case studies on the efficacy of current Australian Seafood SCRC research extension processes.
2012/737	Yellowtail kingfish health workshop and feed analysis
2012/753	RTG: Analysis of gene expression and function involved with fat deposition in Yellowtail Kingfish, using RNA-seq data, NOFIMA, Norway (Paul Whatmore)
2012/754	Visiting Expert: Weaning of SBT larvae; training of CST Hatchery staff
2013/718	RTG:To learn practical skills in conducting viral disease challenge techniques in Penaeid prawn species using white-spot syndrome virus (WSSV) as a model virus to be conducted at Shrimp Biotechnology Business Unit (BIOTEC), Pathumthani, Thailand. (Applicant: Dan Pountney, PhD Student, UTAS)
2013/719	RTG: To gain hands on experience to determine GSM/MIB (taint causing agents) in Barramundi, The University of Ave, Clarksville, USA (Applicant: Priyantha Indrajith Hathurusingha, PhD Student, The University of Adelaide)
2013/722	Seafood Executive Program Bursaries, Gail Thiele,Barramundi Gardens; Mark Boulter ,SFM; Stefan Diacos,Raptis