Innovation is borne of our personal drive and culminates when it is taken for granted by the end-user.

-Len Stephens
By contributing cash and resources to become participants in the Seafood CRC, a group of 39 public, private, commercial and government end-users established partnerships that were unreservedly concerned with delivering usable research outputs.

The resulting outputs ranged from technology taken up by business enterprises to improve production and marketing of seafood, through to new knowledge and capacity created within governments and research institutions. The common thread to all Seafood CRC projects was a clear path to market and adoption of the results of research by an end-user. This maxim underpinned virtually all discussions with project leaders during the life of the Seafood CRC.

The concept worked because people were willing to work together. It was such a “buzz” to see collaborations deliver results time and again. While the CRC’s management framework worked to support collaboration and innovation, it was the personal drive of individuals that invariably made the difference.

After eight years operation of the Seafood CRC, a fitting end-note is the observation that the better the innovation, the faster it was adopted by the end-users and the more rapidly it became taken for granted as part of normal operations. Some examples are given in this book.

It’s a great story of One CRC. Congratulations to everyone involved.

Len Stephens – Managing Director
The Australian Seafood Cooperative Research Centre (CRC) was formed in 2007. Its mission was to contribute to the economic growth and the industrial and commercial success of the Australian seafood industry by assisting end users to profitably deliver safe, high-quality, nutritious Australian seafood products to premium markets, domestically and overseas. Its promise was that the scope of the CRC’s research would span the entire value chain – from production to consumer.

The CRC had four planned outcomes, which were encapsulated as programs.

The total cash expenditure by the CRC over its eight year life was $83 million. This was composed of $35.5 million contributed by the Australian Government and $44.5 million contributed by the 25 Core Participants and 14 Supporting Participants. In addition, in-kind contributions to the value of $68 million were provided by the Participants.

The headquarters of the CRC was based at Flinders University in Adelaide but research projects were conducted all over Australia and in China. The CRC was given an extension of 12 months in 2014 and will cease operations in June 2015.
Programs

1. Production Innovation aimed for a substantial increase in the production and profitability of selected wild-catch and aquaculture species.

2. Product and Market Development was given responsibility for increasing demand and access to premium markets for Australian seafood while fulfilling consumer demands for safe, high-quality, nutritious seafood products and increasing profitability throughout the value chain.

3. Communication and Education’s goal was to deliver additional outcomes in the form of skilled scientists, industry-ready graduate students, informed industry personnel and increased social capital among all participants.

4. Commercialisation and Utilisation was directed to the delivery of the outputs from the other three programs.
Throughout its eight years the CRC Board has had the benefit of Directors who have brought a wide range of knowledge and skills to the table. However, as important, they have had the personal qualities needed to make the Board function effectively and harmoniously. I am grateful for the contribution that each member has made, not only to the Board, but also to the CRC as a whole with many of them taking on roles within the CRC beyond the Board room. These women and men have helped make the CRC the success that it has been.

Mr Peter Dundas-Smith (Chairman)

The Current Seafood CRC Board
Mr Peter Dundas-Smith (Chairman)
Professor Colin Buxton – Tasmanian Aquaculture
Dr Craig Foster – Clean Seas Tuna Ltd
Dr Patrick Hone – Fisheries Research and Development Corporation
Professor Pauline Mooney – South Australian Research and Development Institute
Mr Bryan Skepper – Sydney Fish Market Pty Ltd
Mr Stephen Hood – MG Kailis Group of Companies

The CRC would like to take this opportunity to acknowledge the efforts and insightful input from past Directors of the Board.
Mr Roger Cotton – Former Chairman of Southern Rock Lobster Ltd
Mr Bob Cox – Marine Culture and Australian Seafood Industries
Mr Callum Elder – Simplot Australia Pty Ltd
Mr Nick Moore – Gold Coast Marine Aquaculture Pty Ltd
Ms Erica Starling – Indian Ocean Fresh Australia Pty Ltd
Mr David Thomason – David Thomason Strategy Pty Ltd and former General Manager Marketing of Meat and Livestock Australia Ltd


The Board and the CRC acknowledges the significant contribution that the late David Thomason made to the CRC and its Participants, particularly to the marketing activities of the prawn and Barramundi sectors. The loss to the CRC, the Fisheries Research and Development Corporation and to all individuals who valued his friendship and professional guidance has been greatly felt. A gentle and knowledgeable man whose legacy continues to live on. Rest in peace David.
Staff
CRC administration staff in 2014-2015
Dr Len Stephens – Managing Director
Professor Graham Mair – Manager, Production Innovation
Jane Gallagher – Manager, Product and Market Development
Helen Barraclough – China Projects Officer
Emily Marilla – Manager, Communication, Education, Training and Extension
Andrew Schiefelbein – Communications Officer
Debra D'Aluisio – Business Manager
Alison Connelly – Events Manager
Leah Ferguson – Office Manager
Past CRC staff
Bob Fleming – Commercial Processing Manager
Chelsey Parish – Communications Officer
Rachel Robbins – Communications Manager
Miles Toomey – Seafood Project Manager
Rebecca Wilson – Business Manager

The CRC Program
The CRC was established under the auspices of the Australian Government Department of Industry and Science’s Cooperative Research Centre Program. The Program was established in 1990 to improve the effectiveness of Australia’s research effort by bringing together researchers in the public and private sectors to collaborate with end users. The CRC Program links researchers with industry and government, with a focus on research application. Since the commencement of the Program, there have been sixteen CRC selection rounds, resulting in the establishment of over 200 CRCs over the life of the Program. CRCs operate across the manufacturing, information and social services, mining and infrastructure, agriculture, environmental services and medical service sectors.
Participants

CRC Core Participants
Abalone Council Australia Ltd
Australian Barramundi Farmers Association
Australian Council of Prawn Fisheries Ltd
Australian Prawn Farmers Association
Clean Seas Tuna Ltd
Curtin University of Technology
Fisheries Research and Development Corporation
Flinders University
The University of the Sunshine Coast
Oysters Australia Ltd (formerly the Oyster Consortium)
The South Australian Research and Development Institute
Southern Rocklobster Ltd
Sydney Fish Market Pty Ltd
Tasmanian Seafoods Pty Ltd
Tasmanian Salmonid Growers Association Ltd
University of Tasmania
Western Australian Fishing Industry Council
Western Australian Chemistry Centre
Western Australian Department of Fisheries

Seafood CRC Supporting Participants
Australian Abalone Growers Association Inc
Challenger Institute of Technology
CSIRO
New South Wales Department of Primary Industries
Marine Fish Farmers Association of Western Australia
Mures Fishing Pty Ltd
Northern Territory Department of Resources
Queensland Department of Agriculture and Fisheries
Ridley AgriProducts Pty Ltd
Simplot Australia Pty Ltd
South Australian Marine Scale Sardine Industry Association
Southland Fish Supplies Pty Ltd
Tassal Operations Ltd
University of Adelaide
University of South Australia

Retired Participants
Seafood Services Australia Ltd
Southern Adelaide Health Service
Lonsec Ltd
TASEA Enterprises Ltd
O’Donohue Filter Sand and Gravel Pty Ltd
Southern Bluefin Tuna is one of the most highly prized fish in the world, particularly by Japanese consumers who pay up to $30 per kilogram for whole fish, which are consumed as raw sushi or sashimi.

In 2008, the CRC in collaboration with major tuna farming company Clean Seas Tuna Ltd, commenced a research program to spawn captive Southern Bluefin Tuna broodstock in land-based tanks. The goal was to raise the resulting larvae in captivity to a stage when juveniles could be transferred to sea cages, reducing the reliance on wild catch fish stocks and enabling expansion of the industry which is limited by available quota.

A team of more than 50 scientists and technical staff from the South Australian Research and Development Institute (SARDI), University of Tasmania, New South Wales Department of Primary Industries, The University of the Sunshine Coast and Flinders University agreed to collaborate as part of the CRC to address this challenge.

Significant breakthroughs were made in the early years including the successful spawning of land based Southern Bluefin Tuna broodstock over four successive seasons and the world’s first production of captive bred juvenile Southern Bluefin Tuna. However, progress stalled due to problems in obtaining a reliable and predictable supply of quality eggs from the broodstock held in captivity, limiting our capacity to address the key constraints to larval rearing. The program was eventually suspended, although Clean Seas Tuna Ltd continues to conduct its own in-house research.

Subsequently, an innovative approach was initiated to develop a surrogacy technique which would enable the production of Southern Bluefin Tuna eggs by other closely related species. Early progress indicates that Southern Bluefin Tuna germ cells have been successfully implanted into developing Yellowtail Kingfish. In the long term this could enable a commercial supply of good quality fertilised Southern Bluefin Tuna eggs.

INDUSTRY AWARDS RECEIVED
• South Australian Excellence in Research Award 2010 – Collaboration
• CRC Association’s Excellence in Innovation Award 2010
• Time Magazine Best Invention in 2011 – Runner Up
Healthy fish fed on improved diets

Yellowtail Kingfish the New Sashimi

The fact that Australian diners are now offered Hiramasa Yellowtail Kingfish sashimi and sushi as often as tuna or salmon, is a direct result of ground breaking research and development undertaken by the CRC.

Working collaboratively as part of the CRC since 2007, Clean Seas Tuna Ltd has transformed Yellowtail Kingfish into a high value, domestic and export seafood industry.

This did not happen without considerable effort. The first challenge facing researchers was that despite a successful yield of juvenile fish from eggs, the survival rate to juvenile stage was less than 10% and the incidence of deformities as high as 30%.

Researchers from the South Australian Research and Development Institute, University of Tasmania, New South Wales Department of Primary Industries and Clean Seas Tuna Ltd discovered that two factors were preventing the successful rearing of the Yellowtail Kingfish larvae. These were diet and the hatchery tank environment.

A range of improvements were made to the larval husbandry and diets but the major breakthrough was the discovery that by changing the colour of the walls of the aquaculture tanks and increasing the intensity and distribution of artificial light, there was an immediate reduction in larval jaw deformities which were being caused by larvae colliding with the tank walls.

This helped them to feed more efficiently, become healthier and thrive, reducing deformity rates to below five percent and increasing survival up to 20 percent.

A second challenge appeared during the life of the CRC which threatened the very future of the Yellowtail Kingfish industry. A wide range of detrimental health issues arose resulting in unacceptably high mortality levels in production fish. At its worst, in mid-2012, mortalities reached three and a half percent of production fish per week.

Coupled with further improvements to diets and a genetic breeding program that resulted in a switch from production of essentially wild fish to selected domesticated fish, Clean Seas Tuna Ltd has now expanded its production to achieve its goal of an estimated 1500 tonnes production in 2015.

The CRC has also worked with other CRC participants in Western Australia and New South Wales and as a result of this extensive research and development portfolio, Yellowtail Kingfish production is now expected to grow to become a major sector in Australian aquaculture.

Australia is now seen as the only reliable all-year-round producer in the world of Hiramasa Yellowtail Kingfish, providing a strong potential export competitor to the high-value, seasonal 6000 tonne Mediterranean and South African wild catch market, which is consumed in Europe and Asia.
Cobia sent to market

In 2012-2013, in collaboration with the Queensland Department of Agriculture and Fisheries, Pacific Reef Fisheries Pty Ltd conducted research into larval production, nutrition and feeding. This led to the successful production of commercial quantities of Cobia over two seasons. Simultaneously, consumer research revealed a high level of consumer appeal, strong retailer acceptance and commercially competitive pricing opportunities for Cobia. In fact consumers ranked Cobia alongside salmon and Yellowtail Kingfish in terms of quality and price point. This all leads to a significant opportunity for Cobia in the domestic market, as a quality tropical fish.

Consumers ranked Cobia alongside salmon and Yellowtail Kingfish in terms of quality and price point.
Towards the Perfect Prawn

In 2014, 4000 tonnes of prawns were produced by Australian prawn farmers, with a farm gate value in excess of $66 million per annum. The farms, mainly in Queensland with a few in New South Wales, produce Black Tiger and Banana Prawns for the domestic and export market.

Due to the proximity to the Barrier Reef, water usage and discharge rates from prawn farms are tightly regulated and the industry is always seeking ways to minimise any environmental impact.

One such approach is through the creation of bioflocs in the ponds. These are aggregations of micro-organisms (principally algae and bacteria) which turn the water into a nutrient-rich microbial soup which utilises waste products from the prawns. This helps to maintain water quality and also provides a source of food for the prawns resulting in dramatically reduced water usage.

Research at Australian Prawn Farms Pty Ltd has now pioneered the use of bioflocs in with floc techniques now being applied on many Australian farms.

Unrelated to bioflocs, toxic blooms in prawn ponds caused by the microscopic algae Heterosigma are a major concern to prawn farmers because they can occur suddenly and with little warning and can result in the destruction of the entire pond population of prawns.

Innovative thinking by Australian Prawn Farms Pty Ltd, with support from Ridley AgriProducts Pty Ltd, resulted in the development of an instrument that can detect the occurrence of Heterosigma at the first sign of a bloom, giving the farmer the opportunity to respond rapidly before mortalities occur. A prototype detector has been field tested with promising results.

Red, Red Prawns

Colour is a strong determinant of retail value and consumer acceptance of prawns – the redder, the better.

The CRC evaluated the effect of a range of dietary and management parameters on post-harvest and post cooking colour of prawns and identified that, despite colour varying from farm to farm and pond to pond, there was no clear determinant of colour.

However, it was noted that short-term exposure to a black substrate or to dark coloured bins after harvest on prawn farms can enhance colour.

Although the biological mechanisms underlying this are not yet fully understood, this recommendation has been made to prawn farmers and the CRC is developing an information flyer to provide more information.
Oyster Quality – It’s All in the Genes

The process of “improving the breed” of animals and plants through natural selection is as old as agriculture but has only recently been applied to aquaculture. Scientists from the CRC are combining these established techniques with some new techniques to improve quality and production outcomes for oyster farmers.

The breeding program initially targeted growth rate as a key trait for selection but a CRC project demonstrated the better option of selecting for ‘condition’ in oysters that enables high quality oysters to be available almost year round. Innovative technology of Near Infra-Red Spectroscopy (NIRS) was developed to rapidly determine the quality of oysters and ‘condition’ has now been introduced into the program as a trait for selection.

Pacific Oyster Mortality Syndrome (POMS) arrived on Australian shores in 2010 and caused the complete loss of the Pacific Oyster industry in the Georges and Hawkesbury River estuaries in New South Wales at an estimated cost of $30 million. Thankfully this viral disease does not affect the native Sydney Rock Oyster in New South Wales but it has the potential to decimate the industry nationally if it spreads to Tasmania or South Australia where farmers grow Pacific Oysters almost exclusively. Dealing with the threat of POMS became a major priority for the industry.

CRC research confirmed that selective breeding of oysters for resistance to POMS is a realistic approach to controlling the disease. Natural challenge events and a laboratory challenge test demonstrated differences in resistance to the disease between families.

The genetic selection program has now been adapted to breed sufficient disease resistant oyster spat to serve the industry. Researchers estimate that it will be possible to breed oysters that will have an average survival in a POMS outbreak of 70% by 2018. With CRC support, the industry implemented a new levy on spat production to pay for this program.

Complementary research demonstrated that small numbers of young oysters can be isolated from the effects of an outbreak of POMS through transfer to a land-based facility utilizing filtered water, a practice which could be used as a supplement to the genetic breeding program.
New Feeds for Abalone Boost Productivity

Commercial abalone farming takes place on the Eyre Peninsula and Kangaroo Island in South Australia, in Western Australia, Victoria and Tasmania.

Around 1500 tonnes of farmed abalone will be produced in 2015–2016 with a farm gate value of US$33 per kg.

As with all aquaculture, abalone productivity relies heavily on the quality of feed, which is also one of the largest input costs for abalone farmers. Nutritionalists have long known that farmed animals require different nutrient content in their diet at various stages of growth through their life cycle. Scientists have now shown that this is also the case with abalone.

By modifying the protein/energy ratios according to the season and age of the abalone, the laboratory and on-farm trials conducted by the South Australian Research and Development Institute confirmed a 10 percent improvement in food conversion efficiency. Abalone feed manufacturers – Adam and Amos Pty Ltd, EPA Pty Ltd and Skretting Australia Pty Ltd – are now using the results of the research to improve their commercial feed formulations making the improvements available throughout industry.

Scientists have now shown that this is also the case with abalone.

Taking the Taint Out of Australian Barramundi

Taint or a ‘muddy taste’ is a problem that the hatchery production and ranching is highly prized Sandfish species, which is fortunately plentiful in Australia’s Northern Territory. China’s aquaculture industry produces a massive 150,000 tonnes of Sea Cucumber every year – but it cannot produce the highly prized Sandfish species, which is fortunately plentiful in Australia’s Northern Territory.

It is known that the taint is caused by the buildup of a compound called geosmin and its occurrence varies from farm to farm and season to season. Research conducted by CRC Participant the Queensland Department of Agriculture and Fisheries, revealed a previously unknown synergistic relationship between geosmin producing bacteria and blue green algae that can occur in rafts in fish ponds at certain times of year.

This led to the discovery that geosmin levels in ponds could be controlled indirectly by controlling the blue green algae. Consequently a range of treatments were evaluated for this purpose.

The most cost effective treatments were found to be the addition of lime or molasses to the pond water when the blue green algae blooms are observed and these treatments are now widely used across the industry in Queensland, significantly reducing the incidence of taint in the marketplace and ensuring a more pleasurable dining experience for consumers.

Sea Cucumber Ranching – A New Industry

Sea Cucumber is historically one of Asia’s most prized seafood delicacies. The Sea Cucumber’s dried body wall is revered in the Chinese diet and is considered to have significant health benefits. China’s aquaculture industry produces a massive 150,000 tonnes of Sea Cucumber every year to feed this demand – but it cannot produce the highly prized Sandfish species, which is fortunately plentiful in Australia’s Northern Territory.

Taumata Seafoods Pty Ltd is Australia’s largest exporter of Sea Cucumber and in collaboration with the CRC, the company embarked on a feasibility study to expand production by releasing cultured juveniles into the wild to increase harvest yields, a process known as ranching.

A pilot-scale hatchery and nursery were established at the Darwin Aquaculture Centre and within three years the facility was producing 20,000 juveniles a year. However, many of the barriers to large-scale hatchery production still existed, including high mortality rates during the early juvenile stages, extreme variability in growth and uncertainty around feeding requirements.

The collaborative CRC and Taumata Seafoods Pty Ltd project aimed to continue the juvenile Sea Cucumber breeding program and follow this up by seeding lagoons and estuaries which were normally inhabited by the same species.

Over six years the research program has increased the hatchery and nursery production to 100,000 juvenile Sea Cucumber a year and improved survival rates well above the target of 30 percent.

Sea ranching trials were undertaken in a lagoon in Umbakumba on Groote Eylandt in the Gulf of Carpentaria, in cooperation with Ammarpaing Enterprises a local indigenous corporation, which has now built a processing plant on the island.

The success of this innovative ranching system has proven the technical and economic feasibility of releasing hatchery-raised juveniles as a supplement to wild harvest and stimulated an exciting indigenous business opportunity.

Both the Northern Territory government and local indigenous communities have embraced the vision of a new, value-adding industry, and Tasmanian Seafoods Pty Ltd is already looking to expand its ranching activity from one site to three over the next five years.
Out of the Heat for Abalone

When the $1 million per annum Roe’s Abalone fishery in the Kalbarri region of Western Australia was decimated by a marine heatwave event in 2011, more than 99 percent of standing stock was wiped out.

Attempts to recreate small viable breeding populations from the remnant stock failed as there were too few survivors so it then became necessary to bring in stock from a different region. CRC Participant, the Western Australian Department of Fisheries was called in to re-establish the population by translocating adult abalone from outside the fishery.

The challenge in translocating any species is not to disrupt the genetic structure of the local wild population. Therefore, to better understand the genetic diversity of Roe’s Abalone in Western Australia, polymorphic markers were developed by Flinders University using a genotype-by-sequencing approach. Research using these markers found that despite the loss of most of the population of Roe’s Abalone there had not yet been any significant loss of diversity in the remnant population. Three genetically distinct groups of Roe’s Abalone were identified within Western Australia and the one genetically closest to the Kalbarri stock was identified for restocking.

Sampling of the sites where the abalone were transferred showed that the 9,000 translocated abalone have formed spawning aggregations — a positive sign that the population can be re-established.

Ongoing research has shown that while populations of crabs, scallops and corals, which were significantly reduced by the heatwave, have since recovered, the local abalone have not. Without the success of the translocation project, the fishery may have been destroyed forever.

Translocated Lobster Fit for a President

If lobster destined for the lucrative Chinese export market has to undergo a taste test, it might as well pass the lips of the country’s most powerful man.

That’s exactly what happened in Hobart in November 2014, when China’s President Xi Jinping was served a translocated lobster – an outcome of a research project conducted by the Institute for Marine and Antarctic Studies in collaboration with local fishers.

Research conducted by CRC Participant, the University of Tasmania during the early stages of the CRC established that translocating low value, small, pale yellow Southern Rocklobsters from deep-water fisheries, to shallow waters made the lobsters grow faster and turn redder. The process can more than double the value of each lobster in the Chinese market.

A commercial trial was subsequently established to translocate 160,000 lobsters over two seasons in 2012 and 2013. This resulted in an increase in quota and revenue to fishers of $6 million over the two years of the project for a total outlay of less than $250,000.

Following the success of this work, the Tasmanian Department of Fisheries agreed to vary the regulations covering the fishery to allow for translocation of 100,000 lobsters per annum, yielding an extra $10 million in export income for Tasmania.

This project was one of a suite of projects based on bio-economic modeling, which enabled the estimation of the economic consequences of potential changes to management strategies that can be implemented across an entire fishery.

CRC researchers are among the world leaders in this area and models were applied to Western and Southern Rocklobster fisheries and prawn fisheries in Queensland and South Australia which identified a range of changes that can improve the profitability of fisheries without compromising their sustainability.

These models when formally adopted into decision-making processes will enable these fishers to fish for profit rather than production.
Product and Market Development
Predictive Modelling Makes Safer Oysters

Oyster producers, distributors and retailers follow strict refrigeration regulations to ensure their products arrive at the consumer’s table in the freshest possible condition.

One of the threats to the food safety of oysters is *Vibrio parahaemolyticus* a natural bacterium found in seawater. Some strains of this species, if present at high enough levels, can cause gastrointestinal disease in humans. Yet this very bacterium can be concentrated in oysters as they pump seawater through their gills.

Temperature is a key factor in controlling *V. parahaemolyticus* levels in oysters but until recently there was insufficient information about how fast *V. parahaemolyticus* grows in Australian Pacific and Sydney Rock Oyster species at different storage temperatures.

In 2010 and 2011, a predictive model, named the *Oyster Refrigeration Index*, was produced by CRC Participant, the Food Safety Centre of the University of Tasmania and translated into a user-friendly mathematical model for use in Microsoft Excel® and on the internet.

The model, which has been field-tested with Pacific Oysters and shown to make fail-safe predictions, is now being used by oyster companies to design and monitor supply chains to maximize both oyster safety and quality.

Oyster companies have found that the model is a useful tool to validate their food safety programs for cold chain transport, provide guidance on how to best stack oysters for maximum cooling rates, and learn more about the effects of bacteria on shelf life.

A major outcome for the industry was the recognition of the model by regulatory organisations. An unexpected finding from the research was that *V. parahaemolyticus* does not grow in Sydney Rock Oysters between 4°C to 25°C and this has now led to more flexible temperature requirements to safely handle Sydney Rock Oysters and has markedly reduced transport costs.

Increasing demand and access to premium markets for Australian seafood while fulfilling consumer demands for safe, high-quality, nutritious seafood products and increasing profitability throughout the value chain.
Crab Recovery Stops Half Million Dollar Loss

Mud and Spanner Crabs are highly valuable commercial fishery products in Australia, fetching around $40 per kilogram and generating more than $150 million in retail and restaurant sales every year.

Most Mud Crabs travel to their final point of sale alive and are subjected to a range of environmental factors that can impact their condition, and therefore, their grading and retail price. A strong, healthy Mud Crab commands the highest price, so ensuring that Mud Crabs are handled, transported and stored according to best practice is essential.

Financial losses in the live crab supply chain into the Sydney Fish Market have exceeded $500,000 per annum due to quality downgrades, generally resulting from prolonged transport periods. Over 16 tonnes per year are affected, comprising approximately 5 percent of the annual throughput.

Research undertaken by CRC Participant, the Queensland Department of Agriculture and Fisheries, found that the major causes of stress included emersion (holding crabs out of water), handling disturbance and temperature changes. When Mud Crabs are out of water, but held quietly, undisturbed and in a moist environment, stress levels are low.

Mud Crabs are handled frequently at different points during the supply chain and each handling event involves physical movement of the crabs and often a degree of shock, with all such disturbances adding stress to the crabs. The major recommendation from the research was the inclusion of a recovery step within the distribution chain for live Mud Crabs, involving a purge of two to three hours where the crabs are returned to aerated water to allow excretion of accumulated ammonia.

On the back of these findings, a large-scale recovery unit was established at the Sydney Fish Market and was found to operate effectively in the high-pressure wholesaling environment, consistently returning a recovery rate of more than 50 percent, saving over $250,000 per year.

Transforming Seafood "Trash" into Treasure

What do fish carcasses, guts and heads have in common? They’re rich in protein, omega-3 oils, vitamins and minerals but often end up in the bin. In fact an estimated 10,000 tonnes of Australian seafood processing waste is produced each year.

Scientists at CRC Participant, Curtin University have been working on ways to turn this processing waste into a commercial opportunity. One method trialed is using hydrolysis of seafood processing waste for the production of oil and/or hydrolysate, which can be used in fertilisers, or as a high protein stock feed meal for poultry, pigs and possibly aquaculture.

Another is using more complex oil extraction methods to produce premium food grade oil from seafood processing waste.

These two options were progressed during 2014 with on-site and laboratory trials at SAMPi in Port Lincoln, South Australia where around 3,000 tonnes per year of tuna waste are currently processed.

SAMPi has traditionally produced a hydrolysate for agricultural purposes and recreational fishing oils and baits, and Curtin University researchers investigated how changing existing extraction processes could produce a higher quality oil and hydrolysate for higher value markets.

Feed and oil extraction trials have also been undertaken in a pilot plant at Curtin University with waste from Totoaba, Atlantic Salmon, Australian Salmon, Snapper and Trevally.

A third value added avenue being explored by the CRC with commercial collaborator Abacus Fisheries, is the extraction of mince from finfish frames and rock lobster, crab and prawn carapaces to produce reformed or extruded products for the catering market – particularly for use in institutional settings such as hospitals and aged care facilities.

Dr Janet Howieson won a Curtin University Innovation Award for her CRC work in this area.
Coast-To-Coast Collaboration on Supply Chain Efficiency

One of the most important strategic outcomes from Cooperative Research Centres, is the cut through which can be achieved by disparate research organisations collaborating on national projects.

Nowhere was that more evident than in a “coast-to-coast” supply chain research project involving CRC Participants: the Centre of Excellence in Seafood Science and Health at Curtin University, Pathwest, the Queensland Department of Agriculture and Fisheries, the South Australian Research and Development Institute and the University of Tasmania.

The proposition was that by monitoring the temperatures of seafood and applying strict handling protocols, fish suppliers could boost profitability and cut wastage.

Fremantle-based company MG Kailis agreed to implement a new Quality Index Scheme – a rapid quality measurement system that determines the freshness and remaining shelf life of whole fish.

The company also invested in temperature loggers to enable ongoing monitoring and improvement of their supply chain and introduced new unloading protocols at the boat and handling systems at the wholesaler level. At the end of the trial, MG Kailis estimated that the supply chain improvements saved the company $150,000 in prevention of drip loss alone.

Following the initial trials, standard methods for temperature logging, microbiological assessment, drip loss assessment and quality assessment of whole fish and fillets were documented.

A series of “how to” videos were also produced, to assist in staff training, and to accelerate the uptake of quality management skills at all levels of the supply chain which are available on line through the CRC website and YouTube channel as an ongoing information resource for the sector.

Curtin University and the University of the Sunshine Coast continued their collaboration during the life of the CRC creating a value chain approach to developing and exploiting new market opportunities.

In addition to supporting the Spencer Gulf Prawn Fishery in its development of a new value chain with South Australian based Drake supermarkets, capitalising on their Marine Stewardship Council accreditation, they also assisted Western Australia’s Shark Bay fishery to develop and trial new marketing and branding collateral emphasising their environmental stewardship credentials and helped Queensland’s Moreton Bay prawn fishery to align itself with the wider Moreton Bay Fresh marketing strategy, which had not previously included prawns.
Just Eat More Seafood
Baseline market research conducted early in the life of the CRC revealed a sobering challenge for the sector.

The Ehrenberg-Bass Institute of Marketing Research at the University of South Australia, Colmar Brunton, The University of Sunshine Coast and Brand Council surveyed nearly 4000 people and found that nearly a third ate seafood less than the recommended dietary intake of twice a week.

The research showed that seafood is consumed less frequently than chicken, beef and veal but surprisingly more than lamb and pork.

Australians do hold favorable attitudes toward seafood in terms of its health benefits and taste, and the majority of consumers are satisfied with their seafood purchases. They are also strongly loyal towards Australian seafood over imported products.

Canned seafood (tuna, salmon and sardines) is the most popular form of seafood, accounting for 31 percent of in-home consumption, followed by fresh fillets (18 percent). The supermarket is the most prevalent location for seafood purchases for in-home consumption, accounting for 65 percent of purchase occasions, followed by specialist seafood retailers (9 percent).

Prawns, Barramundi and the “seafood buffet” are the most popular seafood choices when dining at restaurants.

Australian consumers also value correct labeling of seafood and prefer to purchase from clean and reputable retailers.

However, despite all of these positive consumer attitudes, price remains the major barrier to increased consumption. The challenge explored during the term of the CRC was to find ways of improving the real and/or perceived affordability of Australian seafood.

Subsequent research undertaken by the University of the Sunshine Coast with 1500 new consumers identified more specific attitudes to species such as Barramundi and oysters.

Barramundi was generally viewed with pride as a distinctly Australian fish (even though much of it is imported) and there was a wide variation in taste responses, indicating the need and potential for the development of a more consistent farmed product in Australia.

Point of sale consumer research also indicated that staff and management knowledge about oysters was often deficient and poor advice to customers affected sales. This prompted a retail education campaign which directly affected purchases.

The CRC also explored how to stimulate consumption of undervalued species such as School Prawns, Australian Salmon, Silver Warehou, fresh Australian Sardines and Mackerel. Australian consumers have entrenched behavioural preferences for a narrow selection of seafood and these undervalued species generally represent less than 5 percent of customer choices.

Seeking to increase consumption by even one more seafood meal a week and changing consumer behaviour toward undervalued species with education or information, will be a difficult and slow process and this will remain a challenge for the sector after the CRC concludes.

Consumers surveyed
Value Added School Prawns
School Prawns are small and generally used for bait and food processing. In 2011, researchers from CRC Participant, the South Australian Research and Development Institute worked with the Clarence River Cooperative in New South Wales to investigate the mechanical extraction of meat from whole School Prawns as a way of developing a new revenue stream.

The ground-breaking trials used a meat/shell separator on loan from the Sydney Fish Market to achieve a cooked meat recovery of around 80 percent with no residual shell detritus. This converted the undervalued prawns into a valued ingredient, which can be used in liquid based products, such as soups, stocks and sauces. The combination of this high yield factor, with relatively low raw material costs, provided a strong boost to the commercial economics of added value products in the seafood sector.

Loving Australian Prawns
Despite the valiant individual entrepreneurial efforts of some processors, retailers and industry associations, there is no national seafood marketing strategy or levy system – something the CRC is addressing with the Fisheries Research and Development Corporation as one of its final projects in 2015.

Any future strategy will almost certainly look to the success of Australia’s first national coordinated campaign for a seafood category: Love Australian Prawns®

The Australian wild-catch and farmed prawn industry voluntarily contributed $700,000 additional cash over two years in 2013 and 2014 to fund the implementation of the Love Australian Prawns® strategy. The strategy was based on 12 months of consumer research, industry consultation, and marketing strategy development. The research found that Australians do love their prawns but see them as a dining out treat or special occasion, celebration food – particularly at Christmas and Easter.

The Love Australian Prawns® campaign, launched nationally in July 2013, aimed to grow off-peak season sales without cheapening or commoditising prawns. The goal was to remind consumers to celebrate more often by purchasing Australian prawns. As well as the new Love Australian Prawns® brand logo, three visual lifestyle scenarios were created and designed into posters to remind people at point of sale to purchase more prawns.

Easy to follow recipes were also developed, containing appetising imagery and over the three month period 750,000 recipe booklets were distributed to 833 Woolworths stores nationally.

High quality point of sale packs featuring posters, cabinet stickers, recipes, external A-Frame signs, counter cards and more, were also sent to 377 independent seafood retailers, along with instructions on how to theme stores.

The Love Australian Prawns® campaign also used social media as a support mechanism, rather than a full-frontal marketing tool. It established a Facebook page (facebook.com/loveaustralianprawns) and Twitter presence (@LoveAusPrawns) where it published activities linked to the campaign. In many circumstances the social media platforms were used to run competitions alongside media releases and promotional strategies.

CRC Participant, the University of the Sunshine Coast evaluated the first year of the campaign and found that retailers and wholesalers consistently claimed that it increased sales volume by 30 percent to 50 percent, with prices remaining strong. Of the 254 retailers surveyed 75 percent believed that the campaign contributed to increased sales – a victory for collaborative marketing.
Abalone is one of the most desirable culturally important foods in China. In 2011-12 Australian Wild Abalone exports to China and Hong Kong were worth $130 million.

However the price paid for Australian Wild Abalone has gradually declined over the last decade – from $46.30 per kg in 2000 to $39.73 per kg in 2010, a cut in real returns of up to 50 percent for some producers. This was mainly the result of competition from Chinese domestic aquaculture products. As a quota-controlled fishery with fixed supply, the Australian Wild Abalone industry has to maintain high prices to be viable. Consequently the CRC initiated research into the changing Chinese consumer preferences for abalone and ways to distinguish Australian Wild Abalone. The result was a market development and supply chain education program, Australian Wild Abalone™, which focused on quality assurance and provenance.

A certification trademark was created and is being registered in Australia, China, Japan, Singapore, Hong Kong, the USA and potentially other important markets. The trademark is underpinned by a Quality Assurance Code of Practice from harvest to export, which meets the food safety requirements of the Australian government and ensures that the product is healthy and nutritious.

In December 2013, the Australian Wild Abalone™ program was launched in Hong Kong, attracting more than 150 people from the food and beverage sector in Hong Kong, Macau and southern China. The event also focused local media attention on the food safety and sustainability credentials of Australian Wild Abalone™.

Abalone is one of the most desirable culturally important foods in China. In 2011-12 Australian Wild Abalone exports to China and Hong Kong were worth $197 million.
Towards Safer Seafood

Australia has a well-deserved reputation for quality seafood with a recent OECD report ranking it second in the world (only beaten by Denmark) ahead of the USA, the United Kingdom and Canada in quality and safety. But this doesn’t happen by chance. In 2010 the CRC established SafeFish, a partnership between industry, government and the research community to provide robust scientific and technical advice to industry and government on seafood safety issues. By building national and international technical and scientific expertise networks, SafeFish has been at the forefront of maintaining and expanding Australia’s market access by:

- completing food safety assessments on prawns, oysters, finfish, abalone and rock lobster that comprehensively demonstrate the safety of Australia’s seafood;
- providing technical advice to government trade negotiators to reopen markets;
- developing and supporting diagnostic techniques and capabilities that minimise the time taken for seafood to be tested as well as improving accuracy, to avoid unnecessary business shutdowns;
- taking the lead in international standard setting processes, such as Codex, which ensures that an Australian position is noticed and considered.

One of SafeFish’s most significant projects was evaluating the human health impact of chemical and microbial hazards associated with prawns. The research indicated a very low risk of human illness associated with the consumption of prawns produced domestically, as well as imported prawns. This finding is consistent with the public health record, which shows few reports of illness related to the consumption of prawns.

Research demonstrated an extremely low risk of marine biotoxins in Australian and New Zealand abalone products causing human illness. Only one product format (viscera sashimi) was identified as having a low to moderate risk, translating to a relatively low risk of losing market access.

SafeFish has also played an important international role, providing expert technical input to the Codex Committee for Fish and Fisheries Products. Issues successfully addressed included developing a more flexible approach to marine biotoxin testing, removing the requirement for microbiological testing of eviscerated scallops, including short-haul fishery practices into the Scallop Code of Practice and reducing testing requirements for shellfish entering the EU.

A cost benefit analysis undertaken by the CRC in 2013 conservatively estimated that there has been an 11:1 return on the industry’s investment in SafeFish. The CRC is attempting to secure ongoing support from a range of agencies to ensure SafeFish’s important work will continue after June 2015.
Free Trade Agreement (FTA) a Success

The FTA between Australia and China, announced in November 2014, was not just a breakthrough for Australian trade – it was a major win for the CRC’s Seafood Trade Advisory Group (STAG).

The Australian Wild Abalone and Rock Lobster industries are Australia’s most valuable edible fisheries exports, contributing in excess of $1.25 billion in gross domestic product and supporting an estimated 8500 jobs in regional and coastal communities. The FTA is expected to increase the value of the direct trade in Australian Wild Abalone and Rock Lobster to more than $600 million a year – an important outcome for these sectors. However, every seafood producer in Australia will benefit from increased market competitiveness, improved certainty and transparency, a growth in seafood demand through strategic brand building, better market share and higher prices.

Australia also has the potential to improve its brand recognition and compete more effectively with competitors such as Chile, Canada and the United States of America.

The STAG was established by Australian Wild Abalone and Rock Lobster exporters, in conjunction with the CRC and the Fisheries Research and Development Corporation in 2013 and was one of the key advocates for the liberalisation and development of direct trade between Australia and China.

STAG acted as a conduit between industry and government on trade and access issues in relation to all major markets into which Australian Wild Caught Abalone and Lobster are currently or potentially exported.

What the Free Trade Agreements Mean

Australia not only concluded long trade negotiations with China in 2014 with the China Free Trade Agreement but it also signed FTAs with Korea (KAFTA) and Japan (JAEPA).

<table>
<thead>
<tr>
<th>Oysters</th>
<th>Prawns</th>
<th>Rock Lobster</th>
<th>Abalone</th>
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<tr>
<td>• Korea: 20% tariff on fresh/ chilled prawns eliminated in six years; 20% tariff on frozen prawns eliminated within four years</td>
<td>• Korea: 20% tariff on fresh/ chilled prawns eliminated in six years; 20% tariff on frozen prawns eliminated within four years</td>
<td>• Korea: 20% tariff on rock lobsters eliminated within two years</td>
<td>• Korea: fresh abalone excluded (similar to New Zealand); 20% tariff on preserved abalone eliminated within six years</td>
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<td>• Japan: 7% tariff on fresh/frozen/smoked abalone eliminated immediately; 9.6% tariff on preserved abalone eliminated immediately</td>
<td>• Japan: tariffs eliminated on Entry Into Force</td>
<td>• Japan: 10% tariff on rock lobster (not frozen) eliminated in four years</td>
<td>• Japan: 7% tariffs on abalone (fresh/frozen and frozen) eliminated on Entry Into Force</td>
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<tr>
<td>• China: 15% tariff on fresh/chilled oysters eliminated over four years; 1% tariff on preserved oysters eliminated immediately</td>
<td>• China: 15% tariff on fresh/frozen rock lobsters eliminated in four years</td>
<td>• China: 15% tariff on rock lobster (not frozen) eliminated in four years</td>
<td>• China: 15% tariff on live, fresh or chilled abalone eliminated in four years; 10% tariff on dried, salted or frozen abalone eliminated within four years</td>
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</table>

1.3 BILLION seafood lovers from one China FTA
Database Boosts Trade Knowledge

Exports of Australian seafood amount to more than $1.25 billion a year, making it a valuable primary industry and a dynamic driver of many regional economies.

One of the roles of the CRC was to assist in the development of this export sector through improved trade and market access.

A key project was the establishment of Australia’s first Seafood Trade and Market Access Database, a subscription only website, which provides comprehensive information on statutory and regulatory aspects of international trade. This includes standards on contaminants and food additives, export tariff rates and taxes, information about trade barriers to doing business, as well as codes of practice developed by the United Nation’s Codex Alimentarius Commission on food health standards.

The database also provides a detailed resource of trade statistics from a range of exporting countries including commodity values.

The database was one of the first CRC outputs commercialized in 2008 and managed by Seafood Services Australia Ltd. The database is now managed, along with SafeFish, by the Fisheries Research and Development Corporation as part of their trade and market access program. The Fisheries Research and Development Corporation will manage ongoing development and improvement to the database, including a broadening of accessibility and a more streamlined updating process.

Seafood Quality is just an App Away

In 2014 the Queensland Department of Agriculture and Fisheries partnered with the Sydney Fish Market to develop a mobile phone App to help measure seafood quality.

The App incorporates the Quality Index (QI) method of freshness assessment, which measures changes in quality parameters of fish during storage time in ice.

The App includes all of the data and imagery for each parameter change to assist with accurate, objective measurement at sea, on the wharf, in the processing environment and even at retail level.

Previously this was only available in paper-based manuals and the CRC hopes that the wider distribution of the App will make a direct contribution to improving the freshness and quality of seafood.

The App was trialed at De Costi Seafoods, MG Kailis and the Sydney Fish Market prior to the December 2014 trade rush and the software was being fine-tuned before release in 2015.
Communication and Education
Creating Industry Ready Graduates

The Seafood CRC supported 41 PhD students, nine MSc students and 17 Honours students. Twenty two of the PhD students had industry co-supervisors and all were given many opportunities to work beside industry specialists. More than half of these students have continued their involvement with the seafood industry, working in businesses or research institutions.

A booklet entitled “Who are the Seafood CRC students?” containing student profiles, skills, abilities and employment interests, was launched at the World Aquaculture Society Conference in 2014.

Taking Training to the Next Level

One of the key responsibilities of the CRC has not just been to research and develop new technologies, but to apply that knowledge to make the seafood industry more competitive internationally. Throughout the life of the CRC a relationship was developed with Agrifood Skills Australia, the national workforce development organisation for the rural, food, beverage, meat and seafood industries through LMC Training Pty Ltd.

The result has been the modification and upgrading of the National Seafood Industry Training Package, with the inclusion of information from more than 200 CRC projects. New CRC research information led to the update of 12 units of competency ranging from production skills (disease control, water quality and environmental monitoring, feeding activities, hatchery operations and feed stock management) to marketing skills (product concept development, managing production trials, retailing fresh, frozen and live seafood and preparing, packing and dispatching non-live product). Potential new units of competency were also identified for future training packages. These included domestic and international market opportunity analysis, developing seafood waste utilisation strategies, managing aquaculture research trials and developing and implementing genetic enhancement programs.

The CRC conducted preliminary industry consultation and auditing of the subject material before lodgment with Agrifood Skills Australia and it is expected that the new and updated units will be endorsed in 2015.

Resources and products created during the life of the CRC may also be used as teaching materials by registered training organizations and these will be available from the Agrifoods Skills Australia website agrifoodskills.net.au.

New units and Modified units of competency for the seafood national training package

- Analyse domestic seafood market
- Analyse international seafood market
- Develop and implement a sea farming business plan
- Culture new aquaculture species
- Manage a farm-based aquaculture operation
- Implement low water exchange methods
- Develop and implement an aquaculture energy strategy
Master Classes for Master Managers

Raising the seafood sector professional development bar has been one of the key achievements of the CRC. Over seven years, more than 1,000 fishers, processors, retailers and managers attended specialist master classes arranged by the CRC, where 30 visiting international experts were keynote speakers or facilitators. These specialists not only imparted their specialist knowledge but they also created long term linkages and relationships with the Australian seafood industry. The master classes included:

Packaging
Vacuum Packaging
The CRC in conjunction with the South Australian Research and Development Institute, arranged for wholesalers and retailers to have a practical hands-on experience at the Multivac test kitchen in Melbourne. The smaller capacity vacuum packaging machines and manual/semi-automatic tray sealing units at the facility allowed delegates to experiment with pouches and pre-formed rigid trays for use with valve-added products.

Quality
Predictive Microbiology, Seafood Safety and Spoilage
Participants were trained in the Danish Seafood Spoilage and Safety Predictor software, the Oyster Refrigeration Index and the Vibrio model developed by CRC research.

Waste Management
Waste Minimisation and Processing Efficiency
This master class introduced participants to basic concepts of productivity improvement in the seafood sector, with a focus on small to medium enterprises. Participants learnt strategies, tools and techniques to identify waste and inefficiencies in their own businesses and were exposed to real-life case studies to demonstrate how they can improve their long-term business viability and financial returns.

People Management
Human Resources and Change Management
This master class took participants through effective human resource management strategies and provided recommendations about how employers can create positive change within teams and improve leadership skills.

Effective Business Communication
This interactive program provided participants with skills to improve their interpersonal communication in a business environment. It incorporated content similar to the Effective Communication module from the CRC’s Seafood Management Development Program.

Marketing
Introduction to Marketing
This class gave industry an overview of key marketing topics in generic terms and then provided practical tips on how to implement these concepts into their businesses.

Consumer Research and Marketing
The Oyster Refrigeration Index CRC’s consumer market research identified seafood consumption patterns and inhibitors to improve sales. Results were presented in detail and participants were able to learn how they could be implemented to create more competitive seafood businesses.

Aquaculture
Biofloc Pond Management
This initiative aimed to increase the Australian prawn farming industry’s capacity to use microbial biofloc pond production systems. Biofloc systems reduce the need for water exchange on farms by manipulating the algal content of the pond water to eliminate nitrogenous waste. The master class explained the care and skill needed in the management of the treated ponds.

Trends in Seafood Packaging
This master class enabled processors and retailers to understand how international developments in packaging technology for seafood can help extend shelf-life, retail freshness, texture and flavour. Participants were given the opportunity to have one-on-one meetings with the visiting international packaging experts to discuss their individual challenges and ideas.

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Fisheries Management
Resource Economics for Future Harvest
This master class was designed to assist participants to think economically about future harvest yields and challenged their thinking about the role of economics in fisheries management.

EnhanceFish
These classes focused on the use of EnhanceFish fishery management simulation software for developing fisheries and stock enhancement policies and plans.

Genomics
SnailBASE
Participants gained an insight into the opportunities and issues associated with the development of an international genome data collection and data sharing portal. Representatives from seven countries agreed to pursue the development of a portal and delegates agreed that the sequencing of at least one abalone species was essential to building a solid foundation for genomics research.

Specialist courses
60
Program Three / ONE CRC
From Managers to Entrepreneurs
Another practical educational opportunity offered during the CRC’s eight years was the Seafood Management Development Program which enabled individuals to think of an innovative concept to be developed through to commercialization.

The program was delivered in two main formats: an eight month program over eight weekends (where participants produced a business plan) or a four day program focusing more broadly on developing management and decision making skills.

Course topics included creative thinking and entrepreneurship, marketing products and services, learning how to evaluate business opportunities and how to become better human resource managers.

Out of the 124 participants, six industry personnel completed all modules plus an assignment and received a Professional Diploma in Entrepreneurship. The course also credited participants who obtained the Professional Diploma, 18 points towards a Masters in Business Administration (MBA) through the University of the Sunshine Coast.

Retailer’s Network Drives Innovation
Although many of the research results from the CRC are applicable to seafood retailers, project managers found that initially it was difficult to engage with them. Retailers often work with very little outside advice and it was clear that this important customer interface channel was not receiving appropriate communication or support.

To overcome this, the Australian Seafood Retailer’s Network was established by the CRC as a way of delivering research and development outputs to this group.

The inaugural two-day pilot networking event was held in Sydney in 2014 and was attended by 10 retailers to determine if there was a strong interest for an initiative of this nature.

The pilot group visited three leading Sydney retailers, toured the Sydney Fish Market and attended a workshop run by the CRC and the Australian Retailer’s Association.

The success of this workshop, which stimulated participants to change displays and improve staff training, was then followed by several other network events with retailers, retailing experts and researchers in Hobart and again in Sydney with sellout crowds and waiting lists for each event.

The network’s success has been measured through survey results and the enthusiastic attendance and support from retailers has demonstrated a strong commitment to maintain the initiative after the closure of the CRC.

Bringing Chefs, Caterers and Hospitality Staff up to Speed on Seafood
More than 35 percent of seafood sales occur through food service – restaurants, hotels, cafes and bistros. However, limited exposure to selection and preparation during training means many Australian chefs and caterers lack confidence working with seafood – and many front of house and waiting staff are also uncomfortable when answering questions from patrons about seafood provenance and taste.

Research interviews with 60 chefs across Australia conducted by the CRC revealed that there was a strong desire for greater knowledge of seafood supply chains.

In response to the research findings, eight training videos were created by Curtin University and the West Coast Institute of Training.

Eight popular Australian species used in restaurants and catering feature in the videos: Australian Rocklobster, oysters, farmed Barramundi, snapper, Australian Sardines, octopus, squid and prawns.

The training package covers topics such as processing and supply, how the seafood gets to the restaurant door, the recommended procedure for receiving and checking the condition of the seafood and, of course, cooking techniques.

The videos also have a secondary target audience – front of house and other waiting staff who often have to explain menu choices with.diners. The training will result in waiting staff being able to confidently outline where their seafood comes from and more accurately describe its texture and flavors.

To ensure industry-relevance, leading chefs and seafood experts – Pete Manifis, Josh Catalano and Don Hancey – were featured in the training videos, which are available on-line via the CRC YouTube channel youtube.com/user/TheSeafoodCRC.
Investing in the Future
Over the eight years of operation, the CRC has proudly supported 97 participants to attend a variety of educational and professional development activities in Australia and overseas. These have ranged from laboratory exchanges to collaborative research projects with other institutions outside of the CRC, from developing new markets, to improving current production operations by learning direct from other industries in Asia, Europe and the USA.

These research travel grants and bursaries have enabled researchers to seek scientific opportunities to build further research capacity in Australia for the benefit of the Australian seafood industry. Industry bursaries also supported the introduction of new technologies by CRC participants and strengthened the capacity to commercialize and utilize research outcomes.

One of the most important mantras of the CRC has been to build a well-informed, passionate and educated workforce – investments such as these have given many future leaders the confidence to take the sector into the next era.
Commercialisation and Utilisation
Magazine Tells the Seafood Story

Many of the end-users of CRC research results are in the post-harvest sector – processors, wholesalers, retailers and marketers.

While conducting research about how best to communicate to this group it was discovered that there simply wasn’t a single channel that served this group. In response, the CRC established the SeaFOOD Magazine in October 2011.

Ten issues later, the magazine is now a unique medium for businesses interested in the food aspect of our industry, as opposed to fishing and aquaculture. It is published three to four times a year and is read by more than 1,200 seafood processors, retailers, wholesalers and marketers.

In many ways, this glossy, hard copy magazine has gone against the trend to digital communication, but reader surveys have shown that there is no demand for iPad or tablet versions of SeaFOOD Magazine: it is popular as a reference resource and is shared around offices and lunchrooms.

In 2014 the CRC introduced advertising opportunities for suppliers and partners due to the demand.

Deliver commercial and practical outputs from the other three CRC programs.
Crab cakes (and one served to her royal highness)

Sardines and Crab Cakes get the Innovative Twist

Product innovation is a way to both maximize returns from previously undervalued stock and to change consumer preferences. Ground breaking research by CRC Participant The Centre of Excellence for Seafood Science and Health at Curtin University has achieved just that with two species: sardines and crabs.

Cape Le Grande Sardines

Cape Le Grande Sardines and Catalanos Seafood worked with the CRC on new product development opportunities for Australian Sardines in 2012-2013. Traditionally sardines are netted for the low value bait market. However, CRC research showed that sardines could enter the higher value human consumption market if the product was handled according to strict supply chain protocols. Curtin University surveyed chefs to understand their preferred formats, product weights and other information needed, if they were to stock a new Australian Sardine product. This research guided product development, which took place over more than 12 months. This included refining transportation and processing to ensure that every step of the pathway from boat to consumer was optimised for quality. A processing machine was imported from Sweden and installed at Catalanos Seafood’s factory in Bassendean and the raw frozen fillets were packaged in 200g or 500g retail frozen trays and a four kg carton (eight x 500g trays). Crumbed fillets were also sold in five kg packs, which provided portion control for restaurant kitchens.

The defining product difference identified by Cape Le Grande was the taste of their sardines. Supporting product information was supplied to chefs and marketing strategies were developed to assist in building demand. A follow-up survey with chefs who had tried the sardines, found a positive response, particularly the freshness and size of the fish and the convenience of the packaging. It is now up to chefs to convince consumers that the Australian product is better than the canned version but a trend to Spanish, Italian, Portuguese and Greek cuisine has meant the Cape Le Grande Australian Sardines are now selling to chefs in Western Australia and cafes as far afield as Sydney and Melbourne.

New product innovations have increased returns from sardines and crabs.
Super Seafood

In 2012 the Australian government announced that it would be reviewing and upgrading its food labeling laws. This was in response to increasing consumer concerns about food safety and composition.

The proposed legislative changes led to requests from seafood retailers, who were demanding more data on the chemical and nutritional content of Australian seafood.

The CRC found that much of the available data was more than ten years old and often relied on overseas studies.

As part of SafeFish, CRC Participant the South Australian Research and Development Institute embarked on an ambitious project to test 21 of Australia’s most popular seafood and fish species for a range of nutrients, minerals, vitamins and heavy metals.

After more than 20,000 tests the results showed that Australian seafood is not only very safe (none of the samples contained any chemicals at levels above regulatory limits) but many species are also high in Omega 3 and essential vitamins and minerals.

The project created some impressive resources such as Nutritional Information Panels for each species, Recommended Daily Intake graphics and comparative Omega 3 ratings with other foods such as chicken and beef.

The data was summarised in infographic form and published in an easy to understand Super Seafood handbook for retailers, schools and training organisations with industry also able to download the resources on-line for their own packaging and marketing use.

The data was also loaded into the FSANZ Nuttab database and provided to the FAO.

Seafood retailers are also encouraged to download the information from superseafood.com.

Dropping the Temperature on the Northern Prawn Fleet

Individual prawn trawler operators in northern Australia stand to gain financial savings and reduce environmental impact by installing new environmentally friendly refrigeration systems developed during the CRC in 2015.

The demands on refrigeration in the tropical north are extreme – the units are required to snap freeze up to five tonnes at a time of perishable product, dropping the prawns from an ambient temperature of 35°C to minus 35°C over a period of ten hours.

The freezers must also be operated in closed spaces, under heavy load, on a moving vessel, with significant vibration and exposure to corrosive salt water.

Until now this process depended on old refrigeration systems charged with the refrigerant gas HCFC-22. Some fishers can use up to 150 kg of gas in a season at an average price of $160 per kg, an overhead of more than $24,000.

Under the Montreal Protocol on Substances that Deplete the Ozone Layer, HCFC-22 will be phased out by 2016. Consequently all boats in the northern fishery zone will need to replace their refrigeration systems within the coming two years.

The CRC conducted research with the Fishing industry and refrigeration engineers to design a new system that will use new generation refrigerant gases and will operate more efficiently in tropical waters.

A prototype system has been installed on the Cairns-based commercial trawler, Gulf Bounty and its owners are already welcoming the lower cost of refrigerant gas at around $35 per kg and greatly reduced refrigerant gas loss.

The refrigeration reference design standard, operating guidelines and training materials have now been made available to the industry, which the CRC hopes will see substantial cost savings and environmental benefits across the entire northern fleet.
The Pacific Oyster Industry Buys into a Secure Future

Australian Seafood Industries Pty Ltd is a company owned by the South Australian and Tasmanian oyster industries to implement genetic breeding programs for Pacific Oysters. One of its key roles in future will be to manage the Pacific Oyster Mortality Syndrome (POMS) resistance selection program.

Initially supported with CRC commercialization funds, the industry has now obtained Australian Competition and Consumer Commission approval to charge a POMS resistance breeding levy on all Pacific Oyster spat sold by hatcheries in Australia. These funds will be used to maintain the operations of Australian Seafood Industries Ltd, and build on the research undertaken by the CRC to deliver a POMS resistant oyster to industry by 2018.

The Sydney Rock Oyster industry, through its industry owned company SOCO Ltd, has also appointed a Commercialization Manager with the interim support of the CRC. The Manager will encourage commercial hatcheries in New South Wales to increase production of genetically improved oyster spat from the CRC - supported mass selection program and to manage the transition to a family based breeding program.

Native Plum a Natural Prawn Preservative

A natural native plant extract from the Kakadu Plum, used by indigenous communities for generations, has been found to enhance the shelf life of farmed prawns. In a research project commissioned by the Australian Prawn Farmers Association, the extract significantly reduced colour deterioration and microbial spoilage of frozen and chilled, cooked farmed prawns.

Most cooked prawns are frozen for storage, regardless of whether they are caught at sea or produced in aquaculture farms. Over time, they can gradually lose their red colour and become pale and yellow, making them less attractive to the market and less valuable.

The Kakadu Plum extract used in the research trials is a natural anti-oxidant which helps retain colour, quality and freshness in the frozen prawns. The extract also has anti-microbial characteristics so that the quality of the treated prawns after 14 days was much higher than the untreated controls.

The trials confirmed that this new extract will provide an easy on-farm solution to extending prawn shelf life for the farmed prawn industry. The additive can simply be introduced into the normal glazing and brining process at a minimal extra cost so there is no downtime or additional capital investment in new technology.

The CRC has made a call for expressions of interest from companies looking to license the new prawn preservation technology. In the absence of a commercial partner to date, the Australian Prawn Farmers Association is maintaining a supply of the product for distribution to its members.
How does one calculate the benefit to the Australian community of eight years of innovative, ground-breaking seafood research and development?
It developed over 100 usable project outputs or products, which have had direct and practical application to aquaculture, ocean fisheries, domestic and export markets.

Those outcomes, in purely financial terms will have an estimated net present value of $529 million over the 15 year period from 2007 to 2022.

Financially, the CRC also exceeded expectations. Against the cash contribution of $73.5 million specified in the Commonwealth Agreement, the actual contribution was $82.5 million.

But the benefits of the CRC will also be measured in the advances made by 2,000 Australian seafood enterprises – more efficient aquaculture, better fish breeding, faster and more targeted product development, better training, enhanced safety standards, strategic trade breakthroughs and export opportunities.

It will be felt in the lives of 67 graduate students who complete their higher degrees with the support of the CRC, half of whom are already employed in and contributing to the seafood industry.

And it will be felt by millions of consumers all over the world, who will taste fresh, safe, nutritious Australian seafood.
The Legacy / CRC CRC

It will be a travesty if the investment of time, energy and money into the CRC is lost, when the organization closes in June 2015. Fortunately, a number of scientific endeavours, which began under the CRC but did not fully develop during its funding period, will be carried on by former participants.

Science
- Research into the economic and technical feasibility of deep water, off-shore aquaculture facilities, will continue to be conducted by the Port Stephens Fisheries Institute and the University of Tasmania.
- Investigation into methods of propagation of Southern Bluefin Tuna through surrogacy will continue at the University of Sunshine Coast.
- The South Australian Research and Development Institute will continue to refine techniques for distinguishing between active and inactive virus particles detected by PCR techniques for distinguishing between active and inactive virus particles detected by PCR.
- The Seafood Trade Advisory Group (STAG) was established by the CRC to support all seafood sectors to effectively and efficiently address seafood safety issues. SafeFish is a network of national and international seafood safety experts. Guided by a partnership group comprising industry, government and research providers a work program based on prioritized industry needs is developed and implemented. In 2015, Dr Anne Astin was appointed as the Chair of SafeFish and funding has been secured to continue SafeFish operations at the South Australian Research and Development Institute for at least another three years.
- The Seafood Trade Advisory Group (STAG) was formed by the Australian Wild Abalone™ and Australian Rock Lobster exporters, working with the CRC to provide coordinated, up to date, and commercial advice on trade issues impacting on industry profitability. This group played an important role during recent free trade negotiations with China and South Korea. At the Seafood Exporters Forum in November 2014, the industry agreed to continue the STAG beyond the CRC and is developing a business plan to do this.
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Aquaculture
In 2012 the Department of Industry and Science announced a $2.5 million grant to the University of Tasmania to construct an Experimental Aquaculture Facility. The facility is an important asset required by the salmon sector to conduct research that will ensure its future expansion. The facility will be used by salmon companies, feed companies, the University of Tasmania and other researchers, all of whom have been CRC Participants. The CRC contributed additional funds to the Centre to enable it to continue much of the research initiated by CRC PhD graduates and scientists.

Processing
The Curtin University Centre of Excellence for Seafood Science and Health (CESSH) was established during the CRC with additional funds from the Western Australian State Government. The Centre works closely with the Western Australian seafood processing sector and has attracted additional funding from the Fisheries Research and Development Corporation to continue and expand its operations for two years beyond the life of the CRC. Continuation of CESSH will then be in the hands of industry.

Bio-toxins
Following major market disruption as a result of toxic algal blooms in Tasmanian coastal waters, a group of CRC scientists conducting research into marine bio-toxins realized the need to significantly improve Australia’s testing and research capacity. A business case was prepared by the CRC under which all government agencies requiring bio-toxin testing services agreed to support a single entity. Following a public call for expressions of interest, Advanced Analytical Pty Ltd was awarded a contract to establish the Australian Centre for Marine Bio-toxin Testing. This Centre now operates on a commercial basis.

Industry structures
Two industry associations were established specifically to participate in the CRC. Both of these will continue to function beyond the CRC closing date. Oysters Australia Ltd was formed by associations and small companies involved in the oyster sector. With CRC support, this company now has Australian-wide membership and has become the representative service delivery body for the oyster sector, supported by shareholder levies.

- The Australian Prawn Fishing Council Ltd represents the 17 separate prawn fisheries around the coast of Australia. At the beginning of the CRC, the group was on the verge of collapse. However, with the support of the CRC, the Council now has a new constitution and Board, which is driving innovation in the sector. Members contribute their own cash to the Council.

Marketing
One of the most significant legacies of the CRC will be the establishment of a nationally coordinated seafood marketing capability by the industry. This major advance occurred largely as a result of CRC research into market development needs and commercial implementation of pilot marketing programs such as Love Australian Prawns® and Australian Wild Abalone™.
Onward – The Fisheries Research and Development Corporation

Throughout the life of the CRC there was a strong collaborative relationship with the Fisheries Research & Development Corporation (FRDC). The FRDC will continue to drive some of the major CRC legacy activities and will retain copies of all CRC materials for future reference and archiving. The CRC website, seafoodcrc.com which houses all the outputs, will be maintained for the foreseeable future and is the best source of information for anyone interested in the products of the CRC 2007 – 2015.

Acknowledgments

ONE CRC Editorial Panel
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