Strategic Planning, Project Management and Adoption of the FRDC Rock Lobster Post-Harvest Subprogram

Dr Bruce Phillips
Principal investigator

Australian Government

Fisheries Research and Development Corporation

Project No. 2003/241

FRDC Project 2003/241 Rock Lobster Post-Harvest Project 1: strategic planning, project management and adoption

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FRDC Project 2003/241 Rock Lobster Post-Harvest Project 1: strategic planning, project management and adoption (RLPHS)

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Objectives:

1. Co-ordinate the FRDC Rock Lobster Post Harvest Subprogram.

2. Conduct an annual research workshop to present outcomes from the Subprogram and to define research objectives for subsequent years.

3. Facilitate travel of the Subprogram project principal investigators, industry representatives and Subprogram Leader to biannual scientific meetings.

4. Facilitate travel of industry representatives, Subprogram Leader of the enhancement and aquaculture Subprogram, and Subprogram Leader to biannual steering committee meetings.

5. Co-ordinate the preparation of Subprogram media releases and Workshop publications.

6. Integrate with other FRDC funded rock lobster research programs including the FRDC Enhancement and Aquaculture Subprogram.

7. Co-ordinate the preparation and distribution of a biannual Subprogram newsletter.

8. Develop and maintain a strategic plan for post-harvest rock lobster research.

9. Continually supervise the scientific studies within the Subprogram

Non-technical summary:

Outcomes achieved to date

An independent Subprogram Leader, and a highly responsive Steering Committee, that is composed of industry experts from across Australia have provided an effective and efficient system for directing relevant research activities to ensure continued and increased profitability for the Australian rock lobster fisheries. The Steering Committee, under the Subprogram Leader's direction, worked as an integrated group, rather than a collection of individuals, and carefully selected and recommended projects for funding, and then followed their progress and offered advice to principal investigators in the national interest. The industry representatives on the Steering Committee have also acted to provide research facilities within the industry as the best locations to conduct research, and ensuring the uptake of successful projects as soon as they occur.

The research conducted by the Subprogram has continued to significantly improved Australia's understanding of the physiology and biochemistry of lobsters, from the time of capture through to processing in a variety of product forms. This is of considerable assistance in investigating methods of better handling, cooking, and/or processing lobsters for live export.

Studies to alleviate leg loss in western rock lobster have yielded impressive results. However, the introduction of cold-water stunning is not yet endorsed by the Subprogram, as we are awaiting confirmation that it will not cause increased mortality on undersized lobsters, not adversely effect the egg production or cause increased mortality of breeding females. A proposed investigation to determine the answer was not funded.

The dramatic effects of hypo-salinity in causing leg loss has been a major achievement, and its rapid take up by industry will cause a major reduction in leg loss and a consequent multi million dollar increase in value of the fishery.

A major method of communicating research results from the Subprogram has been the Code-of-Practice. The newly revised Code incorporates in a subtle way the best ideas from the results in a form endorsed by the industry. As a result this leads to improved post-harvest handling practices, and thereby to increased safety and profitability of the fishery. During this project a code-of-practice video was prepared for southern rock lobster and released as part of their "Clean-Green" image. This has resulted in the southern rock lobster fishery being award several awards, including the UNESCO

Studies of the methods of cooking of western rock lobsters, with the intention of alleviating the blackening of the flesh after thawing, have already indicated the source of the problem and a likely solution, and a new project to test alternative methods of cooking crustaceans was initiated.

The standard names committee has now proclaimed the rock lobsters in Australia will be called rocklobsters. This name will be adopted in future

reports, but because of the difficulty of changing to this name, it has been left as rock lobster in this report.

The mission of the RLPHS is to ensure that Australia obtains the maximum value for its rock lobster catch.

The markets for rock lobsters, and the forms in which they are sold, are constantly changing. There has been a dramatic change from frozen products to live marketing of a large portion of the catch. Almost all the southern rock lobsters are now all exported live. However, because of fluctuations in the global markets and very high catch levels, much of the western rock lobster catch is now sold in a variety of product forms. Due to these changes, industry constantly faces new challenges to retain, maintain, and expand markets and profitability.

The purpose of the Subprogram is to work with industry to identify the problems that the industry faces in meeting these challenges. It then seeks to support research studies to provide answers to the problems in a cost effective and timely manner. The outputs of the research are rapidly provided to industry in a form that allows industry to capture the benefits of the research for the Australian industry.

An independent Subprogram Leader and a highly responsive Steering Committee that is composed of industry experts from across Australia have made this possible. The Steering Committee, under the Subprogram Leader's direction, worked as an integrated group, rather than a collection of individuals, and carefully selects and recommends projects for funding, and then follows their progress and offers advice and assistance to the principal investigators, in the national interest. The industry representatives on the Steering Committee have also acted to provide research facilities within the industry as the best locations to conduct research, and ensuring the uptake of improved post-harvest handling practices as soon as they are identified.

Subprogram Strategic Plan

RLPHS established a Strategic Research Plan for the needs of the Subprogram, and this has been updated annually. A copy of the 2005-2010 plan is included as **Appendix 6**.

Subprogram management and operating procedures

To ensure that research conducted within the Subprogram was relevant and met the above criteria, a Steering Committee was established to:

1. Provide industry feedback and views;
2. Review existing research based on FRDC contractual obligations;
3. Prioritise new proposals and provide a priority list for other agencies;
4. Ensure outcomes are commercially focussed;
5. Co-ordinate industry and research provider involvement - optimum use

of resources;
6. Facilitate extension and technology transfer.

Scientific and Steering Committee meetings

Annual scientific committee meetings were convened and all meetings were minuted and actioned. Detailed copies of the minutes have not been included in this report for the sake of brevity and the confidential nature of some of the discussions. In addition, direct discussions between the Steering Committee and the principal investigators were encouraged. Written reports and brief presentations by principal investigators were followed by discussion at each Steering Committee Meeting.

Six Steering Committee meetings were held between July 2003 and June 2006. These meetings were held in Hobart, Port Lincoln, Adelaide, Melbourne and Perth.

Subprogram Workshops

An annual Workshop was convened in Perth in September 2003, in conjunction with RLEAS. A full set of proceedings was produced from this Workshop and papers relevant to this Subprogram were included. See **Appendix 3**.

An annual Workshop was convened in Port Lincoln, South Australia on 15 September 2004, jointly with the RLEAS Subprogram. A full set of proceedings was produced from this Workshop and papers relevant to this Subprogram were included. A copy of the proceedings of the Workshop is included as **Appendix 3**.

An annual Workshop was convened in Hobart in October 2005, as usual integrated with RLEAS. It was an integrated part of the industry organized 4 th National Rock Lobster Congress held in Hobart. The proceedings of the Workshop are being prepared for distribution.

Communications

Subprogram newsletters were used as a primary form of communication between the Subprogram and industry.

Annual Operating Plans

Three annual operating plans for the RLPHS were prepared over the course of this project. A copy of the annual operating plan for 2006 has been included in this report as **Appendix 5.**

Collaboration and additional funding opportunities

Additional funding opportunities were investigated for the Subprogram.

Additional funding was provided from the Geraldton Fishermen's Cooperative, the Western Rock Lobster Development Association, Development and Better Interest Fund, an Industry Development Unit of WAFIC in Western Australia, in support of the leg loss and hypo-salinity studies, and MG Kailis and Curtin University of Technology in support of Dr Hannah Williams's melanosis and cooking studies.

KEYWORDS: rock lobster, post-harvest, profitability

ACKNOWLEDGEMENTS

A special thanks to the members of the Steering Committee, Stephen Hood, Nick Polgeest, Richard Stevens, Rodney Treloggen, Patrick Hone (FRDC), Kym Redman and Tony Gibson for their commitment over the course of the project. Roger Edwards also attended a number of Steering Committee Meetings when Kym Redman was unavailable due to his fire fighting duties.

The efforts of Dr Robert van Barneveld, Leader of the FRDC Rock Lobster Enhancement and Aquaculture Subprogram and a member of the Steering Committee of this Subprogram are also acknowledged.

We wish to thank Tim Bray of the Department of Fisheries, Roger Edwards and the South Australian Lobster Industry, Katy Saunders and Seafood Industry Victoria, and Rodney Treloggen and the Tasmanian Rock Lobster Fisherman's Association for assisting with distribution of the Subprogram Newsletter.

Background

This Rock Lobster Post-Harvest Subprogram (RLPHS) was initially established in 1996. In 1999 an independent review of the Subprogram was commissioned by FRDC and conducted in September 1999. The review recommended the continuation of the Subprogram, with an increased requirement for industry to play a more dominant role in determining what, if any, research is carried out in the post-harvest sector. A new project (2000/250) incorporating these recommendations was established and commenced on 1 July 2000.

In July the Subprogram was again continued as FRDC project 2003/241. An external review of this project was conducted in November/December 2005.

A summary of the Subprogram projects and activities under Project 2003/241 is presented below:

	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08
1999/202 – Rock Lobster Autopsy Manual. PI Professor Louis Evans								
2000/250 – Facilitation, administration and promotion of the FRDC Rock Lobster Post-Harvest Subprogram. PI Professor Bruce Phillips								
2000/251 – Development of a method for alleviating leg loss during post-harvest handling of rock lobsters. PI Dr Glen Davidson								
2000/252 – Optimising water quality in rock lobster post-harvest process. PI Dr Brad Crear and Dr Stephen Battaglene								
2001/235 – Striking a balance between melanosis and weight recovery in western rock lobster. PI Dr Hannah Williams								
2001/255 – Quantifying and controlling hyper-and hypo-saline- induced post-harvest leg autonomy in the western rock lobster. PI Dr Glen Davidson								
2002/237 – A code of Practice for Handling Rock Lobster. PI Richard Stevens								
2002/ 238 – Quantification of shell hardness in southern rock lobster. PI Dr Caleb Gardiner								
2002/239 – The effect of on board cold water stunning on the survival and growth of caught and returned western rock lobsters. PI Dr Glen Davidson								
2003/241 - Rock Lobster Post-Harvest subprogram: strategic planning, project management and adoption PI Professor Bruce Phillips								
2003/342 - Value-adding the southern rock lobster fishery-optimising flesh quality of under-valued large lobsters for								

the sashimi market. PI Dr John Carragher								
Impact of heat on PPO in southern rock lobster hemolymph. PI Dr Hannah Williams								
2005/223: "Rock Lobster Post Harvest Subprogram: evaluation of alternative processing technologies applicable to crustaceans PI Dr Hannah Williams								

A new Steering Committee for the Subprogram, comprising mainly industry members**,** was appointed in 2000 and these members were continued in 2003. These members were selected on the basis of their expertise in the post-harvest area; at the same time ensuring that expertise on both the southern and western rock lobster fisheries would be available. Mr Richard Stevens is not an industry member, but is a representative for Industry; and Dr Robert van Barneveld attends as an observer. The Subprogram attempts to assist the rock lobster industry in Queensland and Torres Strait, which is concerned with tropical rock lobsters. However, there is no official member of the Steering Committee with expertise in this area.

Subprogram Projects

The following are the summary details projects within the Subprogram from I July 2003 to 30 June 2006.

Projects at start of Subprogram

1999/202: Rock Lobster Autopsy Manual

Principal Investigator: Dr Louis Evans
Curtin University of Technology
Aquatic Science Research Unit
GPO Box U1987
Perth W.A. 6845

Project Objectives:

The publication of an autopsy manual to be used in the lobster industry.

2000/251: Development of a method for alleviating leg loss during post-harvest handling of rock lobsters

Principal Investigator: Dr Glen Davidson
Geraldton Fishermen's Cooperative (originally Department of Zoology, UWA)
PO Box 23
Geraldton WA 6531

Project Objectives:

1. To identify a cold-water immersion treatment that rapidly immobilises western rock lobsters, while allowing swift recovery from immobilisation upon return to ambient temperature seawater. To investigate the effect of season/acclimation temperature on effectiveness of cold stunning in western rock lobsters. To investigate the use of sea sprays vs. immersion for cold stunning in western rock lobsters.

2. To investigate, in captivity, the effectiveness of the preferred treatment (identified in objective 1) for reducing leg loss in western rock lobsters.

3. To test the accuracy of factory grading of cold stunned western rock lobsters vs. untreated controls.

4. To describe the occurrence of leg loss, morbidity and mortality of western rock lobsters subjected to cold stunning prior to episodes of handling during the post-harvest process (i.e. at the time of pot-pulling and sorting, prior to factory grading) and to compare these to the performance of animals handled using current methods.

5. To investigate the effects of multiple simulated pot capture and release events, either with or without cold stunning, on growth, leg loss and survival of undersized western rock lobsters.

6. To compare, in captivity, effects of handling, with and without cold stunning, on the reproductive success of setose, tar spot and ovigerous female western rock lobsters. To investigate the effects of limb loss on the reproductive success of female western rock lobsters.

7. To conduct a survey to determine the extent and nature of leg loss in the southern rock lobster fisheries of Tasmania and South Australia.

2000/252: Optimising water quality in rock lobster post harvest

Principal Investigator: Dr Stephen Battaglene (originally Dr Brad Crear)
University of Tasmania
Tasmanian Aquaculture and Fisheries Institute
Marine Research Laboratories
Nubeena Crescent, Taroona, Tasmania, 7053

Project Objectives:

- Production of a manual on optimising the provision of oxygen during rock lobster post-harvest processes.

- Determine the median lethal concentration (LC-50) of ammonia to adult southern and western rock lobsters (stressed and unstressed).

- Determine the physiological consequences of exposing lobsters to sub-lethal ammonia concentrations, and the consequences of further exposing lobsters to acute post-harvest stressors.

- Production of a manual on ammonia problems during rock lobster post-harvest processes.

Quantifying and controlling hyper- and hyposaline-induced post-harvest leg autonomy in the western rock lobster

2001/255 Principal Investigator: Dr Glen Davidson
Geraldton Fishermen's Cooperative
PO Box 23
Geraldton WA 6531

Project Objectives

- Survey salinity concentrations of surface films on individual lobsters and on relevant contact surfaces on boats and within factories.

- Describe the relationship between autonomy and exposure to seawater of various salinities for lobsters of various sizes and moult stages.

- Quantify leg loss during industry standard freshwater "drowning" procedures.

- Compare responses to ionic and non-ionic solutions to elucidate the potential role of other contaminants, and the possible nature of the receptors and stimuli.

- Investigate the relationship between daily environmental conditions and levels of post-harvest leg loss.

- Field-test practical solutions for hyper/hyposaline-induced autonomy and make recommendations to industry.

2001/235 Striking a balance between melanosis and weight recoveries in western rock lobster

Principal Investigator: Dr Hannah Williams
Curtin University of Technology
School of Public Health
GPO Box U1987
Perth W.A. 6845

Project Objectives:

1. To establish the impact of temperature and food additives on the activity of *Panulirus cygnus* haemolymph phenoloxidase (PO) in vitro.

2. To establish the impact of current commercial practices on weight recovery and melanosis formation.

3. To establish the impact of post-harvest transportation on PO activity, weight recovery and melanosis formation.

4. To determine the effects of anti-browning agents on weight recovery and melanosis formation.

5. To validate the use of experimentally determined cooking profiles for improvement of cooked weight recoveries and prevention of melanosis.

6. To formulate recommendations and guidelines that will enable industry to apply the findings of the study.

2002/237 Code of Practice

Principal Investigator: Mr Richard Stevens
Abercromby Management Services P/L
21 Eckford Way
Duncraig ,W.A. 6023

Project Objectives:

To produce a Code of Practice for the handling of rock lobster.

2002/238 Quantification of shell hardness in southern rock lobster

Principal Investigator: Dr Caleb Gardner
University of Tasmania
Tasmanian Aquaculture and Fisheries Institute
Marine Research Laboratories
Nubeena Crescent, Taroona, Tasmania, 7053

Project Objectives

1. To calibrate the rate of change in shell hardness before and after the moult of southern rock lobsters relative to lobster size, sex, region and temperature.

2. To identify the region of the exoskeleton that is most suited for measuring hardness.

2002/239 The effect of on board cold water stunning on the survival and growth of caught and returned western rock lobsters (*Panulirus cygnus)*

Principal Investigator: Dr Glen Davidson
Geraldton Fishermen's Cooperative
PO Box 23
Geraldton WA 6531

Project Objectives

1. To determine the effect of commercial capture with or without cold-stunning on the survival and growth of returned protected western rock lobsters.

2. To observe and film in the wild the behaviour of western rock lobsters caught and returned with or without cold-water stunning.

New Projects added to the Subprogram

2003/242 - Value-adding the southern rock lobster fishery-optimising flesh quality of under-valued large lobsters for the sashimi market

Principal Investigator: Dr John Carragher
South Australian Research Development Institute
Adelaide
South Australia

Project Objectives

1. Determine flesh quality characteristics of commercially caught SRL from different locations, seasons, sizes, moult stages and shell colour etc.

2. Determine flesh quality characteristics of southern rock lobster held long term in tanks.

3. Correlate flesh quality indicators with data from experienced sensory analysis panels

PROGRESS

Large lobsters above 1.5 kilograms make up approximately 17% of the southern rock lobster commercial fishery. These lobsters are discounted by approximately $6/kg to sell them through the live trade market to Asia. This accumulates to $4.9 million lost annually through discounting for the combined fisheries of South Australia, Tasmania and Victoria. This is a

marketing issue, with packaging being the primary problem. The product or lobster is clearly too large or expensive on a per kg basis, once the lobsters are above 1.5kg in weight.

These issues are not specific to the lobster industry. Most primary production livestock and more recently finfish industries are progressing to selling their product in smaller value added portions. This has already started with the southern rock lobster with Ferguson Australia Pty Ltd currently marketing several lines of value added lobster products. However, unlike other industries such as beef, sheep and salmon; there existed a fundamental lack of knowledge on the base quality and variation in lobster product. With this in mind the FRDC Rock Lobster Post-harvest Sub-program funded research investigating flesh characteristics of under-valued large southern rock lobster.

Biochemical analysis of small lobsters weighing 600 grams was similar to tail meat from lobsters weighing more than 2 kilograms. There was a slight difference with small lobsters having 2% more moisture content in flesh and drip loss when stored under refrigerated conditions. These differences are not large. This was reflected with results from a trained Sensory Analysis panel where no distinction was evident between the unknown samples from large and small lobsters. These samples were presented raw in order to avoid possible confounding factors such as cooking differences between large and small lobsters. This research clearly showed that the large lobster flesh is of equal quality to that from high valued small lobsters.

The biochemistry of frozen lobster flesh was shown to change between fresh, short term frozen (3 months) and long term frozen (11 months). These changes made it easy to distinguish between different storage treatments. However, the levels of change were lower than expected when compared to changes recorded in finfish. This is most likely due to the much lower fat content of rock lobster flesh with less than 1% fat compared to levels in finfish around 10%, depending on species.

These biochemical changes were also reflected with the results from the trained sensory analysis panel. The panel found fresh flesh had more lobster flavour, was sweeter, and had less crunch, pink colour in flesh, and translucency than short term frozen samples. Despite detecting these differences the panel showed no clear preference for either short term frozen or fresh.

When the trained panel compared the fresh samples to long term frozen samples they detected the same trend with fresh samples having more lobster flavour. It was also interesting to note that there was no clear preference for long term frozen or fresh samples despite the panel being able to tell them apart. This is an indication that the sensory differences between fresh and frozen are very small. Small differences in individual samples had more effect on preference than factors such as frozen or fresh treatment. As these panellists were trained to analyse lobster flesh it was not clear if the results would reflect those of potential consumers. With this in mind a consumer panel was set up using Japanese who had recently arrived in Australia. All

the participants enjoyed eating raw seafood and were used to compare frozen and fresh lobster samples. Of the 16 panellists used only 9 were able to detect the difference between fresh and short term frozen samples. Of these nine less than half preferred the fresh samples. The Japanese panel then compared 2 week frozen samples to long term frozen samples. Only 9 were able to detect a difference and of these less than half preferred the short term frozen compared to long term frozen. For comparisons using both the trained and consumer panel there were individual panellists actually preferred the long term frozen samples over the fresh or short term samples. These results clearly show that few if any consumers are likely to detect differences in flesh characteristics during frozen rock lobster storage.

During the closed seasons of some of the southern rock lobster fisheries, consistent supply of large Rocklobsters is often not practical. To increase supply, attempts had been made to hold lobsters in tanks and feed them cheap by-catch from lobster boats. This project investigated existing methods to see if they were affecting lobster flesh characteristics. Rock lobsters were held in recirculating tanks for up to 4 months and fed exclusively 'skinned' octopus.

No biochemical differences were detected in lobsters after 1 month of feeding. By two months small biochemical differences were evident between lobsters that had been starved and those that had been fed. This was to be expected in not fed lobsters. At this stage cannibalism had become too great and the not fed treatment was discontinued. Feeding the lobsters significantly reduced cannibalism.

After 4 months of feeding rock lobsters were compared to freshly caught wild lobsters with the commencement of the new fishing season. Small biochemical differences were detected between wild and fed lobsters. Subsequent sensory analysis with the trained panel was not able to detect which lobsters were wild or had been fed octopus for 4 months. he octopus diet and extended holding in tanks had not effected flesh texture or lobster flavour. While individual panellists were able to detect the differences and showed a preference, the fact that the panel as a whole did not detect differences between fed and wild shows that any differences were small and not as pronounced as those exhibited during different lengths of frozen storage.

Lobsters that had been selected as suitable for commercial value-adding were sampled for biochemical analysis. These lobsters would have likely been selected as being those in better condition and thus may underestimate the true variation in the entire catch of southern rocklobster. Regardless these results are useful to potential processors as they would likely impose similar selection criteria. Despite this possible selection process it was shown that flesh biochemistry varied significantly between lobsters sampled on different days. This had a much greater effect on flesh biochemistry than other factors such as shell colour, haemolymph pigment colour and shell hardness. It is likely that different batches of lobsters had been subjected to different post-harvest storage times and possibly handling which was influencing flesh

biochemistry. Despite detecting these differences in the biochemistry of the lobster flesh the changes seen were small when compared to the changes seen with different times of frozen storage. These small variations seen in the large lobsters selected for processing is unlikely to be detected using sensory analysis.

The flesh of large southern rock lobsters is suitable for value adding products. The flesh of large lobsters is similar to the higher valued small rock lobsters which would indicate the discounting is not because of an actual difference in flesh quality. The product is quite stable during frozen storage and does not appear to have unfavourable or large changes in flesh quality within a year of frozen storage. This is evident with few of those panellists that detected the differences actually preferring the fresher product.

Despite some small variations in flesh biochemistry between different batches of lobsters, those selected for processing are of a consistent high quality. In addition the current practice of holding lobsters in recirculating tanks and feeding octopus was shown to produce similar high quality lobsters flesh. The use of cheap and readily available lobster fishing by-catch of octopus was able to maintain comparable flesh characteristics and significantly reduce cannibalism for up to 4 months without compromising sensory characteristics. Lobster flesh and the southern rock lobster is a product with very stable and consistent properties that appears well suited to value added products.

Curtin University Funded Project: Impact of heat on PPO in southern rock lobster hemolymph

Principal Investigator: Dr Hannah Williams
Curtin University of Technology
School of Public Health
GPO Box U1987
Perth W.A. 6845

Project Objectives

Evaluation of polyphenoloxidase activity in southern rock lobsters

PROGRESS

Each year 4-5,000 tonnes of western rock lobster are cooked and exported to countries such as Japan and Taiwan. When existing cooking methods are used a proportion of cooked western rock lobster go black, this results in a product that is unacceptable to the customer.

The blackening of the flesh is known as melanosis and is caused by an enzyme called polyphenoloxidase (PPO). Melanosis is a major problem for the western rock lobster industry and it has been estimated that it costs the industry over $1 million per year. Finding a solution to the problem of

melanosis by stopping PPO activity is therefore necessary. Currently, cooking is the most common method used in food processing to stop enzyme activity. However, as the PPO enzyme is evidently still active after lobsters have been cooked it was important to first understand what post-harvest handling and processing factors impacted on its activity.

The following factors were evaluated for all lobsters used in the study:

• Season – PPO activity and weight recoveries were collected at three different points spanning the season
• Moult stage
• Gender
• Initial PPO activity
• Protein level
• Total Phenols level

Evaluation of these factors showed no correlation to the extent of melanosis after processing. Data was also collected on post-harvest handling and processing factors such as:

• Transportation
• Holding
• Drowning
• Position in the cooker
• Anti-browning agents
• Cooking time

For each of these factors information on PPO activity and weight, before and after treatment, was evaluated.

Evaluation of current cooking procedures showed that when lobsters were heated to an internal temperature between 60 and 80°C there was a large increase in enzyme activity. It was not until after temperatures reached 90°C, or more, the enzyme activity stopped. Overall it was found that for 50% of the cooking time, temperatures only reached between 60-80°C. Therefore they did not get high enough to kill the enzyme; rather, current cooking methods actually increased the enzyme's activity.

The question was then asked as to whether or not other important commercial lobster species, such as southern rock lobster, showed a similar heat activation effect. Therefore the same series of test was carried out using southern rock lobsters caught in WA. From these tests it was concluded that southern rock lobsters also show a heat activation effect between 60 and 70°C. If future developments in the southern rock lobster fishery result in an increase in the number of southern lobsters sold as processed cooked lobster then consideration of melanosis and the impacts of processing and handling methods on PPO activity maybe come and important factor.

Simulations of existing transportation and holding conditions of lobsters before they were cooked were used to evaluate the possible impacts on melanosis

and weight recovery. The results of these experiments showed that when current practices in post-harvest handling of live lobsters were followed there was no observable impact on the activity of the enzyme or on melanosis formation and/or weight recoveries.

The question was then asked as to whether or not other important commercial lobster species, such as southern rock lobster, showed a similar heat activation effect. Therefore the same series of test was carried out using southern rock lobsters caught in WA. From these tests it was concluded that southern rock lobsters also show a heat activation effect between 60 and 70°C. If future developments in the southern rock lobster fishery result in an increase in the number of southern lobsters sold as processed cooked lobster then consideration of melanosis and the impacts of processing and handling methods on PPO activity maybe come and important factor.

2005/223: Evaluation of alternative processing technologies applicable to crustaceans

Principal Investigator: Dr Hannah Williams
Curtin University of Technology
School of Public Health
GPO Box U1987
Perth W.A. 6845

Project Objectives

- To determine the standard processing protocol for three alternative cooking method (steam, steam plus pressure and microwave cooking).
- To investigate factors impacting on uptake of water and anti-browning agents during drowning of rock lobster correlated to associated weight recovery and melanosis development.
- To evaluate the impact of alternative cooking methods, (microwave cooking, steam, and steam plus pressure) on weight recovery and melanosis rates.
- To evaluate the postproduction sensory quality of rock lobster processed by alternative cooking methods in comparison to rock lobster processed using standard practice (boiling).
- Optimisation of processing methods.
- Information extension to industry to enable maximal adoption of results.

PROGRESS

FRDC Project 2001/235 showed that prolonged cooking at higher temperatures can prevent melanosis if a total heat input equivalent to **36 minutes at 90°C** is achieved. However, this level of heating will result in increased weight losses. Therefore a further project is proposed to look at different methods of cooking, using higher cooking temperatures over shorter time periods to establish their impact on preventing weight loss and melanosis formation. It is suggested that rapid heating during cooking may result in improved post processing quality, weight recovery and reduced melanosis. Three alternative technologies will be evaluated. They are:

- Steam
- Steam with Pressure
- Microwave

Current processing methods, i.e. boiling, will be used as the control method to which all other processing methods are compared. The pilot plant from FRDC 2001/235 will be used for boiling lobsters to enable direct comparison of results between the two projects. The pilot plant consists of a gas-fired boiler that holds 2 baskets (50 kg lobsters) and an ice slurry tank.

Steam processing has been shown to produce 2% improvement in weight recovery in the American *Homarid* lobster. The impact of steam on melanosis rates has not yet been evaluated. A diesel fired cabinet steamer, which holds approx 100 kg when full, has been made available for the required trials courtesy of Fremantle Octopus Ltd. The steamer holds 18 perforated sloping trays each capable of holding 15 ‘A’ size (450 g) lobsters.

The use of pressure in combination with heating has been shown to increases sensitivity of enzymes to heat. It is postulated that this will therefore result in a decrease in the heating time required to prevent PPO activity, and hence melanosis, while increasing weight recoveries. Therefore a pilot size pressurised steamer has been leased for the duration of this project. The steamer will reach a maximum temperature of 120°C and a maximum pressure of four atmospheres (400 Kpa). The pressure vessel can hold approximately 15 kg of lobsters when fully loaded.

Studies of enzyme activity in mushrooms have shown that microwaves decrease enzyme activity faster than can be accounted for by the temperature profile of the cooking process (Devece et al. 1999; Rodriguez-lopez et al. 1999). The rapid decrease in activity is attributed to the impact of the microwaves on the enzyme’s physical structure. It is widely believed that the rapid cooking times associated with the use of microwaves would also act to improve weight recovery in processed lobsters. At present, the development of microwave as a commercial processing technique is in its infancy. Therefore, to build a system to handle the volumes currently processed in the industry would be very expensive (more than $1 million). However, as the technology catches up with the research this will become a more viable option if it is identified as an effective method of improving weight recoveries and reducing melanosis. A commercial bench top microwave using 4 magnetrons

with wave dispersers and a total power output of 1880 W will be used in this study.
The work to be conducted in this project builds on the information obtained from FRDC Project 2001/235. The first step is to determine the standard processing protocols for each alternative cooking method that meets the criteria determined in FRDC Project 2001/235. Once the baseline protocol has been determined a series of trials using the developed processing protocols will be conducted. The aim of these trials is to produce a range of cooks by each method that give severely undercooked to severely overcooked lobsters. The lobsters will then be evaluated to establish the impact on weight recovery and melanosis rates of the various cooking protocols. From this the best protocol for each alternative processing method will be established. The 'best' protocol will be that method which results in the highest weight recovery with the lowest incidence of melanosis. Rock lobsters cooked using the identified 'best' protocol for each alternative method will be compared to boiled lobster using sensory evaluation techniques. From the data obtained it will be possible to determine if there are significant beneficial differences between current processing methods and the alternative processing methods.

Once the study is completed a series of workshops for industry will be run explaining the technologies and the determined protocols for each method. A handbook on processing technologies for lobster processing will also be produced.

As a secondary objective to the study a series of experiments will be carried out to investigate factors impacting on uptake of water and anti-browning agents during drowning of rock lobster. FRDC Project 2110/235 identified several questions to be answered:

- What ratio of weight of lobsters to the volume of the drowning solution results in the best uptake of the agents?
- Does the temperature of the drowning solution impact on the uptake of the agents? and
- Is the length of drown time an important factor?

Overall, the project aims to identify the drowning and cooking methods most likely to maximize returns on cooked crustaceans. It is expected that the project will be completed in December 2008.

References

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Rodriguez-lopez, J. N., Fenoll, L. G., Tudela, J., Devece, C., Sanchez-Hernandez, D., de los Reyes, E. & Garcia-Canovas, F. 1999, 'Thermal inactivation of mushroom polyphenoloxidase employing 2450 MHz radiation', *Journal of Agricultural and Food Chemistry,* vol. 47, pp. 3028-3035.

Need

The catches of Australia's rock lobster fisheries are at or near their maximum level. However, adding value to the rock lobster catch by way of enshrining maximum quality on delivery to the processing factories, 100% survival of live lobsters shipped to overseas destinations, perfect cooking regimes for the product processed for this market, a continuous maintenance and upgrading of handling conditions, health and safety conditions, and respect for community welfare concerns, will ensure continuing and improved profits for the industry.

A major objective of the Subprogram has been to ensure delivery to the processing factories of rock lobsters that are intact (no limbs missing) and healthy and strong, so that they are in a condition suitable for live export. Not all such lobsters are exported live. However, this provides the processor/marketer with the greatest choice, and lobsters cooked and frozen that are in this condition, provide greater percentages of flesh recovery. The studies conducted under the Subprogram have shown that rock lobsters at the time of capture are healthy and vigorous and that all of the reductions in condition are the result of less than perfect handling and transport conditions on the way to the factory. Additional studies to find ways of reducing these problems, and education of the participants, are still needed.

The markets for rock lobsters and the forms in which they are sold change constantly. The change from frozen products to live marketing of a large portion of the catch has been dramatic. Because of this the industry faces new challenges to retain maintain and expand markets and profitability.

The purpose of the Subprogram is to identify with industry the best possibilities to assist industry in meeting these challenges. It then seeks to support research studies to provide answers in a cost effective and timely manner. The outputs of the research are then disseminated to industry in a form suitable to allow industry to capture the benefits of the research for the Australian industry.

Objectives

1. Co-ordinate the FRDC Rock Lobster Post-Harvest Subprogram.

2. Conduct an annual research workshop to present outcomes from the Subprogram and to define research objectives for subsequent years.

3. Facilitate travel of the Subprogram project principal investigators, industry representatives and Subprogram Leader to biannual scientific meetings.

4. Facilitate travel of industry representatives, Subprogram Leader of the enhancement and aquaculture Subprogram, and Subprogram Leader to biannual steering committee meetings.

5. Co-ordinate the preparation of Subprogram media releases and Workshop publications.

6. Integrate with other FRDC funded rock lobster research programs including the FRDC Enhancement and Aquaculture Subprogram.

7. Co-ordinate the preparation and distribution of a biannual Subprogram newsletter.

8. Develop and maintain a strategic plan for post-harvest rock lobster research.

9. Continually supervise the scientific studies within the Subprogram

Methods

Industry consultation and communication

The Subprogram Leader promoted the activities of the RLPHS through industry newsletters and direct communication with industry organisations and representatives. Heavy reliance was placed upon ongoing maintenance of the Steering Committee with representatives from the rock lobster wild fishing sectors and processing sectors across Australia for the provision of strategic direction and advice.

The Subprogram leader presented the work of the Subprogram to the 4 th National Rock Lobster Congress in Hobart in October 2005.

Strategic planning

Strategic planning for the RLPHS was based on discussions of the Steering Committee and ongoing consultation between the Subprogram Leader and members of industry and researchers in Australia.

Communication with FRABs

Communication with the State FRAB's was via distribution of an annual operating plan for the RLPHS in December of each year combined with direct communications. The Subprogram Leader also attended the annual FRDC FRAB workshop to promote the activities and objectives of the RLPHS.

Development of new research proposals

New research proposals were developed through the use of facilitated strategic planning meetings. The Subprogram Leader convened meetings with relevant researchers and research institutions to:

1. Define the planned outcomes of the new proposal;
2. Manage an indicative budget for the research as defined by the Steering Committee;
3. Identify which researchers/institutions are best placed to undertake the research;
4. Promote collaboration between researchers and institutions where appropriate;
5. Seek external expertise and inputs as required.
6. Ensure the new proposal meets the objectives of the Subprogram and that the research remains relevant and focussed.

The Subprogram Leader ensured new research proposals were distributed to FRABS and the RLPHS Steering Committee for comment and ratification before the proposals were submitted to FRDC, and facilitating adjustments to the proposals prior to submission.

Co-ordination of research reports

The Subprogram Leader collated progress and final reports from projects within the each year for delivery in a common format to FRDC. These reports were distributed to members of the Steering Committee for comment and review.

Review of research progress and direction

The RLPHS Steering Committee interviewed Principal Investigators of each project within the Subprogram twice annually as part of the Steering Committee meetings.

Principal Investigators were required to report progress against contracted milestones, justify any changes in research direction, and demonstrate the research program was making a valuable contribution towards the achievement of the subprogram objectives.

The Steering Committee made recommendations to the FRDC Board in relation to potential changes to the objectives of the research program, or instances where project progress is unsatisfactory.

Co-ordination of research extension

A major function of the Subprogram Leader was the organisation and delivery of an annual research workshop to highlight the activities and outputs of the RLPHS. Workshops were convened with presentations from invited speakers and researchers aimed at delivering key messages to end-users for use in practical rock lobster aquaculture and enhancement systems.

The Subprogram Leader compiled a subprogram newsletter at least annually or as required highlighting research outcomes, developments in rock lobster post-harvest processes and events relevant to the RLPHS. The Subprogram Leader was also be responsible for the approval of all media releases and scientific publications arising from research projects within the Subprogram using the RLPHS Steering Committee communication policy as a guide.

Liaison with FRDC

The Subprogram Leader was the conduit for communications between FRDC and Subprogram participants in relation to project contracts, project reports, new submissions and general correspondence. The Subprogram Leader also represented the RLPHS at the biannual annual FRDC FRAB and Subprogram meetings in Canberra.

Results/Discussion

Subprogram mission and content

At the time of establishment of the current project, the RLPHS included the following projects:

1999/202: Rock lobster autopsy manual

Principal Investigator: Dr Louis Evans
Curtin University of Technology
Aquatic Science Research Unit
GPO Box U1987
Perth W.A. 6845

Project Objectives:

The publication of an autopsy manual to be used in the lobster industry.

Achievements and Summary of the Project

This project was completed.

The aims of FRDC Project 1999/202 were to produce a manual for the rock lobster industry that summarized information on evaluating and understanding rock lobster health. There were two publications resulting from the project. The first was a larger manual that summarised and collated information on lobster health from previous FRDC projects and other resources. The second was a booklet entitled “Rock lobster health and diseases: a guide for the lobster industry”. The booklet summarises in a more visual format some of the information presented in the larger manual.

Information presented in the project’s final report summarises how to assess rock lobster health, factors that affect lobster health and a summary of known lobster diseases world-wide including diseases of rock lobster larvae and juveniles. Information on assessing health status includes a “vigour index” based on physical characteristics of live rock lobsters as well as descriptions of some haemolymph characteristics that can be used to assess rock lobster health. They include some information on biochemical tests, blood gases, clotting time, haemocyte count, types of haemocytes and the presence of bacteria in the haemolymph. Photographs and information on how to dissect and rock lobster and how to submit samples to a laboratory are included in the smaller booklet.

Diagnosis of diseases of rock lobsters follows the same basic principles that apply to other aquatic animals. A history of the animals including the % affected by disease and the % of animals that have died is an important component of assessing and diagnosing the possible causes of the health

problems. Haemolymph (blood) collection and dissection and analysis of tissues are usually important in pinpointing the causes of problems. Live, but sick lobsters usually provide the most information and allow a diagnostic service to undertake histology and bacteriology which are important techniques commonly used following a post mortem or autopsy. Host factors (pertaining to the lobster), environmental or management factors and pathogen (infectious disease agents such as bacteria) often interact and determine the severity of any health problems.

Rock lobsters are more susceptible to developing health problems including infectious diseases when they have been stressed, injured, have just moulted or are about to moult, have had unsuitable feed or been held at a high stocking density. Stress often occurs when lobsters are held in water of less than optimal water quality and during capture and transport, especially if they have been held in air during this process. Australia is fortunate in that the majority of diseases identified in rock lobsters to date have been the result of opportunistic infections rather that primary pathogens. Opportunistic pathogens commonly include bacteria, fungi and protozoa that are present in the lobster's environment but do not cause disease unless lobsters are stressed or damaged by some of the factors outlined above.

Some of the more common disease problems seen in rock lobster include 'white tail', caused by an intracellular protozoan parasite, tail fan necrosis or shell disease, weak lobsters (often the result of a generalised bacterial infection) and fouling of the gills and carapace.

Turgid lobster syndrome in which the soft areas of the lobster bulge from the harder shell and pink fleshed lobsters are conditions that are sometimes seen and may have a number of causes. Further investigation is needed to identify the range of environmental, physiological and disease conditions that can result in the two latter syndromes.

2000/250: Facilitation, administration and promotion of the post-harvest Subprogram

Principal Investigator: Dr Bruce Phillips
Curtin University of Technology
Muresk Institute of Agriculture
GPO Box U1987
Perth W.A. 6845

Project Objectives:

Co-ordinate the FRDC rock lobster post-harvest Subprogram.

Conduct an annual research workshop to present outcomes from the Subprogram and to define research objectives for subsequent years.

Facilitate travel of the Subprogram project principal investigators, industry representatives and Subprogram leader to biannual scientific committee meetings.

Facilitate travel of the industry representatives, Subprogram leader of the Enhancement and Aquaculture Subprogram, and Subprogram leader to biannual Steering Committee meetings.

Co-ordinate the preparation of Subprogram media releases and workshop publications.

Integrate with other FRDC funded rock lobster research programs including the Enhancement and Aquaculture Subprogram.

Co-ordinate the preparation and distribution of a biannual Subprogram newsletter.

Develop and maintain a strategic plan for post-harvest rock lobster research.

Develop a strategic plan for the Subprogram.

Achievements and Summary of the Project

This project was completed.

An independent Subprogram Leader, and a highly responsive Steering Committee that is composed of industry experts from across Australia provided an effective and efficient system for directing relevant research activities to ensure continued and increased profitability for the Australian rock lobster fisheries. The Steering Committee have also acted to provide research facilities within the industry as the best locations to conduct research, and ensuring the uptake of successful projects as soon as they occur.

The research conducted by the Subprogram has significantly improved Australia's understanding of the physiology and biochemistry of lobsters, from the time of capture through to processing in a variety of product forms. This is of considerable assistance in investigating methods of better handling, cooking, and/or processing lobsters for live export.

Studies to alleviate leg loss in western rock lobster have yielded impressive results. However, the introduction of cold-water stunning is not yet endorsed by the Subprogram, as we are awaiting confirmation that it will not cause increased mortality on undersized lobsters, not adversely effect the egg production or cause increased mortality of breeding females.

The dramatic effects of hypo-salinity in causing leg loss has been a major achievement, and its rapid take up by industry will cause a major reduction in leg loss and a consequent multi million dollar increase in value of the fishery.

A major method of communicating research results from the Subprogram has been the Code-of-Practice. The newly revised Code incorporates in a subtle way the best ideas from the results in a form endorsed by the industry. As a result this leads to improved post-harvest handling practices, and thereby to increased safety and profitability of the fishery.

Studies of the methods of cooking of western rock lobsters, with the intention of alleviating the blackening of the flesh after thawing, have already indicated the source of the problem and a likely solution. Further tests will be undertaken to confirm if the solution can be carried out under commercial conditions.

2000/251: Development of a method for alleviating leg loss during post-harvest handling of rock lobsters

Principal Investigator: Dr Glen Davidson
Geraldton Fishermen's Cooperative (originally Department of Zoology, UWA)
PO Box 23
Geraldton WA 6531

Project Objectives:

To identify a cold-water immersion treatment that rapidly immobilises western rock lobsters, while allowing swift recovery from immobilisation upon return to ambient temperature seawater. To investigate the effect of season/acclimation temperature on effectiveness of cold stunning in western rock lobsters. To investigate the use of sea sprays vs. immersion for cold stunning in western rock lobsters.

To investigate, in captivity, the effectiveness of the preferred treatment (identified in objective 1) for reducing leg loss in western rock lobsters.

To test the accuracy of factory grading of cold stunned western rock lobsters vs. untreated controls.

To describe the occurrence of leg loss, morbidity and mortality of western rock lobsters subjected to cold stunning prior to episodes of handling during the post-harvest process (i.e. at the time of pot-pulling and sorting, prior to factory grading) and to compare these to the performance of animals handled using current methods.

To investigate the effects of multiple simulated pot capture and release events, either with or without cold stunning, on growth, leg loss and survival of undersized western rock lobsters.

To compare, in captivity, effects of handling, with and without cold stunning, on the reproductive success of setose, tar spot and ovigerous

female western rock lobsters. To investigate the effects of limb loss on the reproductive success of female western rock lobsters.

To conduct a survey to determine the extent and nature of leg loss in the southern rock lobster fisheries of Tasmania and South Australia.

Achievements and Summary of the Project

This project was completed.

Post harvest leg loss is a significant problem for the western rock lobster industry. Industry incurs costs from leg loss in the following ways:

• Loss of catch weight. Industry estimates suggest that up to 80 tonnes of legs are lost each year between the point of capture and consignment to the processing factories (Steve Hood, pers. com.).

• Reduced marketing options and loss of value. Lobsters with too many missing legs cannot be sold in premium live or whole frozen product forms.

• Reduced growth of returns. Protected lobsters caught and returned to the ocean grow more slowly if they have lost legs in the process (Brown and Caputi, 1985). Slow growing lobsters take longer to reach minimum legal size so more of them succumb to natural mortality before entering the fishery.

• Increased mortality of returns. Protected lobsters caught, damaged and returned to the ocean are more likely to die than their undamaged counterparts.

• There is evidence to suggest that breeding females returned to the ocean in a damaged state are less likely to produce eggs in that season and if they do, they produce fewer eggs.

The current studies focus on the potential for briefly (5-15 sec.) stunning lobsters in cold (5-10°C) seawater to alleviate leg loss at various steps in the post-harvest chain. Cold-stunning was trialled on board a commercial lobster boat for 44 days. The trials involved over 5000 pot lifts and 24 000 lobsters. Stun temperatures ranging from 0° to 15°C were tested. The main findings of these trials were as follows:

• Stunning lobsters in 5-10°C seawater for 5 seconds was effective and achievable.

• Using this treatment an 80% reduction in leg loss during sorting was achieved.

• Equivalent reductions were achieved for both legal and protected lobsters.

• Deck hands preferred to use the stun tank rather than working without it.

• The onboard benefits were retained through post-harvest depot storage and truck transport to the processing factory.

• At the factory a saving of 24 legs/100 lobsters was achieved, resulting in increases in the numbers of intact lobsters and those in a fit for live export condition.

• No mortality was observed during storage of a sample of stunned lobsters in factory live holding tanks, despite multiple stun treatments having been applied.

2000/252: Optimising water quality in rock lobster post harvest

Principal Investigator: Dr Stephen Battaglene (originally Dr Brad Crear)
University of Tasmania
Tasmanian Aquaculture and Fisheries Institute
Marine Research Laboratories
Nubeena Crescent, Taroona, Tasmania, 7053

Project Objectives:

Production of a manual on optimising the provision of oxygen during rock lobster post-harvest processes.

Determine the median lethal concentration (LC-50) of ammonia to adult southern and western rock lobsters (stressed and unstressed).

Determine the physiological consequences of exposing lobsters to sub-lethal ammonia concentrations, and the consequences of further exposing lobsters to acute post-harvest stressors.

Production of a manual on ammonia problems during rock lobster post-harvest processes.

Achievements and Summary of the Project

This project was completed.

Two detailed and well-illustrated industry guides have been produced and published on how to optimize the holding of rock lobsters (Crear and Grant 2002; Crear et al 2003). Oxygen is generally the major water quality variable limiting the success of live holding systems and the first guide provides information to the rock lobster industry on the holding of live rock lobsters focusing on the oxygen requirements and methods of ensuring optimal oxygen supply.

The second guide launched at the 5th Annual Workshop in Fremantle, Western Australia describes the principles of recirculating systems as they

apply to the holding of rock lobsters. It covers all aspects of such systems, from design to daily operation. The second guide uses information gained during the project on ammonia excretion rates and ammonia tolerance of southern and western rock lobsters.

Ammonia Tolerance of Rock Lobsters

Research has been undertaken to determine the concentrations of ammonia that are lethal to adult southern and western rock lobsters. Static-renewal bioassays were used to determine the acute toxicity (96 h LC50 value) of ammonia to the southern rock lobster, *Jasus edwardsii* and the western rock lobster, *Panulirus cygn*us.

Following preliminary trials ammonia concentrations of 0, 40, 60, 90 and 135 mg L-1 NH3-N as well as a flow through water reference treatment were used. The temperature was maintained at 13°C for *J. edwardsii* and 19-20°C for *P. cygnus*. The stocking densities of lobsters within the tanks were held at close to industry levels (80 kg/tonne for *J. edwardsii* and 70 kg/tonne for *P. cygnus*).

Lobsters were held in non-stressed (non-handled) or stressed (handled) conditions. The 96 hour median lethal concentrations (96 h LC50) for non-stressed rock lobsters were 83 mg l-1 NH4-N for southern rock lobsters, and 39 mg l-1 NH4-N for western rock lobsters.

There was no significant difference between stressed and non-stressed animals for either species. Lobsters displayed increased aggression with increasing ammonia concentrations, contributing to mortality of lobsters. Individually held, non-stressed, western rock lobsters had a higher 96h LC50 of 61 mg l-1 than their counterparts held as a group. Re-calculation of the data to adjust for pH changes resulted in a 96 h LC50 for unstressed *J. edwardsii* of 35 mg l-1 NH4-N and for unstressed (individually-held) *P. cygnus* of 25 mg l-1 NH4-N.

Sub Lethal Effects of Exposure to Ammonia

To determine the physiological consequences of exposing lobsters to sub-lethal ammonia concentrations, and the consequences of further exposing lobsters to acute post-harvest stressors lobsters were exposed in static tanks to a range of concentrations (0-130 mg L-1) of ammonium chloride (NH4Cl) in normoxic seawater (n = 6) for 24 h. In a separate experiment animals were held at elevated ammonia concentrations (60 mg.L-1 ammonium chloride) and sampled sequentially over a 24h period.

These results suggest short-term physiological adjustments (within 5 h) in the acid-base status of the lobster due to environmental ammonia followed by longer term (5-24 h) metabolic effects. Recovery appears to be a lengthy process once CO2 reserves (probably in the form of haemolymph HCO3) are depleted suggesting possible "metabolic tolerance" preferred over "mobilisation" of CO2 from "hard reserves" such as the shell.

References

Crear, B.J., and Allen, G. 2002. Optimising water quality - oxygen. Guide for the rock lobster industry. No. 1. Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 36p.

Crear, B.J., Cobcroft, J. and Battaglene, S. 2003. Recirculating Systems for holding rock lobsters.

Guide for the rock lobster industry. No. 2. Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 29p.

Quantifying and controlling hyper- and hypersaline-induced post-harvest leg autonomy in the western rock lobster

2001/255 Principal Investigator: Dr Glen Davidson
Geraldton Fishermen's Cooperative
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Geraldton WA 6531

Project Objectives

Survey salinity concentrations of surface films on individual lobsters and on relevant contact surfaces on boats and within factories.

Describe the relationship between autonomy and exposure to seawater of various salinities for lobsters of various sizes and moult stages.

Quantify leg loss during industry standard freshwater "drowning" procedures.

Compare responses to ionic and non-ionic solutions to elucidate the potential role of other contaminants, and the possible nature of the receptors and stimuli.

Investigate the relationship between daily environmental conditions and levels of post-harvest leg loss.

Field-test practical solutions for hyper/hyposaline-induced autonomy and make recommendations to industry.

Achievements and Summary of the Project

This project was completed.

Summary

In the course of experimental work conducted as part of FRDC Project 2000/251 it was found that western rock lobsters rapidly and spontaneously

autotomise between 1-10 walking legs when they come into contact with hyper-saline seawater solutions. In the current study it was shown that lobsters react when they come into contact with hypersaline water films with salinity values ranging from 62 to 180 ppt.

A survey of the salinities of water films on contact surfaces throughout the post-harvest chain revealed that lobsters regularly come into contact with water films that were sufficiently saline to induce the autotomy response. Thus there is the potential for hypersaline-induced leg autotomy to be a significant problem with substantial commercial consequences, in terms of loss of product weight, downgrading of damaged product, and consequences for management of the resource, through the reduced survival, growth and reproductive success of caught and returned undersized and breeding female lobsters (Brown and Caputi, 1985, 1986; Donohue, 2000).

Hypersaline films can develop rapidly on boats, in trucks and live holding and processing factories. Seawater splashed on contact surfaces evaporates rapidly in the typically hot, dry and windy conditions that prevail during much of the catching season and over most of the fishing locations. If left to continue this evaporation progressively concentrates the salt content until finally crystalline salt precipitates out of solution. Clearly the simplest way to prevent hypersaline-induced autotomy is to prevent the development of hypersaline water. This is easily achieved on board working boats by washing or spraying all contact surfaces, such as gloves and sorting boxes. Salt build up may even occur on the lobsters themselves.

The cuticle of western rock lobsters has a large surface area due to the numerous spines and abundant setae. This expanded surface area forms an excellent evaporator and should be kept wet at all times to prevent evaporative concentration of seawater on the cuticular receptors that mediate the autotomy response.

In land-based situations freshwater can be used to prevent hypersaline films from developing on contact surfaces Washing with freshwater has the added advantage that there is no potential for gradual evaporative concentration of residual salt after washing has ceased. Using freshwater to keep the lobsters themselves wet is not recommended as there is evidence that under some circumstances exposure to freshwater can result in leg loss (see below).

Lobsters that are to be processed are first killed by "drowning" in ambient temperature freshwater. Thus there exists the potential for hypo-saline leg loss to occur.

Experiments conducted showed that leg loss does occur during freshwater drowning. Under experimental conditions, Grade A lobsters (345 490 g) lost 4.3 ± 0.8 legs/50 lobsters (mean ± s.e.m., n = 12). The larger Grade G lobsters (1221- 1800 g) lost 2.8 ± 0.6 legs/50 lobsters. However, it is not known if this damage is the result of exposure to hypersaline conditions *per se*, or whether other effects play a role. For example, when lobsters are tipped into freshwater they react violently and, in the confines of a drowning

tub, there is potential for lobsters to damage themselves from hitting the sides of the tub and other lobsters. Having said this, spontaneous autotomy was observed in lobsters that were motionless in the drowning tub (G. Davidson, pers. obs.).

Leg loss during drowning can be prevented by stunning the lobsters briefly in cold water before tipping them into the drowning tub. Fresh water drowning. Furthermore, over the ranges of temperature and time tested, the reduction is dependant upon the stun time and inversely dependant upon the stun temperature. On average 90% of leg loss during drowning can be prevented by stunning lobsters at 0°C for 15 sec. prior to drowning (n = 6).

Cold-stunning is also effective for controlling hypersaline-induced leg loss. Groups of 6 lobsters were subjected to one of 4 treatments: 1) 5 sec. immersion in 5°C seawater, 2) 5 sec. immersion in 10°C seawater, 3) 5 sec. immersion in 15°C seawater, and 4) 5 sec. exposure to 22.5°C air.

After each treatment baskets of lobsters were left in air (22.5°C) to drain for 10 sec. before the lobsters were tipped from basket into tubs containing 100 mL of a solution of Geraldton seawater + 55 g/L of butcher's salt. Lobsters were left in the tubs for 5 sec before each animal was removed individually and subjected to a simulated on board sorting which consisted of gauging each lobster for size, inspecting each ventrally for reproductive condition and counting the numbers of missing legs.

The numbers of missing legs and the number of legs remaining in the tub after sorting the lobsters were recorded. For the purposes of statistical analysis, each group of 6 lobsters was considered to be a single sample. Each treatment was repeated 20 times, giving a sample size of 20 for each treatment. In total, 480 lobsters were used in the experiment.

In conclusion, hypersaline-induced leg loss is a significant problem for the western rock lobster industry. This can largely be prevented by applying some simple preventative measures. Leg loss during freshwater drowning is also significant and can be prevented by stunning lobsters in cold water before drowning.

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Donohue, K. (2000). *RLIAC News* **3**(2).

2001/235 Striking a balance between melanosis and weight recoveries in western rock lobster

Principal Investigator: Dr Hannah Williams
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School of Public Health
GPO Box U1987
Perth W.A. 6845

Project Objectives:

To establish the impact of temperature and food additives on the activity of *Panulirus cygnus* haemolymph phenol oxidase (PO) in vitro.

To establish the impact of current commercial practices on weight recovery and melanosis formation.

To establish the impact of post-harvest transportation on PO activity, weight recovery and melanosis formation.

To determine the effects of anti-browning agents on weight recovery and melanosis formation.

To validate the use of experimentally determined cooking profiles for improvement of cooked weight recoveries and prevention of melanosis.

To formulate recommendations and guidelines that will enable industry to apply the findings of the study.

Achievements and Summary of the Project

This project was completed.

Each year 4-5,000 tonnes of western rocklobster are cooked and exported from Australia to countries such as Japan and Taiwan. When existing cooking methods are used a proportion of cooked western rocklobster go black after thawing, this results in a product that is unacceptable to the customer.

Increased cooking times results in increased weight loss in lobsters. For the producer this means lost money. A solution was needed as to how to reduce the length of cooking time required, in order to minimise both weight loss and melanosis.

Currently, boiling is the most common method used in cooking lobsters. However, it was important to understand what was happening to the enzyme when lobsters are boiled.

This study showed that when western rocklobsters were heated to an internal temperature between 60 and 80°C there was a large increase in enzyme activity. It was not until after temperatures reached 90°C, or more, that the enzyme activity stopped. Overall, it was found that for 50% of the cooking time, temperatures only reached between 60-80°C. Therefore they did not get hot enough to kill the enzyme; rather, current cooking methods actually increased the enzyme's activity.

Increased cooking times results in increased weight loss in lobsters. For the producer this means lost money. A solution was needed as to how to reduce the length of cooking time required, in order to minimise both weight loss and melanosis.

One possibility lies in the use of chemical compounds called "anti-browning agents". These chemicals work in a similar way to putting lemon juice on cut apples to stop them going brown. Four different anti-browning agents were selected for testing on the basis of their "naturalness". Their effectiveness was first tested in the laboratory. Ascorbic acid was not effective. Citric acid, 4-hexylresorcinol, and carbon dioxide all prevented enzyme activity even when applied at low concentrations. The next stage was to trial the effectiveness of these anti-browning agents in prevention of melanosis during commercial processing of western rocklobster. Different strengths of the three effective anti-browning agents were applied to lobsters during the preparation for cooking. Melanosis development was then measured after cooking. Lobsters treated with 4-hexylresorcinol showed the greatest reduction in melanosis. Stopping the melanosis completely was not achieved by any of the agents.

This study established that anti-browning agents may be of assistance in preventing melanosis but further work needs to be done to determine the best way to use them. It was also found that lobsters must reach a calculated heat input equivalent to at least 36 minutes at 90°C in order to prevent melanosis but that this results in unacceptable weight losses. Therefore a further project is being carried out to look at different methods of cooking that using higher cooking temperatures over shorter time periods. The project will establish their impact

2002/237 Code of Practice

Principal Investigator: Mr Richard Stevens
Abercromby Management Services P/L
21 Eckford Way
Duncraig ,W.A. 6023

Project Objectives:

To produce a Code of Practice for the handling of rock lobster.

Achievements and Summary of the Project

This project was completed.

The best practice video for the Western Rock lobster fishery was presented to the meeting. It followed another production 'A Potted History" which showed the evolution of the fishery from its earliest days in the nineteenth century, to the present day.

The second best practice video, covering the Southern Rock Lobster Fishery, is to be presented to the International Rock lobster Congress in Hobart in February 2004.

The written Code will comprise a series of schedules being a compilation of current information, including the Oxygen/Nitrogen publications, the WAFIC OH&S code for the pot and trap sector, the WAFIC bait code; the WA Department of Fisheries leaflet on handling live crustaceans and other relevant published information.

The Code will be extensively revised for the Southern Rock Lobster Fishery, to incorporate the 'Clean Green' programme for that fishery. The written code will be presented to the next workshop, in September 2004 and also at the Western Rock Lobster Congress in October 2004.

Copies of the Code and the video may be obtained from the relevant rock lobster fishermen's organisations, or from WAFIC on (08) 9244 2933 or wafic@wafic.org.au

2002/238 Quantification of shell hardness in southern rock lobster

Principal Investigator: Dr Caleb Gardner
University of Tasmania
Tasmanian Aquaculture and Fisheries Institute
Marine Research Laboratories
Nubeena Crescent, Taroona, Tasmania, 7053

Project Objectives

To calibrate the rate of change in shell hardness before and after the moult of southern rock lobsters relative to lobster size, sex, region and temperature.

To identify the region of the exoskeleton that is most suited for measuring hardness.

Achievements and Summary of the Project

This project was completed.

Southern rock lobsters *Jasus edwardsii* that are about to moult or have recently moulted have reduced market value due to higher mortality in live transport, higher cannibalism and lower meat recovery.

Limiting the landing of softer shelled lobsters is desirable to maintain product quality; however, attempts to set closed seasons or to introduce industry self-regulation have been hampered by subjectivity in measuring shell hardness. We evaluated the use of durometers as a tool for collecting objective measurements of shell hardness.

Of the ten locations on the exoskeleton that were evaluated, two locations along the lateral suture line of the exoskeleton gave most consistent readings and underwent largest changes through the moult. The effects of several factors on durometer readings were evaluated: sex, temperature (ambient plus elevated 3°C), location (from around the coast), and size. No effect on durometer readings could be detected from any of these factors with the exception of lobster size. A cumulative logistic function fitted to grouped data provides a method for predicting time before or after moulting from durometer readings.

The squeezometer collects a series of rapid readings so that it can detect if the shell hardness reading is being affected by movement of the lobster, which could happen if the operator is aboard a rolling vessel. If movement is detected, the reading is extended until a stable reading can be obtained. For research purposes, readings of shell hardness can be relayed and downloaded to computer. For industry applications, the force readings were calibrated and used to illuminate a series of LEDs – the more LEDs illuminated the harder the lobster. This tool has considerable promise in improving the quality of product delivered to market and could also be used for high grading of catch at sea. Further testing of the squeezometer at sea is underway and we are also investigating options for manufacture.

2002/239 - The effect of on board cold water stunning on the survival and growth of caught and returned western rock lobsters (*Panulirus cygnus)*

Principal Investigator: Dr Glen Davidson
Geraldton Fishermen's Cooperative
PO Box 23
Geraldton WA 6531

Project Objectives

To determine the effect of commercial capture with or without cold-stunning on the survival and growth of returned protected western rock lobsters.

2. To observe and film in the wild the behaviour of western rock lobsters caught and returned with or without cold-water stunning.

Achievements and Summary of the Project

This project was completed.

Post-harvest leg loss is a significant problem for the western rock lobster industry. Industry estimates suggest that up to 80 tonnes of legs, worth $2-3 million, are lost from the catch each year between the time of capture and receipt at processing factories. Even after catches are landed, additional losses occur during sorting in the factory, live storage, processing, packaging for live export and unpacking at export destinations. Previous studies (FRDC Project 2000/251 and FRDC Project 2002/239) have shown that cold water stunning is an effective and simple method for preventing leg loss in western rock lobsters during post-harvest handling. However, those studies raised questions about the effects of on board cold water stunning on the survival of returned protected lobsters, such as breeding females and undersized.

The present work has yielded apparently conflicting results in different fishing areas. In inshore waters between Dongara and Geraldton, no difference was found in the recapture rates of returned stunned undersized lobsters and those returned to the water without stunning. However, in waters surrounding the Southern Group the Abrolhos Islands, stunned lobsters were apparently recaptured at a lower rate than their un-stunned counterparts. This latter result was deemed inconclusive due to the low numbers of recaptures from both groups. Further work is planned to clarify the situation.

New Projects added to the Subprogram

2003/242 - Value-adding the southern rock lobster fishery-optimising flesh quality of under-valued large lobsters for the sashimi market

Principal Investigator: Dr John Carragher
South Australian Research Development Institute
Adelaide
South Australia

Project Objectives

1. Determine flesh quality characteristics of commercially caught southern rock lobsters from different locations, seasons, sizes, moult stages and shell colour etc.

2. Determine flesh quality characteristics of southern rock lobsters held long term in tanks.

3. Correlate flesh quality indicators with data from experienced sensory analysis panels

See Background for details

Curtin University Funded Project: Impact of heat on PPO in southern rock lobster hemolymph

Principal Investigator: Dr Hannah Williams
Curtin University of Technology
School of Public Health
GPO Box U1987
Perth W.A. 6845

Project Objectives

Evaluation of polyphenoloxidase activity in southern rock lobsters

Achievements and Summary of the Project

This project has been completed

Each year 4-5,000 tonnes of western rock lobster are cooked and exported to countries such as Japan and Taiwan. When existing cooking methods are used a proportion of cooked western rock lobster go black, this results in a product that is unacceptable to the customer.

The blackening of the flesh is known as melanosis and is caused by an enzyme called polyphenoloxidase (PPO). Melanosis is a major problem for the western rock lobster industry and it has been estimated that it costs the industry over $1 million per year. Finding a solution to the problem of melanosis by stopping PPO activity is therefore necessary. Currently, cooking is the most common method used in food processing to stop enzyme activity. However, as the PPO enzyme is evidently still active after lobsters have been cooked it was important to first understand what post-harvest handling and processing factors impacted on its activity.

The following factors were evaluated for all lobsters used in the study:

• Season – PPO activity and weight recoveries were collected at three different points spanning the season
• Moult stage
• Gender
• Initial PPO activity
• Protein level
• Total Phenols level

Evaluation of these factors showed no correlation to the extent of melanosis after processing. Data was also collected on post-harvest handling and processing factors such as:

• Transportation
• Holding
• Drowning
• Position in the cooker
• Anti-browning agents
• Cooking time

For each of these factors information on PPO activity and weight, before and after treatment, was evaluated.

Evaluation of current cooking procedures showed that when lobsters were heated to an internal temperature between 60 and 80°C there was a large increase in enzyme activity. It was not until after temperatures reached 90°C, or more, the enzyme activity stopped. Overall it was found that for 50% of the cooking time, temperatures only reached between 60-80°C. Therefore they did not get high enough to kill the enzyme; rather, current cooking methods actually increased the enzyme's activity.

The question was then asked as to whether or not other important commercial lobster species, such as southern rock lobster, showed a similar heat activation effect. Therefore the same series of test was carried out using southern rock lobsters caught in WA. From these tests it was concluded that southern rock lobsters also show a heat activation effect between 60 and 70°C (figure 3). If future developments in the southern rock lobster fishery result in an increase in the number of southern lobsters sold as processed cooked lobster then consideration of melanosis and the impacts of processing and handling methods on PPO activity maybe come and important factor.

Simulations of existing transportation and holding conditions of lobsters before they were cooked were used to evaluate the possible impacts on melanosis and weight recovery. The results of these experiments showed that when current practices in post-harvest handling of live lobsters were followed there was no observable impact on the activity of the enzyme or on melanosis formation and/or weight recoveries.

The question was then asked as to whether or not other important commercial lobster species, such as southern rock lobster, showed a similar heat activation effect. Therefore the same series of test was carried out using

southern rock lobsters caught in WA. From these tests it was concluded that southern rock lobsters also show a heat activation effect between 60 and 70°C (figure 3). If future developments in the southern rock lobster fishery result in an increase in the number of southern lobsters sold as processed cooked lobster then consideration of melanosis and the impacts of processing and handling methods on PPO activity maybe come and important factor.

2005/223: Evaluation of alternative processing technologies applicable to crustaceans

Principal Investigator: Dr Hannah Williams
Curtin University of Technology
School of Public Health
GPO Box U1987
Perth W.A. 6845

Project Objectives

To determine the standard processing protocol for three alternative cooking method (steam, steam plus pressure and microwave cooking).

To investigate factors impacting on uptake of water and anti-browning agents during drowning of rock lobster correlated to associated weight recovery and melanosis development.

To evaluate the impact of alternative cooking methods, (microwave cooking, steam, and steam plus pressure) on weight recovery and melanosis rates.

To evaluate the postproduction sensory quality of rock lobster processed by alternative cooking methods in comparison to rock lobster processed using standard practice (boiling).

Optimisation of processing methods.

Information extension to industry to enable maximal adoption of results.

See background for details.

Subprogram identity

The RLPHS logo is used as a clear identifier for all Subprogram documents.

With the change in Australia from rock lobster to rock lobster a new logo has been developed:

Subprogram management and operating procedures

To ensure that research conducted within the Subprogram was relevant and met the above criteria, a Steering Committee was established to:

1. Provide industry feedback and views;
2. Review existing research based on FRDC contractual obligations;
3. Prioritise new proposals and provide a priority list for other agencies;
4. Ensure outcomes are commercially focussed;
5. Co-ordinate industry and research provider involvement - optimum use of resources;
6. Facilitate extension and technology transfer.

After a selection process including FRDC endorsement, membership of the Steering Committee included Bruce Phillips (Chair), Patrick Hone (FRDC), Glenn O'Brien (WA), Stephen Hood (WA), Nick Polgeest (VIC), Richard Stevens (WAFIC, WA), Kym Redman (SA), Rodney Treloggen (TAS) and Robert van Barneveld (FRDC Rock Lobster Enhancement and Aquaculture Subprogram) attends as an observer. On several occasions Kym Redman could not attend because of his fire fighting duties. Roger Edwards attended on his behalf.

The Steering Committee met in approximately March and September each year to review project progress and establish research priorities. Advice from the September Steering Committee meetings was sent to all Fisheries Research Advisory Bodies so that they were aware of the subprogram research priorities. All new projects relating to rock lobster enhancement and aquaculture were assessed by the Steering Committee and were submitted to the FRDC Board via the subprogram. An annual subprogram workshop was held each March to extend research results to industry and researchers.

In addition to the RLPHS Steering Committee, a Scientific Committee was established to:

To conduct scientific reviews of all projects; ensuring that research to be undertaken is achievable;

- To ensure scientific objectives are met;
- To foster and develop collaboration;
- To coordinate new funding applications.

The Scientific Committee reported to the Steering Committee through the Subprogram Leader.

The participants of the Scientific Committee consisted of the Subprogram Leader, Principal Investigators of the subprogram component projects and direct industry collaborators (as required). Tenure was dependent on the funding term for a particular project. The Scientific Committee met biannually, and if possible, the meetings were held to coincide with other events to minimise travel costs. An annual research workshop ensured that research results and project progress was disseminated to a wider audience and that all members of the rock lobster aquaculture industry and other interested parties could benefit from the research.

Principal investigators were also brought to communicate directly with the Steering Committee via interviews at the Steering Committee meetings and to only hold informal meetings on scientific content of the projects.

Scientific and Steering Committee meetings

Six Steering Committee, and three Scientific Committee meetings were held between July 2003 and June 2006. All meetings were minuted and actioned. Detailed copies of the minutes have not been included in this report for the sake of brevity and the confidential nature of some of the discussions.

Subprogram workshops

A full set of proceedings was produced from the 2003 and 2004 workshops is in the **Appendix 3.**

A full list of publications arising from the workshops and scientific research is contained under **References**.

Communications

The RLPHS Steering Committee facilitated the orderly release of information produced by, and meeting the needs of Subprogram participants.

Where possible, all media releases, publications and presentations produced as a result of Subprogram activities were vetted by the Subprogram Leader

Subprogram Newsletter:

The Subprogram Leader edited the Newsletter.

Workshop Proceedings:

Researchers supplied a disk copy of presentations from the workshop as well as more comprehensive supplementary documentation to include in the proceedings within 2 weeks of the workshop.

Scientific Publications:

Were developed with the input of all appropriate co-authors

- Were submitted through the normal publications review channels of the institution of the primary author
- Were then provided to the Subprogram Leader who examined it and provided comments back to authors.

Subprogram Media Releases:

All media releases should have been sent to the Subprogram Leader via e-mail for review and distribution to the Steering Committee

- Once reviewed by the Steering Committee any suggested editing were forwarded to the Subprogram Leader for collation
- All editing was then forwarded to the author for preparation of a final draft
- A proof of print media was sought by the Subprogram Leader prior to release. If the media outlet was not prepared to release the proof of the text, then approval will not be granted for publication. However, this was not always possible.
- A transcript of radio and television interviews was requested or heard by the Subprogram Leader prior to release. If the media outlet is not prepared to release a transcript, then approval will not be granted for release. However, this was not always possible.

Unsolicited Media Enquiries/Interviews:

Where possible arrange an appropriate future time to discuss the topic so that a brief note can be circulated via e-mail to the Steering Committee detailing;

- Who the media contact is and what organisation they represent
- The topic to be covered
- Details of what issues will be discussed
- Discussion should be restricted to research you have or are conducting (refer to appropriate scientist if required) not issues of a policy or political nature
- Upon completion of the interview a brief summary of what transpired should be sent to the Subprogram Leader
- It should be noted that planned media releases are the preferred option whenever possible.

Subprogram Conference Presentations:

The conference presentation abstract should be sent to the Subprogram Leader via e-mail for review and distribution to the Steering Committee

- The final conference presentation should have been sent to the Subprogram Leader via e-mail for review and distribution to the Steering Committee
- The final conference paper should have been sent to the Subprogram Leader via e-mail for review and distribution to the Steering Committee
- All conference presentations should have used the standardised Subprogram presentation format.

Copies of the newsletter prepared during the course of this project have been included in **Appendix 4.**

Subprogram publications

A special effort is made by the Subprogram to produce publications, which can be readily used and implemented by industry. Each publication is carefully vetted by the Subprogram Leader and then the Steering Committee to ensure the text and form of presentation are in a suitable form.

The Subprogram has now released the following publications:

Optimising Water Quality, Dr Bradley Crear and Dr Grant Allen

Recirculating Systems NH_3, Dr Bradley Crear, Jennifer Cobcroft and Dr Stephen Battaglene

Rock Lobster Health and Diseases: A Guide for the lobster industry, Frances Stephens, Seema Fotedar and Dr Louis Evans

Best Practice in the Western Australian Lobster Industry, WAFIC, Richard Stevens

Impact of boiling on weight recovery and blacking in western rock lobster, Dr Hannah Williams

Codes of Practice for handling cooked, and live lobsters, on delivery to overseas markets, Dr Hannah Williams and Dr Patrick Spanogue

Each of these has been well received and is in constant demand. Each of these is included in **Appendix 7**.

The publication, Best Practice in the Western Australian Lobster Industry, produced by WAFIC, is also available as a Video or DVD.

Subprogram Web site

A web site was established for the Subprogram. Information on the Rock lobster Post-Harvest Subprogram including all of the newsletters can be

accessed by visiting the web-site
www.frdc.com.au/research/subprograms/rlph/index.htm

Annual Operating Plans

Three annual operating plans for the RLPHS were prepared over the course of this project. A copy of the 2006 annual operating plan has been included in this report (**Appendix 6**).

Priority setting and new research projects

Project selection and development was conducted by the Subprogram Leader working with the Steering Committee.

All proposed projects were examined by the Subprogram Leader before presentation before the Steering Committee. Comments from the Steering Committee were provided direct to the proposed Principle Investigator on the day, and then in writing after the meeting. Draft copies of the revised proposals were subsequently circulated to the members of the Steering Committee for comment, prior to submission to FRDC.

Collaboration and additional funding opportunities

Additional funding opportunities were investigated for the Subprogram, but in general were not available..

Additional funding was provided from Curtin University of technology for the melanosis project, Impact of heat on PPO in southern rock lobster hemolymph. PI Dr Hannah Williams.

Benefits

An independent Subprogram Leader, and a highly responsive Steering Committee that is composed of industry experts from across Australia have provided an effective and efficient system for directing relevant research activities to ensure continued and increased profitability for the Australian rock lobster fisheries. The Steering Committee, under the Subprogram Leaders direction, worked as an integrated group, rather than a collection of individuals, and carefully selects and recommends projects for funding, and then follows their progress and offers advice to principal investigators in the national interest. The industry representatives on the Steering Committee have also acted to provide research facilities within the industry as the best locations to conduct research, and ensuring the uptake of successful projects as soon as they occur.

The research conducted by the Subprogram has significantly improved Australia's understanding of the physiology and biochemistry of lobsters, from the time of capture through to processing in a variety of product forms. This is of considerable assistance in investigating methods of better handling, cooking, and/or processing lobsters for live export.

Studies to alleviate leg loss in western rock lobster have yielded impressive results. However, the introduction of cold-water stunning is not yet endorsed by the Subprogram, as we are awaiting confirmation that it will not cause increased mortality on undersized lobsters, not adversely effect the egg production or cause increased mortality of breeding females.

The dramatic effects of hypo-salinity in causing leg loss has been a major achievement, and its rapid take up by industry will cause a major reduction in leg loss and a consequent multi million dollar increase in value of the fishery.

A major method of communicating research results from the Subprogram has been the Code-of-Practice. The newly revised Code incorporates in subtle way the best ideas from the results in a form endorsed by the industry to increase their safety and profitability.

Studies of the methods of cooking of western rock lobsters, with the intention of alleviating the blackening of the flesh after thawing, have already indicated the source of the problem and a likely solution. Further tests will be undertaken to confirm if the solution can be carried out under commercial conditions.

Further Development

Projects

Three important projects have been identified by the Subprogram during the 2005/2006 funding application process:

(a) The global data base on rock lobster production and markets (PI Tony Gibson). This is an important marketing tool which should greatly assist the rock lobster industry with its strategic market planning to improve Australia's competitive marketing of all rock lobster products.

(b) Improving live transportation techniques & technologies for live southern rocklobster (PI Matthew Muggelton) to increase survivability and quality of lobster upon arrival to the existing and new markets. This is also linked with Project 1 because of the need for the data which it will produce.

(c) Preparation of chitin and associated derivatives from rock lobster waste (PI Professor Colin Raston), using novel green chemistry techniques. It would be an important project under the proposed CRC.

The Subprogram

A submission was made to FRDC in the 2006/7 round for continuation of the Rocklobster Post-Harvest Subprogram.

Following a review by an independent consultant for the FRDC, the Subprogram was refunded and will be on-going until 31 December 2007,

Planned Outcomes

The first priority of the Subprogram was to increase the value of the rock lobster production in Australia. The dramatic success of the alleviation of appendage loss project has clearly demonstrated that the research undertaken by the Subprogram will achieve this outcome. These studies are not fully completed but have already affected boat design, and improved handling practices on the boats and operations in the processing factories.

Because of the reduced appendage loss, improved prices area possible for the lobster catch, and the industry can better select its markets for its products.

The Subprogram structure has increased the level of cooperative research on areas of industry interest, mainly because of their meeting together at the time of the annual workshops and when presenting progress reports of research to the Subprogram Steering Committee. These direct presentations by the researchers to industry have significantly improved cooperation and mutual respect between the two groups, and led to more rapid uptake by industry of research outcomes. All Subprogram publications are carefully edited by the Steering Committee before release to ensure that the material is in a suitably form to ensure this uptake.

Research results have been adopted into the newly released revised Code of Practice for the Western Rock Lobster Fishery, and will similarly be adopted into the planned Code of Practice for the southern rock lobster fisheries.

The beneficiaries of the research conduced by the Subprogram have been the rock lobster fishing industry including both fishers and processors, and the State and Federal agencies responsibly for the rock lobster fisheries.

Review of the Subprogram in 2005

The external review of the Subprogram commissioned by the FRDC was strongly supportive of its work for the rock lobster industries in Australia,

The FRDC decided to continue to support the Subprogram.

A new project was funded, **2006/210 "Rock Lobster Subprogram Project 1: facilitation, administration and promotion of the FRDC Rock Lobster Subprogram"**

It is to continue for a period of 18 months until 31 12 2007 after which time it will either be absorbed into the Seafood CRC, if the bid is successful, or the subprogram will cease operations at the completion of the 18 month duration.

Possibility of the Subprogram becoming part of a CRC bid

A bid to establish a CRC “The Australian Seafood Cooperative Research Fund” was made in 2006.

The bid was successful. The Rock Lobster Post-Harvest Subprogram is due to conclude on 31 December 2007 and much of the research and development previously guided by the Subprogram will be incorporated into the CRC.

Conclusions

An independent Subprogram Leader and a highly responsive Steering Committee that is composed of industry experts from across Australia have made this possible. The Steering Committee, under the Subprogram Leaders direction, worked as an integrated group, rather than a collection of individuals, and carefully selects and recommends projects for funding, and then follows their progress and offers advice and assistance to the principal investigators, in the national interest. The industry representatives on the Steering Committee have also acted to provide research facilities within the industry as the best locations to conduct research, and ensuring the uptake of improved post-harvest handling practices as soon as they are identified.

This is a very successful subprogram and strongly supported by industry, particularly in Western Australia. The Subprogram publications:

Optimising Water Quality, Dr Bradley Crear and Dr Grant Allen

Recirculating Systems $NH_{3,\ Dr}$ Bradley Crear, Dr Jennifer Cobcroft and Dr Stephen Battaglene

Rock Lobster Health and Diseases: A Guide for the lobster industry, Dr Frances Stephens, Seema Fotedar and Professor Louis Evans

Best Practice in the Western Australian Lobster Industry, WAFIC, Richard Stevens

Codes of Practice for handling cooked and live lobsters on delivery to overseas markets.

Are well received by industry in both Australia and New Zealand, and we receive requests for these publications from many other countries.

The newsletter “Lobster News” has also been successful. The format is straight forward, and includes a range of material in each issue. Demand has increase to approximately 8000 per issue.

The industry has strongly supported the application to FRDC for renewal of the Subprogram, clearly indicating there appreciation of its value to the rock lobster industry.

References

In the August September 2003 Edition of *Fishing Today* the "FRDC Rock Lobster Post-Harvest Subprogram" was described.

Williams, H. G., Davidson, G. W. and Mamo, J. C. (2003). Heat –induced activation of Polyphenoloxidase and western rock lobster (*Panulirus cygnus*) hemolymph: Implications for heat processing. Journal of Food Science **68**: 1928-1932.

Freeman, Colin (2004) Southern rock lobster into China The Lobster News, September Issue.

Paterson, B. D., Spanogue, P. T., Davidson, G. W., Hosking, W., Nottingham, S., Jusilla, J., and Evans, L. H. (2005). Predicting survival of western rock lobster *Panulirus cygnus* using discriminant analysis of haemolymph parameters taken immediately following simulated handling treatments. New Zealand Journal of Marine and Freshwater Research **39**: 1129-1143.

Final Reports Received and passed to FRDC

FRDC 1999/202. Rock Lobster Autopsy Manual. PI Professor Louis Evans

FRDC 2000/250: Facilitation, administration and promotion of the post-harvest Subprogram. PI Professor Bruce Phillips

FRDC 2000/251 – Development of a method for alleviating leg loss during post-harvest handling of rock lobsters. PI Dr Glen Davidson

FRDC 2000/252 – Optimising water quality in rock lobster post-harvest process. PI Dr Brad Crear and Dr Stephen Battaglene

FRDC 2001/235 – Striking a balance between melanosis and weight recovery in western rock lobster. PI Dr Hannah Williams

FRDC 2001/255 – Optimising water quality in rock lobster post-harvest process. PI Dr Brad Crear and Dr Stephen Battaglene

FRDC 2002/237– A code of Practice for Handling Rock Lobster. PI Richard Stevens

FRDC 2002/ 238--Quantification of shell hardness in southern rock lobster. PI Dr Caleb Gardiner

FRDC 2002/239 – The effect of on board cold water stunning on the survival and growth of caught and returned western rock lobsters. PI Dr Glen Davidson

Appendices

Appendix 1-Intellectual Property

As a result of this project, a further submission was made to FRDC for continuation of the RLPHS, in a modified form.

Appendix 2 - Staff

Professor Bruce F. Phillips**,** Department of Environmental Biology, Muresk Institute,
Curtin University of Technology, GPO Box U1987, Perth, WA 6845, Australia
b.phillips@curtin.edu.au

Appendix 3-Workshop Publications

Proceedings of the Annual Workshop V held in Perth in October 2003

Proceedings of the Annual Workshop VI held in Port Lincoln in September 2004

Proceedings of the Annual Workshop VII held in Hobart in October 2005

Copies of each of the proceedings are attached.

Appendix 4

Newsletter 6

This was issued in February 2004.

Newsletter 7

This was issued in September 2004

Newsletter 8

This was issued in August 2005

Newsletter 9

This was not issued as a separate Newsletter. In order to increase circulation, it was incorporated into R&D News Volume 14 Number 3, issued in August 2006.

Copies of all Newsletters are attached.

Appendix 5

Annual Operating Plan 2006

Rock Lobster Post-Harvest Subprogram

Subprogram Leader Dr Bruce Phillips

A) ACTIVITY DESCRIPTION FOR LAST 12 MONTHS

SECTOR PROGRESS

The demand for live lobsters to overseas markets continues to be maintained for western and tropical rock lobsters. However, the demand and price for southern rock lobsters has declined particularly in Taiwan and China.

Opportunities exist for increased sales of southern rock lobsters in the EU and the US but improvements in transportation techniques and marketing are needed to make use of these opportunities. Because of this two new projects have been developed for submission to FRDC in the current round.

In the 2004/2005 season a catch of 12,142 kg was recorded for the western rock lobster fishery.

MAJOR RESEARCH OUTPUTS OF THE SUBPROGRAM

The “Clean Green” strategy for the southern rock lobster achieved two separate environmental awards during the year. All of the video material used for this program was produced for this fishery under the Post- Harvest Subprogram.

A number of projects were completed and Final Reports submitted:

FRDC 2000/251 **– Development of a method for alleviating leg loss during post-harvest handling of rock lobsters. PI Dr Glen Davidson**

FRDC 2001/255 **Quantifying and controlling hyper- and hypersaline-induced post-harvest leg autonomy in the western rock lobster. PI Dr Glen Davidson**

FRDC 2002/239 **– The effect of on board cold water stunning on the survival and growth of caught and returned western rock lobsters. PI Dr Glen Davidson**

Project 2001/235 **– Striking a balance between melanosis and weight recovery in western rock lobster. PI Dr Hannah Williams**

A new Project 2005/223: “Rock Lobster Post Harvest Subprogram: evaluation of alternative processing technologies applicable to crustaceans. PI Dr Hannah Williams was initiated.

Newsletter Number 8 was distributed at the Workshop and Conference in Hobart. This issue presented the cover and non technical report of each of the recently completed research project.

iii) RELATED PROJECTS AND RESEARCH LINKAGES

A special project was initiated to transfer some of the information gained from the western rock lobster studies to the southern rock lobster fishery**.** A Curtin University funded project was initiated and completed. Impact of heat on PPO in southern rock lobster hemolymph. PI Dr Hannah Williams. The results were presented at the Workshop in Hobart in October 2005.

There is a direct link to the Rock Lobster Aquaculture and Enhancement Subprogram, as the Subprogram Leaders sit on both Steering Committees.

The Subprogram Leader attends the Steering Committee meetings of the Enhancement and Aquaculture Subprogram, and the Leader of the Enhancement and Aquaculture Subprogram attends the meetings of this Subprogram Steering Committee.

iv) ROLE THE SUBPROGRAM HAS PLAYED IN INDUSTRY DEVELOPMENT

The most dramatic activities in the last 12 months have been the revision of the Code-of Practice for the western rock lobster, (2000/237) incorporating sections on, reducing appendage loss, holding of lobsters in display tanks, methods of humane killing, truck transport, and water quality for holding post harvest lobsters.

The release of the new separate code for southern rock lobsters is a major achievement

A Code for tropical rock lobsters is still to be accepted by industry, but will be pursued in the following year.

v) OPERATING PROCEDURES

During the year the Subprogram Leader visited SARLAC in South Australia, and the Institute of Fisheries in Tasmania, on behalf of the Subprogram.

Discussions were held with industry and industry groups, seeking to identify industry post-harvest problems, with a view to solving these problems.

Two new projects will be submitted in the current round (1 December 2004) to FRDC by this Subprogram arising directly from these activities.

A further increase was made of email during the year as a method of communication within the Subprogram, thereby increasing the amount of Steering Committee interaction in the Subprogram on a whole range of issues.

vi) MEETINGS AND WORKSHOPS:

The annual Workshop was held in Hobart in October 2005.

Steering Committee meetings of both this and the RLEAS Subprograms were held in Melbourne in March 2005 and in Hobart in October 2005.

Two Scientific Committee meetings were held in Perth.

Two meetings were held in Adelaide to assist proponents in the preparation of the application to improve marketing profitability in the southern rock lobster.

vi) SUMMARY OF CURRENT PROJECT STATUS

2003/241 Rock Lobster Post-Harvest Subprogram: Strategic planning, project management and adoption

PI Professor Bruce Phillips

Project Objectives:

Co-ordinate the FRDC Rock Lobster Post-Harvest Subprogram

- Conduct an annual research workshop to present outcomes from the Subprogram to industry and the public, and to define research objectives for subsequent years
- Facilitate travel of industry members, and Subprogram leader to biannual Steering Committee meetings
- Facilitate travel of the Subprogram principal investigators, industry members and Subprogram Leader to biannual scientific committee meetings
- Co-ordinate the preparation of Subprogram media releases and workshop publications
- Integrate with other FRDC funded rock lobster research programs including the FRDC Enhancement and Aquaculture Subprogram
- Co-ordinate the preparation and distribution of a biannual Subprogram newsletter

- Develop and maintain a strategic plan for post-harvest rock lobster research
- Continually supervise the scientific studies within the Subprogram

Due to conclude on 30 June 2006

2003/242 Value adding the southern rock lobster fishery – optimising flesh quality of under-valued large lobsters for the sashimi market

PI Dr John Carragher

Project Objectives:

- Determine flesh quality characteristics of commercially caught southern rock lobster from different locations, seasons, sizes, moult stages and shell colour etc
- Determine flesh quality characteristics of southern rock lobster held long term in tanks
- Correlate flesh quality indicators with data from experienced sensory analysis panels

Excellent progress has been made in this project and the current activities are centred on product testing.

This project is slightly behind schedule, but the outcomes are assured.

2005/223: Rock Lobster Post Harvest Subprogram: evaluation of alternative processing technologies applicable to crustaceans

PI Dr Hannah Williams

Project Objectives:

To determine the standard processing protocol for the three alternative cooking methods, steam, steam plus pressure and microwave cooking

- To investigate factors impacting on uptake of water and antibrowning agents during drowning of rock lobster, correlated to associated weight recovery and melanosis development
- To evaluate the impact of alternative cooking methods (microwave cooking, steam, and steam plus pressure) on weight recovery and melanosis rates
- To evaluate the post-production sensory quality of rock lobster processed by alternative cooking methods in comparison to rock lobster processed using standard practice (boiling)
- Optimisation of processing methods
- Information extension to industry to enable maximal adoption of results

This project is established and progressing well. Some equipment has still to arrive.

B) NEW STRATEGIC PLAN

A new Strategic Plan has just been completed and placed on the Subprogram section of the FRDC Website

FRDC Rock Lobster Post-Harvest Subprogram

To ensure that Australia obtains the maximum value for its rock lobster catch

Strategic Outputs	Key Performance Indicators	Target
Enhanced capacity to be internationally competitive and make informed market decisions	**Market data and competitor and buyer behaviour research**	**2008**
Optimal product quality and processing efficiency	**Enhance processing practices**	**2010**
Quality assured supply chains delivering differentiated product to market	**International transport & product packaging**	**2008**
Capacity to -maintain and expand live and other pack styles export markets with maximum returns	**Supply chain management of products for increased profits**	**2009**

Introduction

The catches of Australia's rock lobster fisheries are at or near their maximum level. However, adding value to the rock lobster catch will ensure continuing and improved profits for industry. This can be achieved by way of enshrining maximum quality on delivery to the processing factories, maximum survival of live lobsters shipped to overseas destinations, perfect cooking regimes for the portion of the product processed for this market, the maximum recovery during processing, a continuous maintenance and upgrading of handling

conditions, maintaining and improving health and safety conditions, and having respect for community welfare concerns.

The Fisheries Research and Development Corporation established the Rock Lobster Post-Harvest Subprogram (RLPHS) in 1996 and it was renewed in 1999. A major objective of the Subprogram for several years was to ensure delivery to the processing factories of rock lobsters that are alive, intact (no limbs missing) healthy and strong, so that they are in a condition suitable for live export. Not all such lobsters are exported live. However, this has provided the processor/marketer with the greatest choice, and lobsters cooked and frozen that are in this condition, provide greater percentages of flesh recovery. The studies conducted under the Subprogram have shown that rock lobsters at the time of capture are healthy and vigorous and that all of the reductions in condition are the result of less than perfect handling and transport conditions on the way to the factory.

The Subprogram has been successful in significantly increasing the number of lobsters delivered to the factories is in a condition suitable for live export. Research over the last five years has targeted methods to reduce limb loss both on board the vessel and during transport and within factories. The identification of a correlation between saline films and limb loss was a significant breakthrough. Other research identified the best conditions, particularly oxygen, temperature and ammonia levels, under which to hold live lobsters prior to export, to ensure maximum survival and quality of the lobsters exported to the international markets. Improvements in post-harvest handling practices, including health and safety issues, have been introduced into the industry through a Code-of Practice, and “clean green” programs.

Not all lobsters are exported live, and a recent study has been directed in reducing the blackening of the flesh which can occur when existing cooking methods are used. A proportion of the cooked western rock lobster go black and this results in a product that is unacceptable to the customer. This blackening is known as melanosis and is caused by an enzyme called polyphenoloxidase (PPO). Melanosis is a major problem for the western rock lobster industry and it has been estimated that it costs the industry over $1 million per year. We have not fully solved this problem, but significant progress has suggested that a solution is in sight.

The markets for rock lobsters and the product forms in which they are sold constantly change. There has been a dramatic change from frozen products to live marketing of a large portion of the catch. Due to these changes industry faced new challenges to retain, maintain and expand markets and profitability. These markets are changing again because of the global nature of the market and there are significant opportunities for new products and markets.

The purpose of the Subprogram is to work with industry to identify the opportunities and priorities to enhance products and profitability and to assist industry meet these challenges. It then seeks to identify and support the research needed to provide answers to permit industry to grasp these

opportunities, in a cost effective and timely manner. The outcomes of the research are rapidly provided to industry in a form that allows industry to capture the benefits of the research for the Australian industry.

The global market for lobsters now demands Australia to compete effectively in these markets, and the subprogram assists in ensuring that there the capacity to achieve this to allow the industry to maintain and improve its competitive advantage.

New Strategic Plan 2005-2010

There are many areas of the supply chain for the rock lobster industry that are worthy of investigation. These include quality, value-adding, traceability, health such as residue testing, packaging, processing technologies that include modern cooking and freezing techniques, market data research, analysis of overseas competitor activities, etc. The new Strategic Plan commencing in 2005 identifies four of these areas for attention. These four areas are all sections of the supply chain in which applied research can improve profitability for the Australian rock lobster catch in the domestic and global market place.

Priorities

Enhanced capacity to be internationally competitive and make informed market decisions

To understand global lobster markets, Australian lobster industries require information on their market position relative to each other and other exporting nations resulting in increased understanding by stakeholders of pressures, drivers and economic trends in the global lobster industry. A Global Lobster Market Database was developed in 2004, collating information about prices and volumes of western rock lobster competitors and markets and corresponding data for other lobster producing and importing nations. This project now requires expansion to include both southern and tropical rock lobsters and identify trends in markets enabling development of predictive models by industry, and assisting to develop long-term strategic plans where industry “fishes to the market”. With such information on the global market, the Australian lobster industry becomes a significant and powerful competitor, addressing needs and wants of consumers rather than being dictated to by commodity markets, remaining a valuable contributor to the Australian economy.

Optimal product quality and processing efficiency

Many aspects of processing to ensure maximum product quality are already the subject to research supported by individual companies. However, while this assists the initiator to be competitive it does not cause a flow-on to the rest of industry, at least for a number of years. The world is a rapidly

changing place and it needs industry wide improvements to maintain maximum efficiency against global competitors.

The Subprogram is currently conducting research to evaluate alternative processing technologies for cooking, applicable not only to lobsters but to other crustaceans including prawns and crabs. Other areas of current interest are new packaging concepts including recyclable packaging, and freezing technique effects on storage and flesh quality.

Quality assured supply chains delivering differentiated product to market

The Subprogram already has a project examining practicality of using undervalued, large, southern rock lobsters for a sashimi market.

Many other opportunities exist, including a newly proposed project extracting chitin and associated derivatives from rock lobster waste, thereby providing an increased profit from a by-product of the industry.

Capacity to maintain and expand live and other pack styles export markets with maximum returns

Of high priority is the need to improve live transportation techniques & technologies for live southern rock lobster, to increase survivability and quality of lobster upon arrival to the existing overseas markets, and in new markets in Europe and China. Considerable research has been conducted in this area concentrating on western rock lobsters, which a number of studies have found to be very different physiologically to southern rock lobsters. A new research project to solve these problems for the southern rock lobster and to implement them in the fisheries of Tasmania, Victoria and South Australia is being developed.

Special attention has been paid to developing the new Strategic Plan for the Post-Harvest Subprogram to ensure that it full conforms to:

(a) The Fisheries Research and Development Corporation, Research and Development Plan 2005-10

(b) The Tasmanian Fisheries and Aquaculture Research and Development, Strategic Plan 2005-2008

(c) The Australian Southern Rock Lobster Strategic Horizons 2003-2008

(d) The West Coast Rock Lobster Strategic Plan 2004-2009

C) COMMUNICATION AND TECHNOLOGY TRANSFER ACTIVITIES

Annual Workshop

The proceedings of the Port Lincoln Workshop in 2004 were distributed.

The annual Workshop, which as usual was a combined event with the Rock Lobster Enhancement and Aquaculture Subprogram, was held in Hobart on October 2005 as an integral part of the industry run Rock Lobster Congress.

Talks presented were:

Rock Lobster Post-Harvest Program Overview – Prof Bruce Phillips

Evaluation of alternative processing technologies applicable to crustaceans – Dr Hannah Williams

Evaluation of polyphenoloxidase – Dr Hannah Williams

Determining Flesh Quality Attributes of Undervalued Large Southern Rock Lobsters – Dr John Carragher

Improving Live Transportation Techniques and Technologies for Southern Rock Lobster – Mr Matt Muggleton

Global market database project application – Ms Alice Hurlbatt

The proceedings of the Hobart Workshop are currently being prepared for distribution.

Subprogram Publications

The Subprogram has now released the following publications:

Optimising Water Quality, Bradley Crear and Grant Allen

Recirculating Systems $NH_{3,\ Bradley}$ Crear, Jennifer Cobcroft and Stephen Battaglene

Rock Lobster Health and Diseases: A Guide for the lobster industry, Frances Stephens, Seema Fotedar and Louis Evans

Best Practice in the Western Australian Lobster Industry, WAFIC, Richard Stevens

Best Practice in the southern rock lobster fisheries, WAFIC, Richard Stevens

A pamphlet outlining the results of the studies to reduce melanosis in boiled rock lobsters, Hannah Williams

Impact of boiling on weight recovery and blacking in the western rock lobster. Hannah Williams

These are available free from the Subprogram Secretary. There is considerable demand for these publications.

The Subprogram Newsletter number 8 was issued in September/October 2005. It was forwarded to all rock lobster endorsement holders in WA. SA, Vic and TAS and other interested persons throughout Australia and overseas.

D) PROPOSED NEW RESEARCH

Support for new projects by the Subprogram

The following projects have been examined by the Steering Committee and are recommended to the FRDC for consideration for funding.

Title	PI	Amount requested	Total Cost	Priority for Funding
A global data base on rock lobster production and marketing	Tony Gibson	107,240	228,240	1
Improving live transportation techniques & technologies for live Southern Rock lobster) to increase survivability and quality of lobster upon arrival to the existing and new markets	Matt Muggleton	470,038,80	1,425,228,80	1
Preparation of chitin and associated derivatives from rock lobster waste using novel green chemistry techniques	Professor Colin Raston	127,595	230,595	2
Rock Lobster Subprogram	Professor Bruce Phillips	225,682	273,182	

The Subprogram Leader has supplied letters to FRDC in support of these projects.

E) WORK PLAN FOR NEXT 12 MONTHS

Work plans for the individual projects are set out in their milestones. The Subprogram Leader will be following these up with each PI.

A Scientific Committee meeting is planned for March 2006.

Steering Committee meetings are planned for March 2006 in Adelaide and in Christchurch, New Zealand in September 2005.

Two Newsletters will be issued in 2005. The first will be issued in March 2006 and the second in September 2005.

Renewal of the Subprogram

This Rock Lobster Post-Harvest Subprogram (RLPHS) was initially established in 1996. In 1999 an independent review was commissioned by FRDC. The review recommended the continuation of the Subprogram, with an increased requirement for industry to play a more dominant role in determining what, if any, research is carried out in the post-harvest sector. A new project was established in 2003 and it encompassed these recommendations.

This present project is due to conclude on 30 June 2006. A review of the Subprogram is to be conducted towards the end of 2005. After discussion with some representatives of the FRDC I have lodged an application for renewal of the Subprogram, but with modifications. This application is made to comply with the normal time lines for applications

Clearly some modifications may be needed to take account of the recommendations of the review.

A second complication is that the work of the Subprogram is included as part of the planned bid for the Seafood CRC. The third objective of the proposed CRC is 'Enhancing cost-effective production, supply and processing'. This is already the objective of the FRDC Rock Lobster Post-Harvest Subprogram. The objective of enhancing cost-effective production, supply and processing will lead to a more competitive and profitable fishery, and if this leads to a safe, secure, food supply, which results in a healthy, well nourished population for Australia we will have a multiple benefit from the same achievements.

FRDC representatives had suggested that I apply for a 9 month extension to the Subprogram cover the time until the bid for the Seafood CRC is assessed. However, after several discussions with Industry I propose to make an application for a new contract for 3 years, which the FRDC may decide to modify to 9 months.

F) BUDGET

In the last AOP (2005) stated that:

“The Subprogram has plans for reissuing two pamphlets for Asian buyers of our lobster products. These pamphlets were originally produced many years ago by WRILDA. These will include both Japanese and Chinese summaries. We expect to approach FRDC for a small contribution to the costs of these productions.”

These have now been progressed this and have received design approval from the Steering Committee. We are just in the translation of the summaries stage.

Costs to date are:

(a) Design and development $4950+3850 = $8800

(c) Printing Costs for 500. WRLDA will contribute $2000 towards the printing cost

My estimate is no more than $12,000 in total.

I will have final figures before Christmas. If I have approval can we supply a separate Invoice for the correct amount at 31 December?

G) RECOMMENDATIONS/VARIATIONS

Following discussions with WAFIC and the Rock Lobster Council in Western Australia, I have modify the application for renewal of the Subprogram to remove the restriction to post-harvest issues, and suggested it deal with issues related to wild capture fisheries, but not to enhancement or aquaculture of lobsters.

Appendix 6

Australian Government
Fisheries Research and Development Corporation

FRDC Rock Lobster Post-Harvest Subprogram

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Strategic Plan for 2005 – 2010

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Research Program

A summary of the Subprogram projects since 1999 is presented below:

	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08
1994/132.02 – Code of Practice. PI Richard Stevens.								
1996/344 – Physiological studies of stress and morbidity during post-harvest handling and storage of western rock lobster: 11 Standard autopsy techniques and immune system competency. PI Professor Louis Evans								
1996/345 - Physiological studies of stress and morbidity during post-harvest handling and storage of western rock lobster: 1 Physiological Stress Indicators. PI Dr Brian Paterson								
1999/202 – Rock Lobster Autopsy Manual. PI Professor Louis Evans								
2000/250 – Facilitation,								

administration and promotion of the FRDC Rock Lobster Post-Harvest Subprogram. PI Professor Bruce Phillips								
2000/251 – Development of a method for alleviating leg loss during post-harvest handling of rock lobsters. PI Dr Glen Davidson								
2000/252 – Optimising water quality in rock lobster post-harvest process. PI Dr Brad Crear and Dr Stephen Battaglene								
2001/235 – Striking a balance between melanosis and weight recovery in western rock lobster. PI Dr Hannah Williams								
2001/255 – Quantifying and controlling hyper-and hypo-saline-induced post-harvest leg autonomy in the western rock lobster. PI Dr Glen Davidson								
2002/237 – A code of Practice for Handling Rock Lobster. PI Richard Stevens								
2002/ 238 – Quantification of shell hardness in southern rock lobster. PI Dr Caleb Gardner								
2002/239 – The effect of on board cold water stunning on the survival and growth of caught and returned western rock lobsters. PI Dr Glen Davidson								
2003/241 - Rock Lobster Post-Harvest subprogram: strategic planning, project management and adoption PI Professor Bruce Phillips								
2003/342 - Value-adding the southern rock lobster fishery-optimising flesh quality of under-valued large lobsters for the sashimi market. PI Dr John Carragher								
Impact of heat on PPO in southern rock lobster hemolymph. PI Dr Hannah Williams								
2005/223: “Rock Lobster Post Harvest Subprogram: evaluation of alternative processing								

technologies applicable to crustaceans PI Dr Hannah Williams								

Publications

A number of publications have arisen from studies conducted within the Subprogram. The following are some recent papers, which will be of interest:

1 Jussila, J., McBride S., Jago, J. and Evans, L. H. (2001) Hemolymph clotting time as an indicator of stress in western rock lobster (*Panulirus cygnus* George). Aquaculture 199, 185-193.

2 Paterson, D. B., Davidson, G.W. and Spanogue, P. T. (2001) Identifying stress when western rock lobsters are stored out of water: The average and individual blood lactate concentrations. Contact Aquatic Science Research Unit, Curtin University of Technology, Perth.

3 Paterson, D. B., Davidson, G.W. and Spanogue, P. T. (2001) Measuring total protein concentration in blood of the western rock lobster (*Panulirus cygnus* George). Contact Aquatic Science Research Unit, Curtin University of Technology, Perth.

4 Powell, M., Crear, B. and Allen, G. (2001) Lobsters in the toilet: Acid-base effects of ammonia exposure in the spiny lobster *Jasus edwardsii*. Presented at the Australian and New Zealand Society of Comparative Physiology and Biochemistry, Adelaide, December.

5. Williams, H. G., Davidson, G. W. and Mamo, J. C. (2003). Heat –induced activation of Polyphenoloxidase and western rock lobster (*Panulirus cygnus*) hemolymph: Implications for heat processing. Journal of Food Science 68: 1928-1932.

Subprogram Publications

The Subprogram has now released the following publications:

Optimising Water Quality, Bradley Crear and Grant Allen

Recirculating Systems $NH_{3,\ Bradley}$ Crear, Jennifer Cobcroft and Stephen Battaglene

Rock Lobster Health and Diseases: A Guide for the lobster industry, Frances Stephens, Seema Fotedar and Louis Evans

Best Practice in the Western Australian Lobster Industry, WAFIC, Richard Stevens (Video and DVD)

Best Practice in the southern rock lobster fisheries, WAFIC, Richard Stevens (Video and DVD)

A pamphlet outlining the results of the studies to reduce melanosis in boiled rock lobsters, Hannah Williams

These are available free from the Subprogram Secretary.

Full copies of FRDC final reports (see Appendix 8) are available as hard or electronic copies from the FRDC website www.frdc.com.au/research.

Annual Workshop

The last Annual Workshop was held in Port Lincoln in November 2004. Copies of the proceedings are available from the Subprogram Secretary.

In 2005 the annual workshop will be held in Hobart in October, in conjunction with the industries Rock Lobster Conference.

Selecting Research Projects

With the help of the FRDC, the rock lobster industry throughout Australia has the opportunity to capture new opportunities and increase its profitability.

This Subprogram examines applications through a Steering Committee composed of industry members. Therefore applications considered worthy of support go to FRDC with a solid industry backing. FRDC values this evaluation process in its annual examination of the projects to be considered for funding.

To make this process effective, the Subprogram makes an annual call for pre-proposals of applications to be sent to it for examination. This occurs in June each year. These should also be sent to the State Fisheries Research Advisory Bodies that provide an examination priorities, value to industry in that State, the level of funding sought, and the type of work to be undertaken. Both the Subprogram and the FRAB's, prioritise, comment and rank these applications to ensure that they are targeted to specific needs.

An electronic form is available to streamline this process. Copies can be obtained from the individual State Fisheries Research Advisory Bodies. A list of the FRABs may be found on the FRDC website www.frdc.com.au The Steering Committee meets twice a year, and during these meetings examines applications for possible support by the Subprogram.

Applications must be submitted to the FRDC on 1 November each year.

Ideas for applications can be discussed with the Subprogram Leader at any time of the year. This is encouraged, as it usually takes some months to work with industry to develop applications to a state sufficient for submission to the FRDC.

Further Information

Additional information on the Rock Lobster Post-Harvest Subprogram including all of the newsletters can be accessed by visiting the web-site www.frdc.com.au/research/programs/rlph/index.htm or by contacting the Subprogram Leader (b.phillips@curtin.edu.au) or the Subprogram Secretary, Emma Phillips (emmaphil@ozemail.com.au).

Appendix 7

Subprogram Publications

The Subprogram has released the following publications which are distributed free:

Optimising Water Quality, Dr Bradley Crear and Dr Grant Allen

Recirculating Systems $NH_{3,\ Dr}$ Bradley Crear, Dr Jennifer Cobcroft and Dr Stephen Battaglene

Rock Lobster Health and Diseases: A Guide for the lobster industry, Dr Frances Stephens, Seema Fotedar and Professor Louis Evans

Best Practice in the Western Australian Lobster Industry, WAFIC, Richard Stevens

Best Practice in the southern rock lobster fisheries, WAFIC, Richard Stevens

Impact of boiling on weight recovery and blackening in western rocklobster Dr Hannah Williams

These are available free from the Subprogram Secretary, or Leader.

Full copies of FRDC final reports are available as hard or electronic copies from the FRDC website www.frdc.com.au/research.

Appendix 8

Final Reports

A number of projects were completed and Final Reports submitted to FRDC:

FRDC 1999/202. – Rock Lobster Autopsy Manual. PI Professor Louis Evans

FRDC 2000/250: Facilitation, administration and promotion of the post-harvest Subprogram. PI Professor Bruce Phillips

FRDC 2000/251 – Development of a method for alleviating leg loss during post-harvest handling of rock lobsters. PI Dr Glen Davidson

FRDC 2000/252 – Optimising water quality in rock lobster post-harvest process. PI Dr Brad Crear and Dr Stephen Battaglene

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FRDC 2002/237– A code of Practice for Handling Rock Lobster. PI Richard Stevens

FRDC 2002/ 238--Quantification of shell hardness in southern rock lobster. PI Dr Caleb Gardiner

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All reports can be ordered from the Website www.frdc.com.au either as hard or electronic copies.