

Final Report

FRDC Project 2011/225

Using Industry Expertise to Build a National Scheme for Grading of Live Mud Crabs

Developing the Australian Industry Live Mud Crab Grading Scheme



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Fisheries Research and Development Corporation

Using Industry Expertise to Build a National Scheme for Grading of Live Mud Crabs

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The assistance of the Sydney Fish Market (SFM) in hosting the forum and the work of John Mayze and Sue Poole from the Department of Agriculture Fishery and Forestry - Queensland (DAFF QLD) were critical factors in the success of the forum and the extension of the outcomes. John's involvement and commitment to the project has been integral to its success. Brad Warren's (OceanWatch) facilitation assistance, as an industry advocate at the forum, provided a balanced link between industry needs and the project's outcomes.

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Glossary

| Acronym | Description |
|-----------------|---|
| ACT | Australian Capital Territory |
| C-AID | C-AID Consultants |
| CI | Co investigator |
| Co-Ops | Co-Operatives |
| CUC | Commercially Unsuitable Crabs |
| DAFF Qld | Department of Agriculture Fishery and Forestry Queensland |
| FRADS | Fresh Adjustments |
| FRDC | Fisheries Research and Development Corporation |
| NMCIRG | National Mud Crab Industry Reference Group |
| NSW | New South Wales |
| NT | Northern Territory |
| PI | Principal investigator |
| Qld | Queensland |
| RD&E | Research Development & Extension |
| SA | South Australia |
| SFM | Sydney Fish Market |
| TRF | Tactical Research Fund |
| Vic | Victoria |
| WA | Western Australia |

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1 NON-TECHNICAL SUMMARY

| | |
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| Project No. 2011/225 | Using Industry Expertise To Build A National Scheme For Grading Of Live Mud Crabs |
|-----------------------------|--|

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Sue Poole DAFF Qld.

1.1 OBJECTIVES

- 1 Identify key industry representatives from the live mud crab supply chain across key states and territories to attend a forum
- 2 Hold a forum to develop a universal, industry-driven, Australian grading scheme for live mud crabs
- 3 Extend the agreed scheme to all sectors
- 4 Evaluate adoption of the scheme
- 5 Production of professional media extension capturing outcomes from the workshop.

1.2 OUTCOMES

As outlined below the project lead to a large number of outcomes that provided significant benefit to the Australian live mud crab industry supply chain. These include;

- Agreement on an easy to use, national, industry-driven, grading scheme for live mud crabs (the Australian Industry Live Mud Crab Grading Scheme) and the development of a range of material to extend the scheme widely
- Industry ownership and support for the grading scheme has been evident, with many sectors, individuals and groups taking the scheme on board, including the Sydney Fish Market (SFM) adopting the Australian Live Mud Crab Grading Scheme as part of its grading guidelines.

- Improved revenue return to the supply chain through a reduction in downgraded live mud crab, resulting in maximum price per unit. Even though not formally adopted until December 2012, data indicates up to a \$1.40/kg increase in value for properly graded product at the SFM since the forum.
- Supply chain partners have indicated greater consumer satisfaction and less disagreement due to the development of the extension material and easy to use grading scheme. With the formal launch of the scheme on 3rd December 2012, in conjunction with the SFM, the linking with key sector sites and groups, and all of the material going live, it is anticipated that as consumers become better informed in their decision making process when choosing mud crab, there will be elevated consumer confidence to buy premium quality, live mud crab, engendering more frequent purchases.
- The linking of project 2010/302 and this project has seen far greater utilisation of Research, Development and Extension (RD&E) resources along the supply chain. Six trips were undertaken jointly to meet with key people and groups along the supply chain (NT x 2, NSW x 2, Vic x 1, Qld x 1), and the linking of best handling and grading became intertwined. In addition, when work on either project has taken place by the individual project teams, the opportunity to cross reference the projects has allowed the combined knowledge of the projects to be further extended.
- The forum methodology, which focused on providing optimal input from industry, was extremely well supported and can serve as a template for future whole of supply chain meetings.
- The benefits of using professional media/design personnel as part of capturing outcomes from the workshop and developing extension material proved very successful and resulted in production of high quality, client focussed, targeted material.
- Other benefits from the project have been;
 - the formation of the National Mud Crab Industry Reference Group (NMCIRG)
 - development of closer links with OceanWatch/SeaNet through involvement of the OceanWatch Chair at the forum, and the linking of YouTube material to sites that increases their link to industry as an extension hub
 - opportunity to instigate interaction with the recreational community to assist them in how best to fish for mud crabs to optimise quality, as this process is often unknown to untrained or novice mud crab fishers
 - possible adaption and extension of the grading scheme to the fledgling northern Western Australian mud crab fishery.

1.3 KEYWORDS

Mud crab, grading scheme, quality, facilitation, extension, industry, supply chain.

FINAL REPORT

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|----------------------|---|
| Project No. 2011/225 | Using Industry Expertise To Build A National Scheme For Grading Of Live Mud Crabs |
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2 BACKGROUND

Mud crabs provide a valuable commercial fishery in Australia and are estimated to generate over \$100 million in retail and restaurant sales every year. They are also a highly prized recreational catch and an important source of food for many indigenous Australians.

Mud crabs are commercially caught in the Northern Territory (NT), Queensland (Qld), and New South Wales (NSW), and there is an industry in its infancy in Western Australia (WA).

Mud crabs are sold to every state and territory in Australia, and currently there is an export market for top grade product into a number of Asian destinations. The importance of live mud crabs to the Australian market is highlighted by the fact that they now represent the highest value of product going through the Sydney Fish Market (SFM).

From a commercial perspective many people are involved in the process of putting a mud crab on the consumer's plate - from catchers to transport operators to wholesalers to retailers to restaurant chefs. Most mud crabs travel to their final point of sale alive, and the quality of the crab at its final destination -- its meat content and 'liveliness' - has a major impact on price, or even whether it can be sold, as poor quality mud crabs may be rejected by buyers along the chain.

Historically, there have been different interpretations of quality grading along the supply chain between crabbers, wholesalers and retailers across Australia. There have been differing views as to what makes a 'top quality' mud crab and, more importantly, what constitutes a 'poor quality' mud crab that buyers may reject and/or refuse to pay for. This issue has been open to a wide range of personal views, has been highly emotive, and has greatly impacted on revenue and relationships throughout the supply chain.

The problems with variable mud crab grading systems were consistently highlighted through two research projects funded by the Fisheries Research and Development Corporation (FRDC). These projects (FRDC 2003/240¹ and 2010/302²) aimed to firstly determine best-handling practices for live mud crabs and, secondly to inform the supply chain about the results. These two projects indicated that many active industry members along the supply chain throughout the various jurisdictions were unclear of quality based grading parameters for live mud crabs, and had little understanding of the supply chain for their product.

¹ FRDC 2003/240 - Maximising revenue within the NT Mud Crab Fishery by enhancing post-harvest survival of mud crabs

² FRDC 2010/302 - Equipping the mud crab industry with innovative skills through extension of best practice handling

There were different perceptions between catchers, between buyers and between jurisdictions (for example, between the NT and Qld). To address this, a national system was proposed and supported by industry to ensure catchers, buyers and marketers had a consistent, workable grading system for the entire industry – that is from trap to plate.

To assist with the development of such a system, the FRDC supported an independently facilitated national forum through a Tactical Research Fund (TRF) FRDC Project 2011/225 entitled *'Using Industry Expertise to Build a National Scheme for Grading of Live Mud Crabs'*. The forum brought together people from throughout the supply chain, and from across Australia, to develop an industry-driven, objective and mutually-agreed Australian grading scheme for live mud crabs.

Twenty two participants covering the major State and Territory key industry groups, some regional centres, and key supply chain participants -- catchers, distributors and buyers - attended the forum at the SFM in January 2012. Through a process of consensus the Australian Industry Live Mud Crab Grading Scheme was developed.

Based on industry needs, a wide range of professional materials has been developed in conjunction with media and design experts to extend information about the agreed scheme to the commercial supply chain, and other sectors.

3 NEED

Differing interpretations of grading for live mud crabs between fishers and buyers was highly emotive and greatly impacted industry revenue and relationships throughout the supply chain. Live mud crabs are the SFM's most valuable product, but are one of its most time consuming and problematic products, mainly due to grading issues. The urgent need for a national grading scheme was illustrated by the high level of confusion existing within all industry sectors. Many currently active industry members indicated they were unclear of quality grading parameters for live mud crab.

At the time of the project's genesis the above was compounded by environmental conditions that created an oversupply and low mud crab prices at market. Floods in Qld resulted in 'old' crab with little meat content entering the market in higher than normal proportions, as well as an abundance of newly moulted 'empty' crab that have little meat content and are more susceptible to mortality within the supply chain, and are therefore lower priced.

With newly adopted improved handling practices, developed through FRDC Project 2003/240 and extended through FRDC Project 2010/302, harvesters were looking to shore up existing supply chains and seek new markets, but were experiencing various grading interpretations, or dealing with buyers who had no little idea of how to grade mud crabs.

As live mud crabs are part of a complicated and extensive supply chain nationally (see Figure 1 for a very simple example), supply and price fluctuations are felt by all jurisdictions and all parts of the supply chain.

This situation can also lead to a lack of consumer confidence (and understanding) in purchasing a ‘quality’ mud crab. This impacts industry revenue across the whole supply chain because if a consumer purchases a crab with poor meat content/quality, these consumers may be unwilling to purchase or recommend the particular product line again.

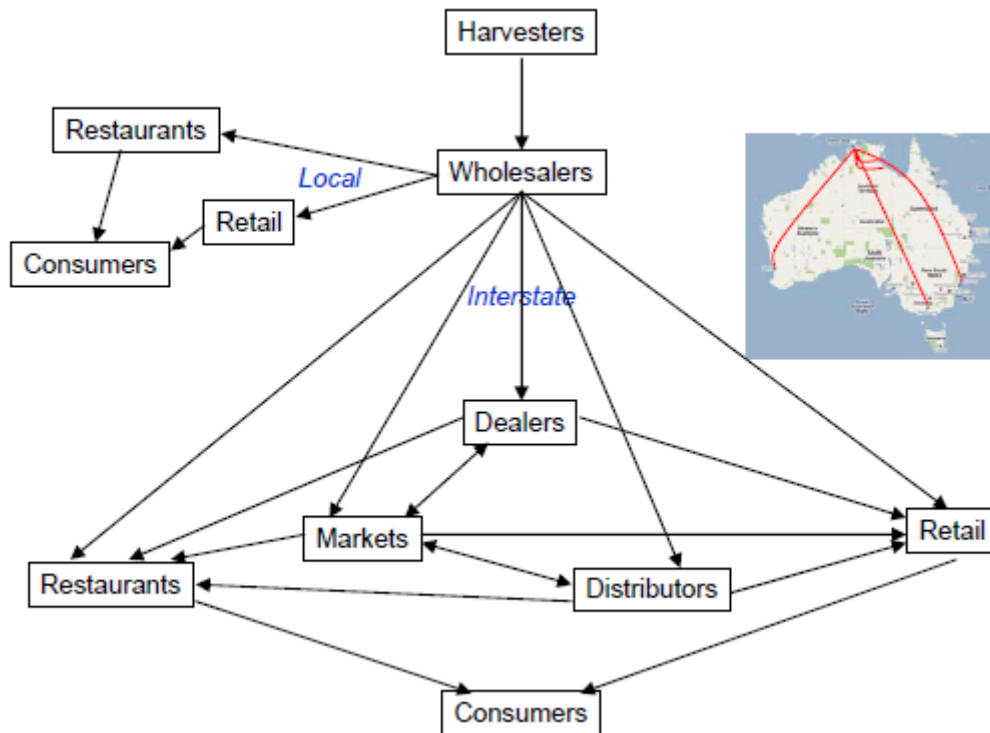


Figure 1: Sample of One Catcher’s Distribution Chain from the NT to Domestic Markets (from Final Report FRDC Project 2010/302).

There was also overwhelming industry support to develop a universal, objective, agreed and workable scheme. The national scheme was supported by major industry groups involved in the Australian industry (see the list of industry project supporters – Attachment 1), with a view to ensuring harvesters, buyers and marketers had consistent gradings for live mud crab.

Some initial attempts had been made to develop grading schemes, but in all instances they had been produced by an individual or an organisation, and not across the supply chain and jurisdictions. The process used in this project was different and it was felt it would have the greatest chance to generate strong national industry buy in.

Further, with a Qld crab management review in progress, the development of a grading scheme was considered timely by some industry groups, as it was felt it may assist the transition to any adjusted management regime.

As the catch of mud crab is a major component of the recreational fishery, in many jurisdictions, it was considered important to provide educative material on how to tell if a crab had little meat, or was of poor quality and would be best returned to the water to allow it to improve in quality.

4 OBJECTIVES

- 1 Identify key industry representatives from the live mud crab supply chain across key states and territories to attend the forum
- 2 Hold a forum to develop a universal, industry-driven, Australian grading scheme for live mud crabs
- 3 Extend the agreed scheme to all sectors
- 4 Evaluate adoption of the scheme
- 5 Production of professional media extension capturing outcomes from the workshop.

5 METHODS

The methodology was developed across three key components of the project;

1. The industry forum – participants, process, logistics and development of the grading scheme
2. The extension of forum outputs
3. Assessment of the uptake of the outputs.

These are outlined below.

5.1 INDUSTRY FORUM

5.1.1 Participants and Logistics

As part of FRDC project 2010/302 there had been extensive contact with industry participants involved in the live mud crab supply chain across Australia. That project identified key industry representatives and participants who had expressed overwhelming support and a desire to participate in a forum to resolve issues around grading definitions. The strong industry support for the forum and proposed approach has been outlined previously.

The process to bring key commercial industry stakeholders from along the supply chain and from key regions together in one room for an independently facilitated forum was a key aspect of this project. A robust process that had industry support was designed to ensure there was the greatest chance to get industry buy-in and ownership of the grading scheme.

It was critical that the forum was undertaken in such a way as to enhance industry participation prior to, during, and after the workshop, as well as to maximise the outputs and outcomes that would be generated. For those reasons, the process to identify participants and facilitators, and develop the program format, was a very important component of the project.

It was agreed by the Project Team (the PI and CIs) to limit total forum participant numbers so as to allow full participation (this was supported informally by industry members contacted) and participants were to be selected from;

- Chairs of formal industry groups, or their nominated representatives
- Key wholesalers and major retailers, based on throughput and/or extension networks; and
- Key buyers (consolidators), based on volume of purchase or number of clients.

Contact was made with a large number (40 plus) of potential participants (individuals, businesses, associations etc) by email, letter, phone calls and face to face discussions, seeking Expressions of Interest (EOI) (see Attachment 2 for sample correspondence provided to potential participants).

It was noted that the upper number for funded participation was limited by the budget, with funding for travel and accommodation for up to 18 participants. It was also determined that local participants, who didn't require travel and accommodation, would be limited by the possible need for additional space, facilitators etc, if interested numbers were too high. A cap of a maximum of 25-30 participants was set for the forum.

The Project Team identified the need to have criteria to determine suitable applicants coming through the EOI process (if there was an oversubscription), to ensure that people with the necessary skill sets, representative spread and/or extension networks took part in the forum. A matrix was developed that assessed potential participants' profiles against the criteria to ensure coverage from each key state/territory and each supply chain sector, and with a key condition that participants be actively involved in the industry.

It was acknowledged that the final participant list may be a 'moving feast' as potential participants had to determine their availability (business, weather, etc considerations) closer to the forum date, and that final participation would firm up closer to then.

5.1.2 Developing the Forum Agenda and Processes

As part of developing the forum agenda, the Project Team met face to face three times and maintained ongoing telephone and email contact to develop the participant list, workshop format and to identify venue, accommodation and travel requirements.

It was proposed that the forum be independently facilitated and take place through an interactive participant process at a cost effective venue early in 2012.

It was agreed that the forum be scheduled to run over 1½ days to allow sufficient time for matters to be fully discussed, and consensus based outcomes and recommendations developed. Day two would also provide an opportunity to cook the graded mud crabs to test any grades developed on day one.

From a logistics point of view, the SFM was considered an ideal venue as it had appropriate facilities, there was access to product, was centrally located, and was proximate to reasonably priced accommodation (the SFM readily agreed to the proposal).

As outlined previously, the aim of the forum was to develop a universal, Australian, grading scheme for the mud crab industry through an industry driven process. To achieve this, the forum was to be structured as follows;

- Focus on interactive facilitated dialogue between participants to discuss the existing grading protocols -
 - Identify the various grading 'schemes' and processes in place for live mud crab to illustrate differences and similarities between existing methodologies
 - Undertake subjective testing, using existing methodologies, ('feel', touch, visual weight etc) to highlight both the current vagaries and similarities of grading processes and interpretations
 - Stream the subjective grading assessments live to the forum using multi-media to provide visual confirmation of parameters as being discussed
 - Use group facilitation processes to develop consensus based decisions to set grade definitions
 - Use group facilitation processes to develop consensus based decisions on the boundaries for each subjective grade (especially for 'top grade' and the 'lowest grade').
 - These boundaries to be tested and reinforced through objective measurement of total blood protein by assessing the refractive index (RI) via a process developed by Qld DAFF³ (this method can be correlated to total meat content, which is the basis of the majority of disputes of crab being out of grade)
- The agreed grade definitions to be recorded using written documentation and visual formats (using media professionals to capture pictures, video, commentary) to remove ambiguity during extension
- To provide greatest impact, the subjectively and objectively graded live mud crabs would be individually marked, cooked by standard methodology (18 minutes per kilogram in boiling water), and provided to the forum to illustrate meat content within each defined subjective grade. These cooked crabs would be assessed by forum participants to retest the grading system identified on day 1. Any discrepancies would then be reassessed

³ John Mayze in prep

- A direct output from the forum would be documented grading definitions and a scheme to assess the grade as an industry-friendly and culturally appropriate format for extension to the wider industry.
- Appropriate formats for extension were to be determined at the forum by the participants and professional media and design personnel engaged to ensure quality material produced
- The Project Team and forum participants were to investigate the relevance and practicalities of converting the grading scheme to a numerical continuous scale to provide finer definition within the grades (i.e. similar to the numerical 100-point scoring system for wine).

Facilitation was to be undertaken independently to ensure that the ownership of the outcomes belong to industry, not to any particular group, jurisdiction or organisation.

5.1.3 Extension of Forum Outcomes:

The outcomes of the grading scheme forum were to be distributed widely across jurisdictions, along the supply chain, and across sectors.

The Project Team proposed the following extension model to the forum participants for feedback, endorsement or variation;

- The grading scheme to be disseminated to industry members throughout the mud crab supply chains by the forum stakeholders via their usual communication networks, with the support of the Project Team
- Extension be amplified by other relevant media such as industry magazines, newsletters, brochures, YouTube and similar electronic technologies
- Additional synergistic extension take place through FRDC project-2010/302 during face to face interactions with individual industry members
- To increase confidence in product purchase, opportunities would be sought to raise the awareness of consumers through various channels, such as appropriate websites, field days, festivals, and specific launches.
- The grading scheme would be provided to the recreational sector for dissemination through their peak bodies and via YouTube links.

Forum participants were to be requested to consider the appropriateness of the above extension methods and provide additional concepts.

Where appropriate, and practical, professional media personnel and extension design experts were to be used to ensure that high quality material was produced.

5.1.4 Evaluate Adoption of the Scheme

The level of industry awareness of the grading scheme was to be measured after an implementation period (to be determined at the forum) and by feedback during face to face

meetings undertaken during the concurrent FRDC project 2010/302. The degree of confidence in grading live mud crab within sectors would be evaluated.

Measurement and assessment of the impact of the grading standards would be undertaken through the number of 'Fresh Adjustments' (FRADS) reported through SFM, compared between pre and post adoption periods.

The level of formal support/uptake for the scheme at an industry level would be assessed as practicable.

6 RESULTS AND DISCUSSION

This section assesses the project's results and seeks to review the effectiveness of the processes used, the success of the methods employed, and where possible, provide guidance for any follow up work.

In addition, details of the Australian Industry Live Mud Crab Grading Scheme are reported on and discussed.

6.1 FORUM PARTICIPANTS

Based on the Project Team's knowledge of the industry, and contacts identified through FRDC project: 2010/302, a draft participant list was developed. A number of individuals and organisations also expressed an interest in being involved in the forum, and these were considered by the Project Team, with a view to ensuring there was a mix of participants that best aligned with the forum participation criteria and matrix.

The draft list was provided to key industry members for comment. Based on feedback, a final proposed participant list was developed and invitations sent out (see copy of generic invitation at Attachment 2).

The forum date aligned with the opening of the Qld barramundi season, and as a number of operators in that state have endorsement, or entitlements, to take barramundi as well as mud crab, this meant some potential participants could not attend. They however provided input to other participants who attended on their behalf. In addition, the workshop coincided with a potentially severe tropical storm that was impacting on those operators in the Gulf of Carpentaria, and this meant that at least one participant had to withdraw the day prior to the workshop – he also was happy to have existing representatives present his view on his behalf.

Due to operational and business constraints a small number of the initial invitees were unable to attend. Replacement participants were identified through the network and invited as necessary. Twenty two participants covering the catching, transport, wholesale and retail aspects of the industry accepted to attend, along with the Project Team (see Table 1 and Figure 2).

Table 1: Forum Participants

| Industry Participants | State | Supply Chain Role |
|-----------------------|--------|--|
| Adam Jin An | NSW | Buyer, Wholesaler, Distributor |
| Beni Iakoba | NSW | QA Officer |
| Bob Appo | Qld | Crabber |
| Brad Warren | NSW | Industry Advocate/facilitator |
| Chris Calogeras | Qld | Facilitator |
| Dave Perkins | Qld | Crabber, Industry Representative |
| David Caracciolo | NT/Qld | Wholesaler, Distributor, Retailer |
| David Chung | NSW | Buyer, Wholesaler, Distributor |
| David Tran | Vic | Wholesaler, Distributor, Retailer |
| Doug Neville | NT | Owner, Industry Representative |
| Erik Poole | NSW | Supply Liaison Manager |
| Hung Seow Yong | NT | Buyer, Wholesaler, Distributor |
| John Harrison | NSW | Industry Representative |
| John Mayze | Qld | Industry Scientist/facilitator |
| Lawrie McEnally | NSW | Crabber |
| Peter Jackson | Qld | Crabber, Industry Representative |
| Scott Bolton | Qld | Crabber |
| Shane Geary | NSW | Wholesaler, Distributor, Retailer |
| Sherwood Thorbjornsen | NT | Owner, Transport, Wholesaler |
| Spencer Wilkinson | Vic | Wholesaler, Distributor, Retailer |
| Sue Poole | Qld | Industry Scientist |
| Tony Reisenwebber | Qld | Owner, Wholesaler, Industry Representative |
| Troy Billin | NSW | Crabber |
| Wes Gordon | Vic | Wholesaler, Distributor, Retailer |

**Figure 2:** Participants at the Australian Industry - Live Mud Crab Grading Forum – Sydney, January 2012

Developing a matrix to identify potential participants prior to commencing the EOI process allowed the Project Team to ensure that as wide a spread of expertise as possible was maintained during the invitation process; i.e. if a potential participant could not attend, an alternative who fitted the desired criteria could be found. In addition, by sharing the initial participant list with key industry stakeholders it ensured that as far as possible each sectors' needs were addressed.

Overall the participant identification process proved successful in indentifying a wide range of participants from across the supply chain and key/major jurisdictions.

6.2 THE AGENDA AND FORUM PROCESSES

6.2.1 Agenda

It was a critical part of the project design to ensure that there was broad industry involvement and engagement as part of the development of the forum agenda, process and logistics. This was to engender industry buy in through involvement, and to provide the necessary flexibility for industry participants to be involved.

The agenda focussed on;

1. Perspective Setting
 - aim, scope, processes
 - introduction of participants
2. Information Exchange
 - What is already happening?
 - What has taken place to date (FRDC projects, NT Code of Practice, Co-Operatives [Co-Ops], SFM grades etc)?
3. Key Questions that Need Answering
 - What's the end point look like?
 - How do we get to the end point - can we use what is already in place, adapt, or start afresh?
 - What science or proof is there to back up any scheme?
 - How accurate and repeatable are the tests?
 - How do we extend the scheme, including identification of existing networks?

With the above in mind, the final agenda was developed and provided to forum participants as shown in Table 2. All agenda items were covered during the forum.

Table 2: Final Forum Agenda

| Australian Industry - Live Mud Crab Grading Scheme Forum 31 st January and 1 st February 2012. Sydney Fish Market, Pyrmont, NSW | | |
|---|---|------------------------------|
| DAY 1 AGENDA | | |
| Time | Topic | Facilitator/Speaker |
| 9.30 | Welcome and Forum Overview | Chris |
| 9.45 | Introduction of Participants | Brad |
| 10.15 | Morning tea | |
| 10.30 | Existing grading systems | Chris |
| 10.45 | Discussion on Grading Parameters – session 1 <ul style="list-style-type: none"> • Liveliness of crab • Physical attributes of crab <ul style="list-style-type: none"> ○ damage ○ shell hardness ○ other | Chris John Sue |
| 12.00 | Using Refractive Index (RI) of blood as indicator of potential meat yield | John |
| 12.20 | Recap morning session | Chris |
| 12.30 | Lunch at SFM | |
| 1.15 | Discussion on Grading Parameters – session 2 <ul style="list-style-type: none"> • Shell Hardness/Flex Index <ul style="list-style-type: none"> ○ how to test ○ where to test ○ other issues | Chris John Sue Brad |
| 2.30 | Afternoon tea | |
| 2.45 | Agreement on Grading Parameters <ul style="list-style-type: none"> • Liveliness of crab • Physical attributes of crab | Chris |
| 3.15 | Development of a Grading Flow Chart and Grading Index | Brad, Chris |
| 4.50 | Recap day 1 and set direction for Day 2 | Chris |
| 6.30 | Refreshments - Dinner – venue to be advised | |

DAY 2 AGENDA

| Time | Topic | Facilitator/Speaker |
|-------------|---|----------------------------|
| 6.00 | Sydney Fish Market Auction Tour | Erik |
| 8.30 | Breakfast – meeting room | Brad |
| 9.00 | Recap and question session from Day 1 | Chris |
| 9.30 | Cooked Crab Visual evaluation | John |
| 10.15 | Final Grading Discussions and Resolutions | Chris, Brad |
| 11.30 | What Happens From Here? <ul style="list-style-type: none"> • production • distribution • education • adoption | Chris, Brad, Sue, John |
| 1.00 | Forum Close | Chris |

6.2.2 Forum Processes

This forum was the first of its kind in Australia to bring participants from across the live mud crab supply chain together in one place. This had its challenges due to the, at times, factional nature of the industry, and some individual's concerns about 'intellectual property'. However, it became very clear that industry participants believed that there was

a critical need to put these matters aside, with a view to developing a scheme that would be for the betterment of the industry as a whole. This was assisted by clearly outlining the purpose and scope of the forum prior, during, and after the forum, to make it clear there were no hidden agendas.

Before the final contract was signed between the PI and FRDC, a variation to the project was arranged that provided resources to professionally photograph and video aspects of the workshop, so as to be able to develop high quality extension material. Strategy First PR & Marketing was engaged for this aspect of the project. Strategy First PR & Marketing were provided with relevant information to allow necessary footage and photographs to be taken to produce an informative and descriptive video showing the grading scheme in detail, and to also provide key still shots for reports and other media. The Project Team worked with Strategy First PR & Marketing to develop a 'script' for filming (that aligned with the agenda) so that what were believed to be key shots could be captured during the forum. Where possible shots (still and video) were taken during actual forum processes, but if adequate shots were not available these were later staged.

Through forum participants, live mud crabs of various quality were sourced from NSW, Qld and the NT for use during the grading component of the forum. The venue, most meals and workshop equipment (including some crabs of various grades for testing and cooking) were supplied by the SFM.

Using consensus based decision making tools and processes ensured that the views of all participants were taken on board, and all outcomes were agreed to unanimously. This was achieved by round-table acknowledgment of each participant during the forum, and out of session follow-ups with each participant by the facilitators, to double check meeting decisions.

Significant time was put into ensuring that the agenda (

Table 2) and forum processes would not only meet industry needs, but also allow the project objectives to be achieved and its outcomes supported. This included ongoing checks with participants as to satisfaction with how each session was progressing.

Buy in was achieved through extensive industry involvement in all aspects of the forum, and by utilising the skills of the three facilitators to cover various aspects of the forum.

To ensure each facilitator was working toward the same outcome a working sheet was developed outlining the item, key person, session aim and process to be followed (see Attachment 3). Facilitators' roles were;

- Chris Calogeras took on an overall coordinating role throughout the workshop, and focussed on collecting the relevant data, ensuring continuity and transition between sessions, and reconfirming each session output
- John Mayze and Sue Poole provided a range of technical information from which industry participants could link scientific information to the more subjective process used in the grading process - this proved invaluable

- Brad Warren, from OceanWatch, was used in an Industry advocate role, and when working to reach agreement on issues where agreement was not readily forthcoming.

This overall process worked extremely well and was strongly supported by industry participants (see comments and support at Attachment 4).

Due to the extensive work undertaken prior to the workshop through previous FRDC projects, the Project Team's experience, and through discussions prior to and early in the forum, it became clear what the end point was for a 'quality' live mud crab. That is a lively mud crab that is full of meat. Having a clear and agreed end point made it easier to work through the various parameters to best achieve that outcome.

The overall process used during the forum focussed on developing consensus based decisions on the boundaries for each subjective grade (especially for 'top grade' and the 'lowest grade'). The methodology was based on setting critical points that could be assessed for each crab as it was being graded.

The other key component of the process was to be able to test the subjective parameters and measures through a series of objective measurements. DAFF Qld had, over previous years, undertaken extensive blood sampling and other analysis to test mud crab quality and stress levels (see FRDC project-2010/302 Final Report for details). High stress levels are indicative of an animal that is more prone to mortality, and crabs that are not 'lively' or are dead are of lower or no value in the market.

The objective tests as to meat quantity were undertaken by testing the blood protein levels via a process developed by DAFF Qld (this method, refractive index (RI) can be correlated to total meat content, which is the basis of the majority of disputes about crab being out of grade). This technique is a reliable reference method, but at this stage it is not feasible as a field tool for unskilled persons or to do large volumes of crab. The accuracy of this method was highlighted on day 2 when the subjective tested crabs were cooked and the prediction of meat quantity based on RI was assessed.

All issues discussed and agreed to were recorded by facilitators/scribes on whiteboards or through a live computer screen, so participants could be kept abreast of what had been discussed. A live picture feed, using one, two or three screens at any time, depending on need, was also available to show forum participants any particular tests that were being undertaken on crabs.

The process worked extremely well and led to the development of an agreed, easy to use grading scheme that is applicable across all parts of the supply chain.

6.3 Development of the Australian Live Mud Crab Grading Scheme

Forum participants agreed on a simple to use national scheme for grading live mud crabs that was based on the steps that people along the supply chain should utilise (sometimes subconsciously).

The first cut of the scheme was arrived at by the close of day one, and the detail and decision points are shown at Table 3. The table shows the grading parameter or attributes, the descriptor and the steps or actions to be taken. The table also indicates whether a still shot or video, or male (M) or female (F), shots were required for extension material.

Figure 3 was shown to the forum participants to provide some visual guidance of the hypothetical type of scale that could be developed. It was noted that the transition areas between grades (the grey areas) were more difficult to be specific about. That is identifying what is a really good crab and what is a really poor crab was easy to gain consensus about, but it becomes more difficult as the crab quality moved closer to the next grade; i.e. the transition from a hypothetical 1st to 2nd and 2nd to 3rd etc as show in Figure 3.

| 1 st GRADE | Transition 1 to 2 | 2 nd GRADE | Transition 2 to 3 | 3 rd GRADE | transition | GRADE |
|--|-------------------|---|-------------------|---|------------|-------|
| Hard both sides nice clean Legs etc | | Maybe one side hard Some damage Missing legs etc | | Soft both sides Scared/scaly Badly damaged etc | | |

Figure 3: Example of Hypothetical Grading Scale Showing Unclear or ‘Grey Areas’ at Transition Zones between Grades.

Consideration of names for the grades, e.g. 1st, premium, A1, Super etc were discussed by forum participants. By the close of day one the forum participants decided, by consensus, on a three tier grading system; A grade (first quality), B Grade (medium quality, ranging from almost A grade to almost C grade), and C Grade (low quality and at times unacceptable in some markets or jurisdictions). The grades were developed using the attributes worksheet developed during the forum (Table 3).

There was agreement by consensus that to be classified as a top grade crab (A Grade) the crab would need to meet a range of parameters relating to physical attributes (e.g. level of damage and wear and tear) as well as physiological attributes related to ‘liveliness’ (e.g. no frothing, level of response to stimuli, and amount of movement). However the key determinate related to the degree of shell hardness and the amount of flex, or lack of it.

Table 3: First Cut Live Mud Crab Grading Scheme (1st version – day 1)

| Grading Parameter | | Description | Step/ action | Video/photo (M/F) |
|-------------------|----------------|--------------------------------------|------------------|-------------------|
| Mud crab | Scylla species | Different species | Reject | P |
| | | Correct species | Continue | V |
| | Alive | Dead | Reject | V or P |
| | | Alive | Continue | |
| Claws | Number | None | Reject | |
| | | One | ‘One claw’ grade | P |
| | | Two | Continue | |
| | Uniform size | One claw >30% smaller than the other | ‘One claw’ grade | V or P M&F |
| | | Close to even size | Continue | |

| | | | | |
|-------------------|-------------------|--------------------------------------|---------------------------------|--------|
| | 'Teeth' Condition | Very worn (old crusty) | Reject or 'B' grade | V or P |
| | | No sign of wear (new moult) | Reject or 'B' grade | V or P |
| | | Some wear | Continue | V or P |
| Legs and flippers | Number | 4 or more missing (or both flippers) | Reject or 'B' grade | V or P |
| | | 1-3 missing (but not both flippers) | Mark as legs missing - Continue | V or P |
| | | All intact | Continue | V or P |
| Carapace | Damage | Heavily scarred (crusty) | Reject or 'B' grade | V or P |
| | | Some minor damage | 'B' grade | V or P |
| | | Bleeding | ?? | V or P |
| | | No damage | Continue | V or P |
| | Belly colour | Transparent | Reject | V or P |
| | | Semi transparent or opaque | 'B' grade | V or P |
| | | Fully opaque, solid colour | Continue | V or P |
| Vigour | Frothing | Excessive or dark frothing | Reject | V |
| | | Slight frothing | 'B' grade | V |
| | | No frothing | Continue | V or P |
| | Legs | Very limp, no strength | Reject or 'B' grade | V |
| | | Limp, weak | 'B' grade | V |
| | | Strong | Continue | V |
| | Eyes | No response | 'B' grade | V |
| | | Respond to movement/touch | Continue | V |
| Shell | Shell hardness | Very soft, easily flexed | Reject | V M&F |
| | | Slight flex with moderate pressure | 'B' grade | V M&F |
| | | Hard with firm pressure | 'A' grade | V M&F |
| Rejects? | | | | |
| | CUC | Empty | ??? | |
| | Contaminated | Maggots, oil, fuel | Reject | |
| | Legal size | Undersize | Reject | |
| | Berried female | Berried | Reject | |
| | Claws | No claws | Reject | |
| | Damaged | Badly damaged | Reject | |
| | XS Soft shell | Excessively soft shell | Reject | |
| | Frothing | Heavily frothing | Reject | |
| | Deformed | Deformed, diseased, parasitic | Reject | |

Participants identified a number of areas where shell hardness can be tested as a proxy for meat content. Shell hardness can be a sound indicator of meat quantity as crabs need to moult to grow to a larger size. As part of that process they shed their old shell, expand in size by increasing the level of 'water' in the body, and then wait for the shell to harden at the larger size. In this immediate post moult stage the crab has little or no meat (as low as 20% of total body weight) and the shell is very thin and flexible. Over a short time (3-4

weeks) the shell hardens and the meat content within the shell increases (up to 35% of total body weight), and the crab body and claws becomes full⁴.

At the completion of day 1, a sample of the variously graded crabs (A, B and C grade, male and female) were cooked using standard methodology (cooking in boiling water for 18 minutes per kilogram), and then immediately chilled in ice slurry until the core temperature reached 4°C. Each crab was then opened up and the claws cracked to show meat content. The amount of meat in a claw is an excellent indicator of overall meat content (Figure 4). A full claw equates to a full meat crab.



Limited meat content - Immediate post moult



Full meat content - estimated 4- 6 weeks post moult

Figure 4: Example of full claws and post moult claws with little meat content.

On day 2, to determine what the final grading scheme would be participants compared the subjectively graded crabs that had also been assessed by RI and then cooked. This showed that the subjective testing and grading as undertaken on day 1 was a very good guide to determining meat quality/quantity. It also showed that the use of RI is an accurate predictor of meat quality.

The draft flowchart that indicates the process to determine the grade of a live mud crab is shown in Figure 5. This was sent out to forum participants for feedback and then revised into the final flowchart as shown in Figure 6.

⁴ Further information on this can be found at Fact Sheet – ‘Testing live mud crab for meat fullness’ developed by John Mayze, DAFF Qld

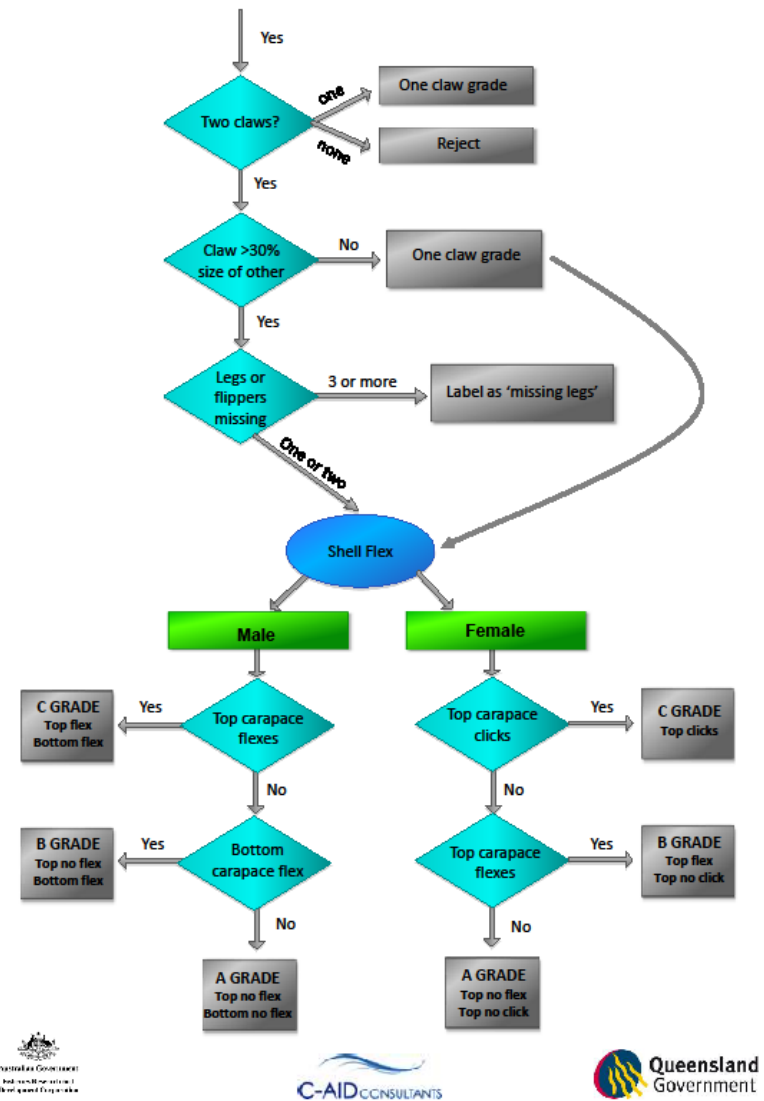
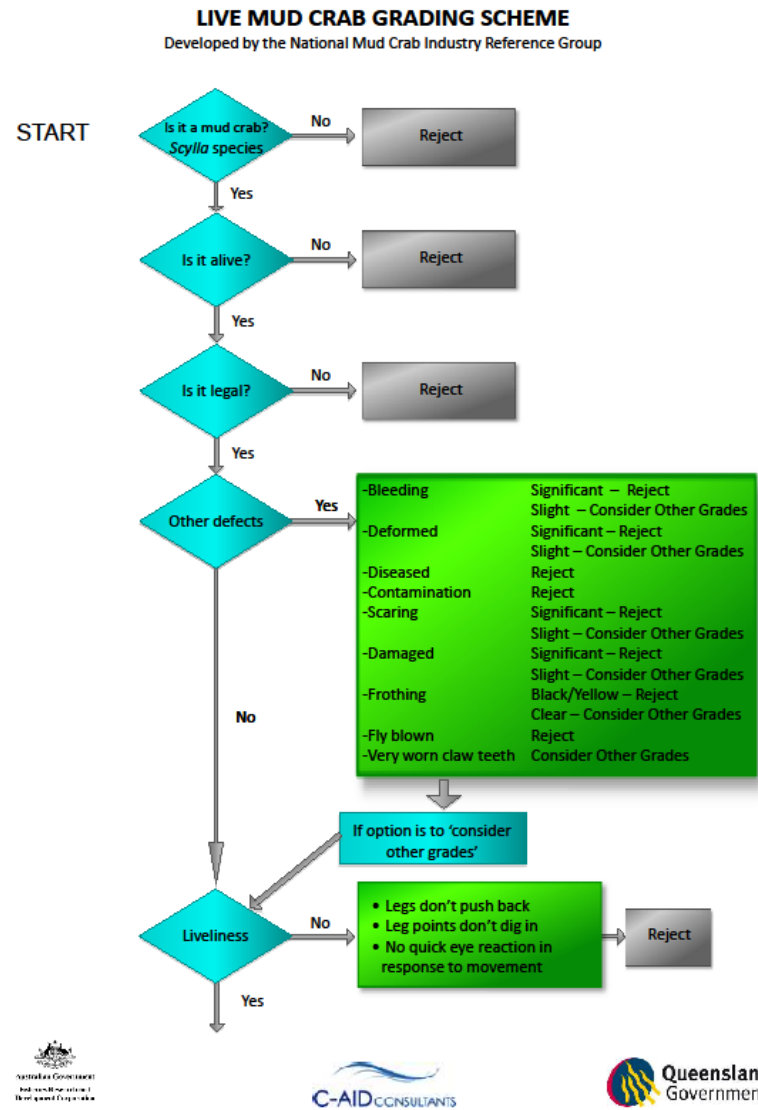


Figure 5: Draft Flow Chart Developed at Forum and Provided for Comment to Participants and Key Industry Links

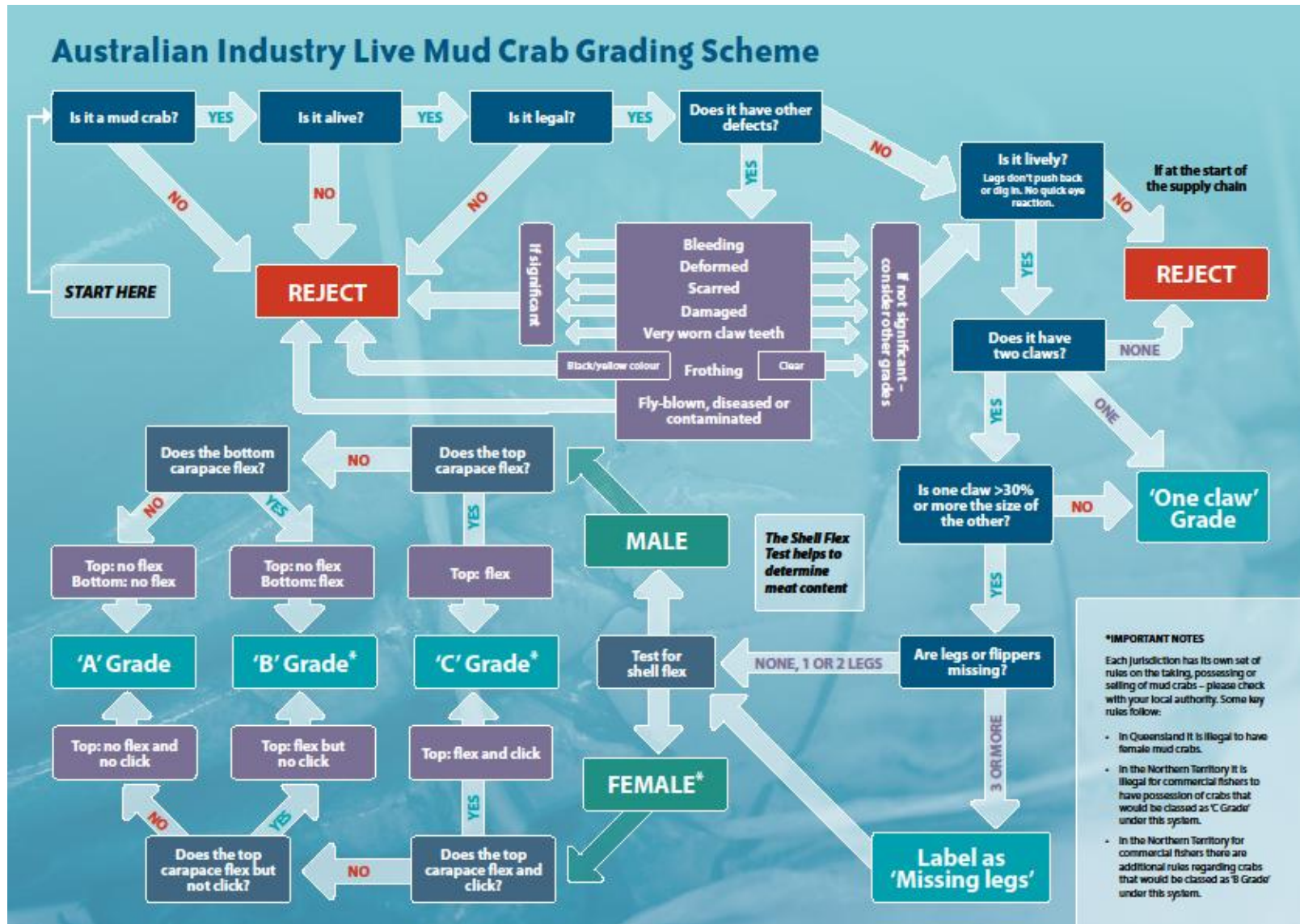


Figure 6: Final Flowchart Showing Australian Industry Live Mud Crab Grading Scheme

Forum participants agreed to a range of determinates being used to grade mud crabs based on shell flex (acknowledging that there are a number of parameters to be considered prior to the shell flex test coming into play).

Following is the agreed methodology to test for shell flex for live mud crabs.

Male Mud Crab Shell Flex Test

The major area to test for males is on the underside carapace of the animal, and in some instances on the top of the carapace (for very low grade crabs). Based on these tests the forum participants came to the following agreed position and specific processes for male crab grading, based on shell flex. Following is the full descriptor for testing shell flex in male mud crabs. This is described in much greater detail in the Crab Standards Guide (see Attachment 5).

Male Mud Crab Top Carapace Test

To test if the top carapace flexes on a male mud crab, hold the crab in your palms (abdominal flap facing down) and then place thumbs on the carapace in line with the widest part of the carapace and where the string is (or would be if the crab was tied up) and press gently (Figure 7). If the shell has no give then press more firmly to see if there is any shell flex. If the shell flexes at all it should be graded as **C GRADE**.

(NB - it was noted at the forum that this grade is illegal in the NT and is termed Commercially Unsuitable Crab (CUC), it will also not be accepted by many traders).

Figure 7 If the shell has no give then press more firmly to see if there is any shell flex. If the shell flexes at all it should be graded as **C GRADE**.

(NB - it was noted at the forum that this grade is illegal in the NT and is termed Commercially Unsuitable Crab (CUC), it will also not be accepted by many traders).

Figure 7: How to hold and test the top of a male mud crab for shell flex.

Male Mud Crab Underside Carapace Test

The standard way to test shell flex on the underside (bottom carapace) in male mud crabs is to hold the crab in both hands, with palms facing upwards and the abdominal flap of the crab facing upwards (Figure 8).

To test for shell flex, place your thumbs on the middle segments (next to the 2nd walking legs and either side of the flap) and press gently (see **X** on Figure 9). If the shell has no give then press more firmly to see if there is any shell flex on either side.

You can test each of the six segments if you wish but the middle segments (marked **X** Figure 9) are the last ones to harden up and if solid, the others will also be (unless they have been damaged by previous thumb tests).

If the shell flexes at all on any segment it should be graded as **B GRADE**.

(NB - it was noted at the forum it is illegal to sell a male mud crab in the NT if both of the middle segments flex – it is termed a CUC).

If there is no flex on the top or any bottom segments of the carapace the crab can be graded as **A GRADE**.



Figure 8: How to hold a male mud crab so as to test for bottom for shell flex.

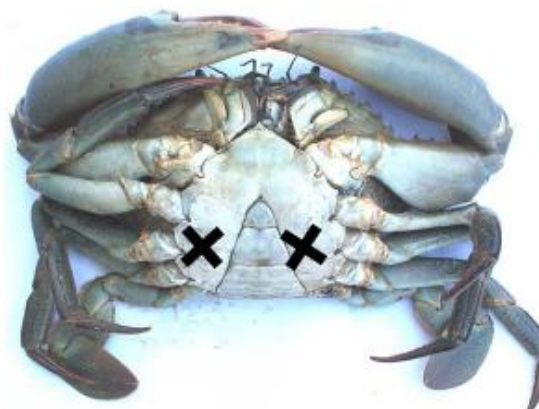


Figure 9: Where to test the bottom carapace of a male mud crab for shell flex.

Female Mud Crab Shell Flex Test

The only area to test for females is on the top of the carapace. Along with possible shell flex, if the crab has recently moulted, there may be a very clear and audible clicking sound. Based on these tests the forum participants came to the following agreed position and specific processes for female crab grading, based on shell flex.

Following is the full descriptor for testing shell flex in female mud crabs.

Female Mud Crab Top Carapace Test

The standard way to test shell flex on the top carapace in a female mud crab, is to hold the crab in both hands, palms facing upwards, and abdominal flap facing down (Figure 10).

Place thumbs on the carapace, in line with the widest part of the carapace and where the string is (or would be if the crab was tied up) and towards the front quadrant, and press gently (see **X** on Figure 11). If the shell has no give you can then press more firmly to see if there is any shell flex and an associated 'clicking' noise.

If clicking occurs the crab should be graded as **C GRADE**.

(NB - it was noted at the forum it is illegal to sell a female mud crab in the NT if both sides click – it is termed a CUC. It will also not be accepted by many traders).

If the shell has no give then press more firmly to see if there is any shell flex on either side.

If the shell flexes (but doesn't click), the crab can be graded as a **B GRADE**.

If the shell has no flex on the top carapace and doesn't click, the crab can be graded as **A GRADE**.



Figure 10:How to hold a female mud crab so as to test the top carapace for shell flex



Figure 11: Where to test the top carapace of a female mud crab for shell flex and click.

The flowchart (see Figure 5 and Figure 6), grading criteria and descriptors (Table 3) was distributed to all forum participants and there was no feedback indicating that system did not satisfy requirements along the supply chain, and there were no changes suggested that altered the scheme.

The scheme was also tested more widely during extension, as part of FRDC project 2010/302, and again there was overwhelmingly supported. Some negative comments related to queries around C Grade and also in some instances, B Grade crabs and their suitability for the market. It was also noted that the laws in the NT make some of the crabs that could be graded as B or C illegal under the scheme. The PI noted these comments, but what grade of crab should or should not be on the market was outside the terms of reference of the project, and was a legal, whole of industry, or a business decision.

The concept of having a more definitive system that looked at converting the grading scheme to a numerical continuous scale to provide finer definition within the grade (i.e. similar to the numerical 100-point scoring system for wine) was considered by the forum participants. It was felt however that the practicalities of doing this were beyond the scope of industry at this

stage. In addition, there were a large number of stop/go points along the grading tangent and an animal could still score highly but fail on one key indicator (i.e. ranks highly on all criteria, except for example, significant shell damage which would preclude it from being considered A Grade). The recommendation is to not take this further at this stage unless a definitive test for meat content is developed.

6.4 EXTENSION OF FORUM OUTCOMES

The outcomes of the grading scheme forum was widely distributed across jurisdictions, along the supply chain, and across sectors. In the period immediately following the forum the meeting summary and the draft flow chart (Figure 5) were provided to all forum participants for feedback, and the revised flowchart (Figure 6) was also provided to a range of industry participants for feedback. The only change suggested related to providing a linkage from crabs that had been graded as single claw to enable them to be reincorporated so that they could be tested under shell flex parameters.

The need for a range of extension material to meet client demand and requirements, as recognised and developed as part of the work undertaken under FRDC project-2010/302 was also noted through feedback from forum participants and as a result of contacts between industry and the Project Team. From those discussions it was clear that a multi faceted approach was necessary due to the wide geographical distribution and isolation of industry, the long supply chain, the literacy issues evident in the demographics of the those in the supply chain (many don't have high literacy levels and/or English as a first language), and the changing participation rate in the wider industry. There was also awareness that some material that may be suitable for the commercial supply chain may not be particularly relevant for those in the recreational sector or for general consumers.

It was acknowledged that to achieve optimal take up there was a need to have practical, easy to use, professionally developed and readily available material. For those reason the following material was developed and extension methods used.

6.4.1 Extension Material

The following extension material has been developed through the project (all can be found at <http://www.c-aid.com.au/mud-crabs/> or accessed via the following QR Code;



6.4.1.1 Comprehensive Grading Skill Transfers DVD and YouTube

Due to some language and literacy issues within the supply chain and potential problems in skill transfer using static media, or word of mouth, approaches to extension, it was considered a critical component of the process to record all aspects of the grading scheme in a comprehensive, yet simple to understand, professionally produced video format. This could then be provided in a number of media for ease of access along the supply chain.

A key finding from FRDC 2010/302 was that there was more rapid industry ownership/acceptance when self images, or images of known, or trusted people are used in the extension material (see Final Report FRDC Project 2010/302 for more detail on this).

The video produced by Strategy First PR & Marketing and the Project Team runs for around 15 minutes, is very precise, and provides clear steps to undertake grading under the Australian Industry Live Mud Crab Grading Scheme.

Key steps in the process are reinforced in the video by using spaced repetition to assist learning of the steps involved in the grading scheme.

Comments received from all industry persons who viewed the video are supportive of content, context and delivery, albeit that it is scripted in a quite dry and formal manner. The intention of the video was to ensure that it was concise and not ambiguous and so it is quite formal.

Two thousand videos were produced that incorporate the grading scheme and best handling practices as developed under FRDC projects (2010/302 and 2011/255).

There was however some significant delays in this video being finalised and this meant that formal distribution didn't take place until November 2012.

See http://www.youtube.com/watch?feature=player_embedded&v=ml88OiF9kKY

6.4.1.2 Information Brochure

The 4 page full colour professionally printed brochure (text and broad concept by the Project Team – design by First Class Graphics) was designed to provide a quick reference document that gave an overview of the forum, background to the rationale behind a national grading scheme, where further information can be found, sponsors and supporter details, and the decision making flow chart (Attachment 6).

Key handling tips, as developed under FRDC Projects FRDC 2003/240 and 2010/302 have also been included, to maximise cross flow of information across the projects. It has been prepared as a printable and a downloadable document. Two thousand copies were printed.

See http://www.c-aid.com.au/wp-content/uploads/Live-Mud-Crab_Grading-Scheme_WEB.pdf

6.4.1.3 Flowchart - Australian Live Mud Crab Grading Scheme

During discussions with a number of key industry participants the need for a highly visible reminder of the process to follow under the Australian Industry Live Mud Crab Grading Scheme was mentioned. To address this, a single page larger format (A3) sized chart was developed (text and broad concept by the Project Team – design by First Class Graphics) that is suitable for hanging in packaging/ processing areas and shop fronts (see Figure 6).

A small number of copies in waterproof material have been produced but the bulk are in plain paper. It has been prepared as a printable and a downloadable document. Five hundred copies were printed.

See <http://www.c-aid.com.au/wp-content/uploads/GuidetotheAustralianLiveMudCrabGradingSchemeFLOWCHART.pdf>

6.4.1.4 Using the Australian Industry Live Mud Crab Grading Scheme

This is a key document that was developed as a result of the forum and is a comprehensive reference booklet that provides a straightforward decision process and step by step guide to assist those anywhere in the supply chain in making decisions about how to grade live mud crabs in line with the Australian Industry Live Mud Crab Grading Scheme (text, broad concept and design by the Project Team) (see Attachment 5). It is designed to accompany and assist when using the grading scheme flow chart and the grading DVD.

Importantly, to provide guidance, in some instances informative diagrams and pictures were added. This simple process has been used a number of times by the PI when extending such information to people who do not have English as a first language. An example of this content is shown in Figure 12.

The guide has been prepared as a printable and a downloadable document. Two thousand copies were printed.

See <http://www.c-aid.com.au/wp-content/uploads/Guide-to-Using-the-Australian-Industry-Live-Mud-Crab-Grading-Scheme.pdf>



Figure 12: Sample of Informative Diagrams in the Guide

6.4.1.5 Recreational/Consumer focussed YouTube

A key aim of the project was to provide information to some key participants outside of the commercial supply chain; i.e. recreational and consumer⁵. It was felt this would be best achieved by providing information in a more condensed format than was provided to the commercial sector. As such a short, sharper, lighter approach to delivery was considered the optimal approach.

A ten minute YouTube video highlighting the key aspects of quality and how to test in line with the Australian Industry Live Mud Crab Grading Scheme, specifically relating to the shell flex tests was developed (content and broad concept by the Project Team – design and production by Bangz Hous).

See http://www.youtube.com/watch?feature=player_embedded&v=I6hfSyYfhtc

6.4.2 Extension Methods

The following extension methods have been undertaken for the project;

6.4.2.1 In field extension as part of FRDC Project 2010/302

Face to face meetings have been held with several hundred industry people through FRDC project 2010/302, and details and material relating to the Australian Industry Live Mud Crab Grading Scheme has been widely distributed, and further details are provided in that project's final report.

⁵ Although not specifically designed for extension through Aboriginal and Torres Strait Islander networks, options will be investigated through the FRDC Indigenous Reference Group.

6.4.2.2 Australian Live Mud Crab Information Package Mail Out

On investigation by the Project Team it was identified that around 700 commercial entitlements to take mud crab are in place in Australia (approximately - NT 50, Qld 350, NSW 270 and WA 5). In addition there are around 100 other fishers who don't own, but operate crabbing entitlements, who in many instances are the coal face of industry. Contact details for many of these people have been obtained through the various fishery agencies and key industry organisations.

The SFM has approximately 250 people on their books who may be involved in purchasing live mud crab through the market.

In addition, during this project and FRDC projects 2003/240 and 2010/302, a database of around another 100 industry participants, in the supply chain, have been developed, including in the NT, WA, NSW, Qld, Australian Capital Territory (ACT), Victoria (Vic) and South Australia (SA).

All of these people have been incorporated into a mailing list of approximately 1,200.

Each person on the mailing list received a package that contains all of the extension material (see Figure 13) developed during this project and FRDC project-2010/302. This included;

- A cover letter outlining details of the package and material included
- Comprehensive Grading Skill Transfers and Best Handling Practices DVD
- Guide to Using the Australian Industry Live Mud Crab Grading Scheme Booklet (6 pages)
- A4 Flowchart - Australian Industry Live Mud Crab Grading Scheme
- Information Brochure - Australian Industry Live Mud Crab Grading Scheme (4 pages)
- Best handling protocols information fact sheets (7 sheets).

For a low cost of around \$2,000 in postage these packages have been sent to the wide range of industry groups along the supply chain. After the initial mail out (as at 30 December 2012) there have been further requests for an additional 70 copies of the material.

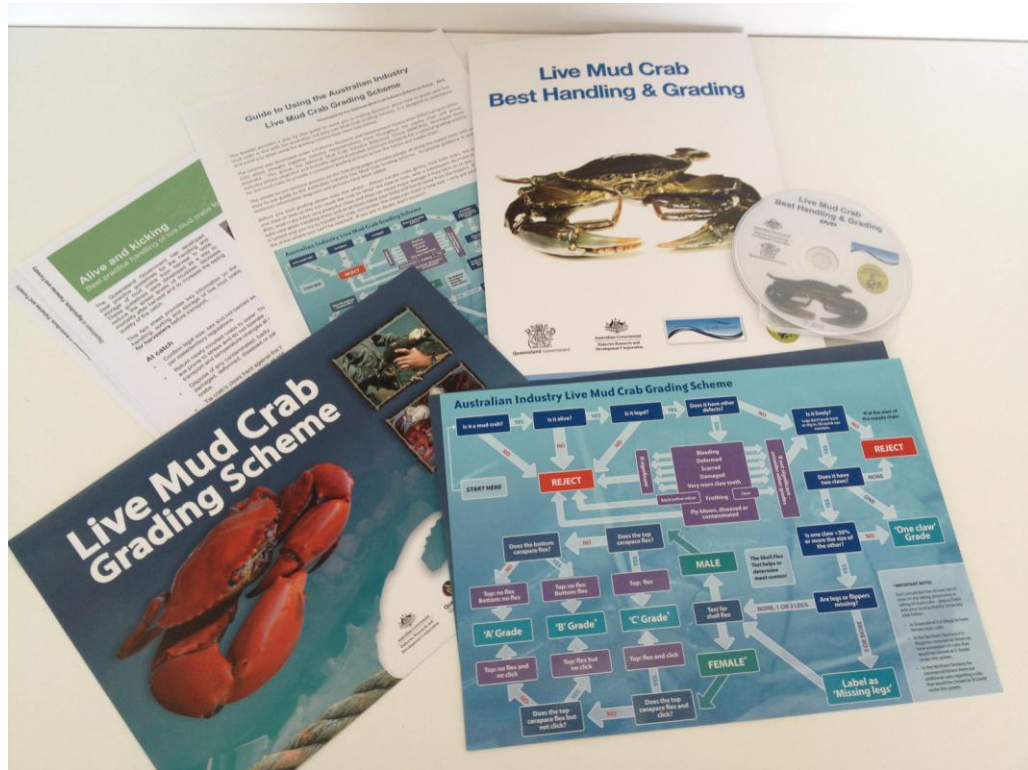


Figure 13: Material in the Australian Live Mud Crab Information Package Mail Out

6.4.2.3 SFM Quality and Grading Standards

The SFM is a significant player in the live mud crab trade in Australia (largest species by value in 2012), and by default is the national standard and price setter.

The SFM has been testing the effectiveness of the scheme informally since early 2012 and staff noted significant improvement in quality due to the uptake of the scheme.

The SFM have now formally changed their grading scheme and as at 3rd December 2012 have fully adopted the Australian Industry Live Mud Crab Grading Scheme.

Copies of the Flow Chart are strategically placed at the SFM.

The SFM has provided the Australian Live Mud Crab Information Package Mail Out to SFM members.

6.4.2.4 Websites

All of the extension material developed as part of this project, and relevant to the Australian Live Mud Crab Grading Scheme, has been sent to a range of industry groups providing them an opportunity to host information relating to the scheme on their websites.

6.4.2.5 Industry contacts

Copies of relevant material (including additional copies of the mail out) have been sent to a wide range of industry contacts, including;

- Relevant Peak commercial industry bodies
- Members of the National Mud Crab Industry Reference Group (NMCIRG)
- Key recreational groups, where their participants may interact with mud crabs.

6.4.2.6 Media

Articles have been published in the Queensland Fishermans Magazine, the FRDC FISH magazine, Seafood News and through media releases (see Attachment 7).

FRDC have promoted the link to the Grading Scheme on their Facebook and Twitter pages.

DAFF Qld put out a press release in relation to the Grading Scheme on 6th December 2012.

As part of the soft launch of the scheme by the SFM, the information was provided to a range of trade based SFM media contacts such as, key publications, online magazines, SFM buyers and other relevant contacts.

Links to the announcement by SFM media group can be found at the following sites; <http://www.sydneyfishmarket.com.au/SeafoodTrading/AuctionNoticeBoard/tabid/163/Default.aspx> and <http://www.sydneyfishmarket.com.au/MediaRoom/tabid/103/Default.aspx>.

Opportunities to further extend the findings will be assessed and relevant articles and media opportunities will take place.

6.4.2.7 YouTube

Copies of the Comprehensive Grading Skill Transfers Video and Recreational/Consumer focussed video are hosted on YouTube. Sites at this stage include www.c-aid.com.au, www.sydneyfishmarket.com.au and www.daff.gov.au. To date there have been around 600 views of the videos.

Peak industry groups (e.g. NTSC, QSIA, MBSIA, SIV, ECCFN, PFA) and recreational sector sites (e.g. AFANT, SUNFISH, Recfish West) have been provided with material that can be uploaded to their sites or linked to the C-AID website.

6.4.2.8 Field Day, Seafood Festivals and Scheme Launch

The grading scheme has been presented at a number of seafood field days and festivals, including the Hervey Bay Seafood Festival, which was attended by around 6,000 people.

A soft launch of the scheme was undertaken in conjunction with the SFM on the 3rd of December 2012 as part of their formal adoption of the scheme.

6.5 EVALUATION OF ADOPTION OF THE SCHEME

Evaluation has been undertaken through interviews, as part of the extension of FRDC project-2010/302, contact with forum participants, the level of formal uptake by key groups, and by assessing the number of FRADS at the SFM.

It must be remembered that the scheme has only been fully implemented since 3rd December 2012 as there have been delays in developing all of the extension material (which are all closely linked and had to be completed at the same time to ensure consistency of wording, context and message and to be able to be delivered in one complete package to industry), i.e.;

- Comprehensive Grading Skill Transfers and Best Handling Practices DVD and YouTube
- Guide to Using the Australian Industry Live Mud Crab Grading Scheme Booklet (6 pages)
- A4 water proof material Flowchart - Australian Industry Live Mud Crab Grading Scheme
- Information Brochure - Australian Industry Live Mud Crab Grading Scheme (4 pages)
- Recreational/Consumer focussed YouTube.

THE key measure of adoption to date has been through contact between industry and QA staff at the SFM, measurement of the level of FRADS at the SFM, through a SurveyMonkey® questionnaire undertaken as part of FRDC project-2010/302, qualitatively through contact between the Project Team and industry, and through formal letters and email support from key industry groups (see Attachment 8).

The message received to date shows strong support and confidence in the scheme.

There have been a small number of queries relating to application of the scheme with clients of the SFM. This has been (and will continue to be) addressed by SFM QA staff attending and/or providing additional support to those who have made the queries. To date there has only been one such trip to northern NSW and that was reportedly very successful, with around 14 fishers attending.

As part of a new SFM CRC Project 2012/758⁶ there will be a face to face extension/training component. Although the focus of the project will be on handling, grading will also be a key component, and the process used in NSW is expected to form the model for this work.

⁶ CRC Project 2012/758 'Increase sustainable use of crab fisheries resources by recovering revenue from crabs currently rejected at market'

6.5.1.1 Impact on FRADS and Feedback re SFM QA

The scheme was only officially launched by the SFM on 3rd December 2012 so it has not been possible to quantitatively assess the impacts of the implementation of the Australian Industry Live Mud Crab Grading Scheme on the quality of live mud crab entering the SFM.

The scheme however has been unofficially trialled at the SFM since the January 2012 Forum. This prompted pre-emptive adoption of the scheme by suppliers and some identifiable trends became obvious, however it cannot be fully correlated to the impacts of the grading scheme and/or the best handling practices that have been adopted widely by industry.

An analysis by the SFM on the impact of the scheme is provided in Attachment 9. Briefly the following trends and impacts on supply and quality are noted;

- The average price per kilogram of live mud crab for 2012 has increased by approximately \$1.40/kg at the SFM compared to the previous year. This has taken place even though sales have risen by around 27,000 kg during the same period. The SFM daily average is referenced and quoted throughout the crab supply chain nationwide from seller to interstate buyer. Therefore any increased average will flow into all wholesale markets, resulting in all suppliers experiencing higher average prices during this financial year and beyond. (There is a view that buyers will continue to pay an increased average price due to the high quality of crab suppliers are sending both via the SFM and direct to buyers in recent times).
- Significantly fewer slow and dead mud crabs are being seen at the SFM. Recent observations (October 2012) at the SFM showed a significant decrease in the numbers of crabs down-graded. This means higher revenue return for the SFM and back to the Co-operatives and harvesters. The minimised loss of return adds to the increase in revenue return, and increased end-user and consumer satisfaction with crab quality.

Both the value and quantity of supplied mud crabs have reached new highs (see Figure 14 for example of boxed live mud crabs at the SFM awaiting auction). The SFM are of the view that the changes in behaviour at the SFM are a direct result of crabbers' awareness of the national grading scheme and the best handling practices that are now being adopted, along with the established operation systems and trading platforms in place, and the vigilance of the SFM QA staff vigilantly communicating with crabbers and enforcing grading standards.

The processes used as part of this project have highlighted the value and success that can be achieved using industry networks in extending industry focussed outcomes.





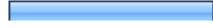


Figure 14: Boxed live mud crabs in the 'cage' awaiting auction at the SFM



6.5.1.2 Survey



As part of the evaluation of FRDC project-2010/302, a survey was undertaken using SurveyMonkey® and content relating to this Project was incorporated in the questionnaire. A snapshot of the matters relating to the Grading Scheme is noted below, with the full survey results provided in the Final Report for FRDC Project FRDC 2010/302.

Key findings were that over 85% of respondents were aware of the grading project and almost 70% noted that there were improved grading practices in place (see Questions 2, 18 and 19).

Also in the survey participants were invited to provide further comment (see Question 26 below). Issues around grading were noted strongly and in most instances it provided positive feedback on the need for the scheme.

| 2. What improvements have you heard of? | | | |
|---|---|------------------|----------------|
| | | Response Percent | Response Count |
| Mortality |  | 63.6% | 21 |
| Slows |  | 30.3% | 10 |
| Quality |  | 45.5% | 15 |
| Grading |  | 69.7% | 23 |
| Meat Fullness |  | 33.3% | 11 |
| Other (please specify) | | | 3 |
| answered question | | | 33 |
| skipped question | | | 3 |

| 18. Are you aware of the National System for Grading Live Mud Crab? | | | |
|---|--|------------------|----------------|
| | | Response Percent | Response Count |
| Yes |  | 85.7% | 24 |
| No |  | 14.3% | 4 |
| answered question | | | 28 |
| skipped question | | | 8 |

| 19. How important to you is meat fullness in your mud crab? | | | |
|---|--|------------------|----------------|
| | | Response Percent | Response Count |
| Very important |  | 88.9% | 24 |
| Moderately important |  | 11.1% | 3 |
| Not at all | | 0.0% | 0 |
| answered question | | | 27 |
| skipped question | | | 9 |

| Page 5, Q26. Any final comments... | | |
|------------------------------------|--|-----------------------|
| 1 | Industry needs to be able to trust the grading at the point of sale IE SFM | Sep 20, 2012 8:55 PM |
| 2 | Hopefully we can start to see young crabbers start to push through to keep this part of the fishing industry going. With some structure from industry guiding them along the way so their returns match their effort. | Sep 20, 2012 4:25 PM |
| 3 | We look forward to doing further work with the QDPI team in the near future to further improve on the gain already achieved. | Sep 17, 2012 11:03 AM |
| 4 | John & sue chris well done | Sep 17, 2012 10:50 AM |
| 5 | national grading standards has made huge positive difference | Sep 17, 2012 10:29 AM |
| 6 | The grading system is eagerly awaited so that a national system can be implemented | Sep 17, 2012 9:59 AM |
| 7 | There is always more to learn lets continue to make this industry not just sustainable but also economically sustainable. | Sep 17, 2012 9:59 AM |
| 8 | I really appreciate all the work John has put into this. I have seen operators who have not been equipped with the skills John has provided and they still have the huge losses like I used to. It is not only during transit that mortalities occur but in the Gulf we store the crab for a week before sending it out. We used to have large losses during that period and now have almost none. John's advice has helped us, and many others improve their bottom line. | Sep 16, 2012 11:15 PM |
| 9 | crab fullness does not worry me too much because I keep all legal mud crab but grade them for sale. The reason for that is because I crab in a area with a lot of rec pressure if I let go B grade crab they keep them when caught. So I must get something for them than nothing if I was not able to keep B grade crab and rec fishers were I would go broke | Sep 16, 2012 11:10 PM |
| 10 | We need a specific launch date for the new grading scheme to be declared nation wide as the national standard and we need to get the message out to all suppliers and buyers through an effective information campaign. | Sep 16, 2012 7:18 PM |
| 11 | The project has been beneficial to the industry and most importantly the extension component has been well executed. The credibility of the researchers and consultant has been enhanced by these extension activities | Sep 16, 2012 11:05 AM |
| 12 | Extremely important with grading system to maintain integrity of Darwin crab over Old species and not mix the species either overtly or by omission as Darwin crab has already higher grading system in place for a number of years and is the preferred choice of the buyers | Sep 15, 2012 10:09 AM |
| 13 | For the last 21 years I have always used escape hatches on all of my crabpots. Big crabs eat smaller and weaker crabs period!! Experiments of my own have shown that one large male crab can eat up to 6 smaller crabs per day with these smaller crabs having a shell measurement averaging 3" across. I believe that because I use escape hatches in my area this is the sole reason why I catch more crabs than anyone else along the entire QLD coast. Escape hatches that will let all undersize crabs escape from pots needs to be made compulsory!! | Sep 14, 2012 8:02 PM |
| 14 | I would like a copy of the National Grading System sent to me so I can forward it to other commercial crabbers. | Sep 14, 2012 4:36 PM |
| 15 | mud crab grading is very important to our business, but both parties have to | Sep 14, 2012 12:49 PM |
| | be playing the game | |

6.5.1.3 Industry Representatives

Letters of support and adoption of the scheme have been provided through relevant industry contacts (see Attachment 8) and this has seen generally strong support for the scheme from a national and regional perspective from;

- Peak commercial industry bodies

- Members of the NMCIRG
- SFM.

Some queries, as previously mentioned, relating to application of the scheme have been received and are being addressed by the SFM with their clients.

Feedback from key recreational groups, where their participants may interact with mud crabs, is still outstanding as material has only recently been provided.

6.6 OTHER FORUM OUTPUTS

6.6.1 The National Mud Crab Industry Reference Group (NMCIRG)

Forum participants acknowledged that the live mud crab industry is valued at around \$40 million dollars annually over the gunwale, and therefore over \$100 million at retail.

Participants felt that key decisions regarding the industry's future would be best addressed through a broad group of industry representatives with appropriate expertise, rather than solely through an agency focussed approach.

To this end the forum participants resolved that they form the National Mud Crab Industry Reference Group (NMCIRG), which can be used as a first point of contact for issues regarding the industry, and to also identify key issues that would benefit from research, development and extension (RD&E).

The group identified a number of priority RD&E areas that required further action (see Table 4).

Table 4: Priority RD&E Issues identified by National Mud Crab Industry Reference Group – Sydney February 2012.

| ISSUE | POSSIBLE SOLUTION | ACTION |
|--------------|--|---|
| Traceability | <ul style="list-style-type: none"> • Labelling or tagging • black marketing and reinforce product status (A, B etc) • Knuckle tag – one way tags • What about the expense??? • Cable tie or zip ties • QR codes added to tags to provide more details – highlight the sustainability and other sectors | <ul style="list-style-type: none"> • Possibly look at new R&D project • QLD crab management working group considering • Media launch – industry sustainability |

| ISSUE | POSSIBLE SOLUTION | ACTION |
|--|--|---|
| Packaging | <ul style="list-style-type: none"> Promote best practice – extension project trying to reach transport sectors Need to insulate yourself from external factors associated with transport Should you put holes in box and if so where Where to pack in trucks for transport in a truck Need to extend best packaging practices to transport companies | <ul style="list-style-type: none"> John M to do fact sheet on packaging best practices John M – talk to some of the buyers to get more info |
| What about rec fishers, how do we get them to adopt sustainable practices? | <ul style="list-style-type: none"> Commercial fishers throw out unsuitable crabs which are taken by other sectors? Putting crabs into ice slurry – kills crab so can't be released Highlight sustainability Get into schools Let jurisdictions deal with own local issues Set national standards in place – get in order and then look to incorporate with other sectors | <ul style="list-style-type: none"> Possible new R&D project Extend information to recreational sector on handling and 'grading' Best practice guide – magazines, video, electronic media In school education program – bigger than just crab to highlight commercial sectors value – seafood industry partnerships in schools – adopt a fisherman. Look at links with NSW and Qld members |
| What is the network? | <ul style="list-style-type: none"> Develop a NATIONAL MUD CRAB INDUSTRY REFERENCE GROUP Like to see some ownership and ongoing involvement | <ul style="list-style-type: none"> Share contacts Share information – e.g. escape vents Improve output and outcome ownership See some level of support for ongoing - national industry get together e.g. lobster congress option, - every 2 years. Powerful national force - recommendation Spread and share information |
| Grading | <ul style="list-style-type: none"> Further explore more objective methods for measuring meat content (not just shell hardness) e.g. scanning, pingers | <ul style="list-style-type: none"> Possible new R&D project – look for methods |
| Bycatch and interactions with other species | <ul style="list-style-type: none"> No problems NT fishers will be looking at pots that are biodegradable to reduce ghost fishing Escape vents | <ul style="list-style-type: none"> Look to share even if voluntarily across all jurisdictions A biodegradable panel Anodes on pots to breakdown so lost traps spring open?? |

| ISSUE | POSSIBLE SOLUTION | ACTION |
|-------------------------------|--|---|
| Interference and loss of gear | <ul style="list-style-type: none"> Steal and/or damage gear Not lost to ghost fishing Cost of lost gear Lost catch Legal issues with pots being used by others problem with cheap pots – are left behind and can negatively interact with marine life | <ul style="list-style-type: none"> What strategies Game trail motion camera Can't touch gear that has been abandoned?? Clarification of what they can do with them – need information Assess number of crabs sold – used?? Marine debris clean up – legal issues with collecting old pots etc Impacts of lost pots on marine life |
| Animal welfare strategy | <ul style="list-style-type: none"> Crustacean not included at this stage but being discussed at animal welfare forums – aquatic working group. exempt at this stage but potential problem in future with live transport Identify problems real or perceived which will most likely need to be addressed in the future | <ul style="list-style-type: none"> Possible new project - R&D need work on science to underpin current methods Brief people to be industry spokesperson on issues Get on front foot Humane handling Live seafood restaurant handling practices – fact sheet Well positioned with science and expertise Be proactive Need to develop short, sharp messages |

6.6.2 Forum Follow Up

A component of this project was to contact each forum participant about two weeks after the forum to assess how they felt the forum went. They were asked to comment on;

- how the forum was run
- quality of catering, accommodation, travel arrangements
- whether processes and outcomes met their needs.

Four formal responses were received and they commended every aspect of the forum. Follow up conversations with other participants provided similar feedback. No negative responses were received.

7 BENEFITS AND ADOPTION

The forum has provided a number of benefits to industry, such as;

7.1 BENEFITS

Industry Focussed Supply Chain Meeting Models

The forum and processes involved in developing, undertaking and following up with industry, the facilitation process, and outcomes, resonated with the industry participants as they felt it

was focussed on their needs, and the agency people and facilitators were there to address their needs.

The model used at this forum could provide a means to address similar collective industry needs in the future (see Attachment 3 for comments).

Networking Opportunities

The forum provided a first time networking opportunity for key participants and representatives to share ideas and discuss issues relating to the national live mud crab industry.

This was particularly valuable for those people from remote areas, but also for those urban distributors in the supply chain, to allow them to better contextualise the difficulties and complexities of delivering a quality live mud crab to the consumer.

Forum participants felt that more regular (annual or biannual) meetings would provide an opportunity for information exchange and R&D sharing, and also allow the industry to continue to grow in a way that would optimise returns to industry and the community.

Supply Chain Understanding

The forum provided an opportunity to allow participants to gain a better understanding of the supply chain and how each person and each step is critical to delivering live mud crab.

Like many industries, each step along the chain often felt that their job was done once they passed the product on to the next step in the chain. However, as the deductions for mortalities and inferior quality product impact directly to the supplier, this cost is transferred (directly or indirectly) down the supply chain all the way back to the fisher.

The need for supply chain management was identified as a critical component for the industry.

Development of a National Grading Scheme

A whole of industry grading scheme provides certainty and consistency along the supply chain. Early indications, based on SFM figures, are that it is leading to improved quality and higher prices.

Development of the National Mud Crab Industry Reference Group

The industry based forum participants believed that real industry engagement and input will provide optimal outcomes for industry. As such they agreed to form the National Mud Crab Industry Reference Group to provide a focal link for industry lead and focussed RD&E for this fishery.

There is now a mechanism (and extensive contact list) to bring industry together in this fishery to resolve similar, or variant, issues in the future.

They also felt that this was a supply chain based model that would work well for other fisheries.

Building Trust and Relationships between Industry and Science

The build up to the forum, the forum itself, and the follow up activities have provided a sound model to improve the level of trust and engagement between industry and those in the science and technical field ('scientists'), especially those that are agency based.

Many conversations were had at the forum about how good it was to see 'scientists' and industry working together to solve common problems. This was said in response to comments such as *'scientists come and collect information from us all of the time but never give any feedback to us, the first we hear about anything is when we get some bad news'*.

As a sign of this new trust, industry in a national context, now contact DAFF Qld for a range of issues relating to live mud crab matters.

7.2 ADOPTION

There has been adoption of the scheme at a number of levels – from individual fishers along the supply chain to retailers. The full level of adoption has been hard to quantify as the final documentation was only widely distributed in November 2012 due to delays in being able to finalise all of the material.

A key to the adoption of the scheme has been the decision by the SFM to use the Australian Industry Live Mud Crab Grading Scheme as the market guideline for live mud crab as of the 3rd December 2012. The SFM guidelines act as a proxy for the Australian industry for many species and they are a key player in the Australian mud crab market. Price and grading is set defacto through the market and influences the supply chain across the country.

Formal adoption has also been noted by the following groups, with copies of support shown at Attachment 8. Some key comments have been;

Doug Neville Chair NT Mud Crab Licensee Committee.

'I thought the forum held in Sydney was a masterstroke as it allowed producers from the three states and buyers to firstly share thinking about the grading issues and finally reach a consensus on what a single (national) scheme should look like.'

I think the benefits will flow in 2013 and include less dissatisfaction amongst buyers who will now be able ask that crabs they purchase be graded according to the Standard.

If the regular buyers ask for crabs to be graded accordingly and support this with their wallets I expect that producers will respond accordingly.'

Coffs Harbour Fishermans Co-op, NSW

'The Co-op has already implemented the scheme into its operations and is using it to educate and encourage its fishers to return C grade mud crabs back to the water which in most cases would end up in the SFM dump bin, and it is also providing buyers with a more consistent grade of mud crab which in turn in most cases provides a better return to the fisher.'

S. H. Wilkinson, Melbourne, Vic

'These new guideline have continued to act favourable on my customer base.'

'The clear distinction drawn between A and B grade crabs at the forum has addressed an issue which has been the bane of the industry and the cause of innumerable disputes over the years.'

PFA, Clarence River, NSW

'The full supply chain was covered at the workshop with a lot of positive interactions which in turn led to a better understanding of the process. The forum was interactive and provided the opportunity for and indeed encouraged everyone to speak. This can only be encouraged for future project experiences, to develop the full value of the mud crab fishery to ensure that they maximise their returns for effort.'

'We recommend that further work is undertaken to reinforce with fishers in particular how they should assess mud crab for quality and return non-compliant specimens to their habitat due to not attracting desired prices, etc.'

Feedback from key recreational groups, where their participants may interact with mud crabs is still outstanding as material has only recently been provided.

8 FURTHER DEVELOPMENTS

As a result of the success of the forum in providing assistance for industry along the supply chain, participants have developed a reference group to provide a point of first call for mud

crab focussed RD&E, policy development and extension. There was a recommendation that an opportunity to hold similar meetings annually or biannually be investigated and a funding source identified.

In addition, due to higher than expected mortalities into the Sydney markets, especially with respect to *Scylla olivacea* (brown mud crab) a request has been made from the fledgling northern WA mud crab industry (five 'licences', two of which are indigenous owned) regarding testing and possibly adapting the best handling and grading scheme in the area. The above species make up the majority of the catch from the region. It is very uncommon (i.e. not seen at all in most places) in the rest of the industry nationally, so the handling procedures and practices, and the grading scheme were not been tested on this species.

9 PLANNED OUTCOMES

The following planned outcomes and outcomes already achieved as part of this project are shown in the **Table 5** below.

Table 5: Planned Outcomes and Actual Outcomes

| Planned Outcome | Actual Outcome |
|--|---|
| Industry ownership: - success of adoption of the grading scheme relies on industry buy-in to ensure ownership of standards. | <p>Industry support and adoption of the grading scheme has been strong. Letters of support and adoption are included at Attachment 8.</p> <p>There has been strong industry feedback and support for the scheme.</p> <p>Some queries relating to implementation of the scheme have been directed to the SFM and are being addressed.</p> |
| Improved revenue return to the supply chain: – reduction in downgraded live mud crabs, resulting in maximum price per unit. Losses due to mortalities minimised. | <p>Although the Scheme only came into force at the SFM on 3rd December 2012, industry participants were aware of this and started to adopt the scheme as part of their general practices prior to this.</p> <p>Data from the SFM shows that prices have been on average around \$1.40/kg higher since the Grading Scheme Forum was held, and</p> |

| | |
|--|--|
| | downgrades have decreased significantly. |
| Increased consumer satisfaction: - raised consumer confidence in purchase of premium quality live mud crab, engendering more frequent purchases. | <p>This has not been assessed quantitatively but feedback has been forthcoming through the supply chain to the Project Team.</p> <p>With the official adoption of the scheme on 3rd December 2012 and the availability of the extension material from that date for the public, understanding and confidence is expected to increase.</p> |
| Enhanced sustainability within mud crab industry: – maximising profitability by optimising quality of live mud crab harvested. | <p>Data from the SFM has shown an increase in price per kg, indicating greater return per kg harvested.</p> <p>Some industry groups (in locations that are suitable) have noted the possible benefits that can accrue to industry as a whole of returning low grade crabs to the water to allow them to fatten and thereby gain increased return in the future as A Grade crabs.</p> |
| All sectors along the supply chain, including consumers, will benefit through compounded gains attained from apposite resource utilisation. | <p>The linking of project 2010/302 and this project has seen far greater utilisation of resources along the supply chain. Six trips were undertaken jointly to meet with key people and groups along the supply chain (NT x 2, NSW x 2, Vic, Qld) and the linking of best handling and grading became intertwined.</p> <p>In addition, when work on either project has taken place by the individual project teams, the opportunity to cross reference the projects has allowed a combined knowledge of the projects to be extended.</p> |

10 CONCLUSION

The project successfully addressed all of the identified objectives and exceeded expectations in a number of them.

The quality and diversity of the participants at the forum provided a unique opportunity for people involved in the live mud crab industry, from across the supply chain and jurisdictions, to work together, through a consensus based approach, to develop a grading scheme that meets the national needs of industry, and was a significant achievement.

The forum process, focussing on industry input along with science and technical based support and independent facilitation, was supported by participants, and would appear to be a sound model for whole of industry supply chain issues to be addressed in the future.

As a direct outcome of the forum held in Sydney in January 2012, there has been the development of and agreement on an easy to use, national, industry-driven, grading scheme for live mud crabs (the Australian Industry Live Mud Crab Grading Scheme), and the development of a range of material to extend the scheme widely.

There has been strong industry ownership and support for the grading scheme, with many sectors, individuals and groups taking the scheme on board, including the SFM adopting the Australian Live Mud Crab Grading Scheme as part of its product guidelines.

The wide range of professionally produced and designed extension material and the delivery methods used have been strongly supported by industry participants, as it was felt that to meet the divergent and specific needs of a large and diverse supply chain a single approach would not have been as successful.

Supply chain partners have indicated greater consumer satisfaction and less disagreement due to the development of the systematic and easy to use grading scheme. With the formal up take of the scheme on 3rd December 2012, at the SFM, the linking with key sector sites and groups, and all of the material going live, it is anticipated that as consumers become better informed, there will be raised consumer confidence to buy premium quality live mud crab, engendering more frequent purchases.

In addition to addressing the project's objectives there were two other outcomes that will enhance whole of industry benefits for the live mud crab industry. These relate to the formation of the NMCIIRG to provide whole of commercial industry guidance on mud crab issues, and the instigation of closer links with the recreational community to assist them in how best to fish for mud crabs to optimise quality.

Strong industry involvement and ownership of the process and outputs has been a key outcome from this project. This has led to rapid adoption and improved understanding and relationships across the supply chain.

Although quantitative analysis was not possible during the life of this project due to time constraints, the anecdotal feedback from a wide range of industry partners has been that the project has delivered a scheme that is readily adoptable, will lead to improved prices, and has minimised waste and product downgrades.

11 BIBLIOGRAPHY

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Sydney Fish Market (2010). Sydney Fish Market Seafood Handling Guidelines.

Appendix I: Intellectual Property

No intellectual property was developed under this project and any knowledge gained through this project is available to the broader Australian fishing and seafood industry.

Appendix II: Staff

The following staff were involved with this project;

| | | |
|-----------------|-------------------|------------------------|
| Chris Calogeras | C-AID Consultants | Principal Investigator |
| Sue Poole | DAFF Qld | Co Investigator |
| John Mayze | DAFF Qld | Co Investigator |
| Gail Calogeras | C-AID Consultants | General Manager |

ATTACHMENT 1: Support Provided By Major Industry Participants

The following people/organisations provided written support for the project.

| | |
|--------------------|---|
| David Caracciolo | (Director, Mackay Reef Fish Supplies and NT Fish, Qld and NT) |
| Doug Neville | (Chair NT Mud Crab Licensee Committee, NT). |
| John Harrison | (EO Professional Fishermen's Association, NSW) |
| Kristina Georges | (Managing Director, Samies Girl Fresh Seafood Market, Qld) |
| Malcolm McLaughlin | (Managing Director, McLaughlin Consolidated Fishermen, Vic) |
| Mark Boulter | (QA-Manager, SFM) |
| Martin Perkins | (Queensland Seafood Marketers Association, Qld) |
| Neil Green | (crab fisher 35 years, ex-president QSIA, Qld) |
| Peter Jackson | (President East-Coast Crabfishers Industry Network, Qld) |
| Robert Pender | (QSIA representative Gulf of Carpentaria Mud crab Fishery, Qld) |
| Tony Reisenwebber | (Chair QSIA Crab Committee, Qld), |

The following people/organisations provided verbal support for the project.

| | |
|-----------------------|---|
| Gary Ward | (Chair, Gulf of Carpentaria Commercial Fishermen's Association) |
| Geoff Blackburn | (Fisher Coffs Harbour, NSW) |
| George | (Chief crab-buyer, Claudio's Quality Seafoods, NSW) |
| Jim Swan | (QSIA representative Area 5 Mud crab fishery, Qld) |
| Mark Ahern | (Director, Debbie's Seafood, Mackay) |
| Sherwood Thorbjornsen | (Director Bevwood Crab, NT). |
| Spencer Wilkinson | (Director, S H Wilkinson P/L, Vic) |

ATTACHMENT 2: Copy of Generic Invitation Letter Sent to Potential Participants



Mr David Caracciolo

Dear David

RE: Invitation to Participate in the Live Mud Crab Grading Workshop - Sydney Fish Market, 31st January and 1st February 2012.

The Australian live mud crab fishery has differing interpretations of grading between crabbers and distributors across Australia. It is highly emotive and greatly impacts industry revenue and relationships throughout the supply chain. That there exists a high level of confusion within all industry sectors was identified through the Fisheries Research and Development Corporation (FRDC) project: 2010/302 'Equipping the mud crab industry with innovative skills through extension of best practice handling', highlighting an urgent need for a national industry driven grading system

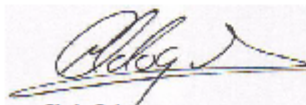
With improved handling practices developed through industry expertise and the above project, industry members are looking to shore up existing markets as well as identify new markets, but are experiencing various grading interpretations which impact on viability and relationships. Many current active industry members along the supply chain and throughout the various jurisdictions have indicated they are unclear of grading parameters for live mud crab from buyer to buyer, and state to state. To address this, a national system has been proposed to ensure harvesters, buyers and marketers have a consistent workable grading system for live mud crab. Since the concept of a national system was proposed there has been overwhelming Industry support to develop the system. To assist with this development the FRDC has supported a process to allow industry people from across Australia, and throughout the supply chain, to meet at a funded forum to develop an industry-driven, objective, and agreed Australian grading system for live mud crabs. An overview of the project is attached to this letter. I will be assisting the forum as an independent facilitator.

Around 25 participants are being invited, with a view to covering the major State/Territory key industry groups, some regional centres, and key supply chain participants (catchers, distributors and buyers). At the forum the process will seek to determine an agreed grading system through consensus - not voting.

Initial discussion with Industry has indicated that, due to your experience, skills and ability to spread the message within Industry, your attendance at the forum would greatly enhance the outcomes. Forum dates have been set for 31st January and 1st February 2012, and is to be held at the Sydney Fish Market. The project has funding to provide you with discount airfares, accommodation and meals in Sydney.

If you are able to attend could you advise me by 10th December 2011. I will then start making arrangements for your travel and provide you with more information about the forum. If you have any queries please contact me on 0401692601 or at calogeras@iint.net.au. I look forward to seeing you in Sydney next year.

Regards



Chris Calogeras
Project Principal
23 November 2011

FRDC Project No: 2011/225 'Using industry expertise to build a national system for grading of live Mud Crabs'

ATTACHMENT 3: Forum Working Sheet for Facilitators

DAY 1 - 31st January Work Sheet: Australian Industry - Live Mud Crab Grading System Workshop

| Time | Item | Facilitator | Key Issues |
|-------|-----------------------------|-------------|---|
| 9.30 | Welcome and Forum Overview | Chris | <p>15 minutes <u>AIM – to set scene for two day forum</u></p> <ul style="list-style-type: none"> • Background to project – via FRDC extension • Funded by FRDC Not Govt – Industry • How the forum fits into the big picture - reality check • Supply chain – national issues crabs from everywhere end up on people’s plates – John has supply chain maps • All talking the same language • (not about price – that is linked to demand, when are peaches cheapest when they are most abundant and best) • Not a representative group – expertise • Not to get rid of ‘B’ • Not to bash SFM or other people • Norms/Protocols • Outline <u>participants’</u> responsibilities • how it will run <ul style="list-style-type: none"> ○ logistics etc ○ what we hope to achieve ○ Explain what how we will capture photo, word video and why ○ Parking lot for all of the other issues that may be identified. • Pass on to Brad |
| 9.45 | Introduction of Participant | Brad | <p>30 minutes – AIM - Allow all participants to understand who is in the room</p> <ul style="list-style-type: none"> • Round table introduction • Name, where from, sector(s), extension links • Transition to next session about existing grading • Morning tea in room – smokers outside –start sharp at 10.30 |
| 10.15 | Morning tea | | <p>15 minutes</p> <ul style="list-style-type: none"> • In meeting room • Smoking outside |
| 10.30 | Existing grading systems | Chris | <p>15 minutes <u>AIM - To identify any existing formal grading systems</u></p> <ul style="list-style-type: none"> • SFM – happy to adopt outcomes • NT – incorporates some grading • Whole heap of others – personalised but not standardised (can’t all be right) • Pass on to Chris and John |
| 10.45 | Grading Parameters | | <p>75 minutes <u>AIM – to identify grading parameters based on all attributes – BUT NOT shell hardness</u></p> |

| | | | |
|-------|---|--|--|
| | session 1 <ul style="list-style-type: none"> • Liveliness of crab • Physical attributes of crab <ul style="list-style-type: none"> ○ damage ○ others ○ shell hardness | Chris intro John technical Sue wrap up | <ul style="list-style-type: none"> • Identify existing parameters acknowledge hardness is one – but address later • Based on extension project go through each item as per QI (need live screen!!) <ul style="list-style-type: none"> ○ Discuss each one ○ Seek agreement • Seek any other identifiers from group (need live screen!!!) <ul style="list-style-type: none"> ○ Discuss each one ○ Seek agreement • Document each agreed position – words, photo, video • Sue to update the QI as we go along and work with Martin re recording • Sue (with John and Chris) to confirm recorded findings with participants (probably need live screen) • Pass on to John |
| 12.00 | Using Refractive Index (RI) of blood as indicator of potential meat yield | John | 20 minutes AIM – to explain the how RI can be used to correlate RI with potential meat content <ul style="list-style-type: none"> • Background to use of refractometer and pH – other examples and way/why it works • Show process in action • Provide examples from work – graph showing stylised RI – v meat content over time • Explain why not a field tool • Pass on to Chris |
| 12.20 | Recap morning session and set direction for afternoon | Chris | 10 minutes total AIM - To ensure morning information is clear and has been captured (and no one has been left behind) and set direction for afternoon <ul style="list-style-type: none"> • Summarised morning agreed outcomes – depends on how the morning went • Identify any areas of dispute • Check with group if happy with process to date – if not • Transition, what's following and details • Clarify time back in room – time to chat |
| 12.30 | Lunch at SFM | | 45 minutes <ul style="list-style-type: none"> • In meeting room • Smoking outside |
| 1.15 | Grading Parameters – session 2 <ul style="list-style-type: none"> • Shell Hardness/Flex Index <ul style="list-style-type: none"> ○ how to test ○ where to test ○ other issues | Chris intro John technical | 75 minutes AIM – to identify grading parameters based on shell hardness/flex etc <ul style="list-style-type: none"> • background to test (from a NT perspective?) • why meat quantity is important in respect to survivability • 1st testing on males as covers all states/territories – then females after • Go thru harness tests on <u>males</u> first – impt for all states/territory (need live screen!!) <ul style="list-style-type: none"> ○ how to test ○ where to test ○ what the different levels of hardness/flex mean ○ acknowledge variability (but !!!) • seek agreement on test sites and level of flex (nil for 1st) • 2nd testing on females |

| | | Sue Sue/Brad | <ul style="list-style-type: none"> go thru harness tests on females (need live screen!!) <ul style="list-style-type: none"> how to test where to test what the different levels of hardness/flex mean acknowledge variability (but !!!) – feed experiments re soft shell? seek agreement on test sites and level of flex (nil for 1st) Sue to update the QI as we go along and work with Martin re recording Sue and Brad (with John and Chris) to confirm recorded findings with participants (probably need live screen) Transition to next session about all grading parameters Afternoon tea in room – smokers outside –start sharp at 2.30 | | | | | | | | | | | | | | |
|--|--|---|---|---|-------------------|-----------------------|-------------------|-----------------------|------------|-------|--|--|---|--|---|--|--|
| 2.30 | Agreement on Grading Parameters <ul style="list-style-type: none"> Liveliness of crab Physical attributes of crab | Chris | 30 minutes AIM - To ensure that there is consensus from the group as to agreed parameters <ul style="list-style-type: none"> Recap all agreed parameters – use live screen as and where needed – best to use existing agreed shots taken by Martin Identify any areas of dispute Check with group if happy with process to date – if not Transition, what’s following and details Clarify time back in room – time to chat Pass on to Chris | | | | | | | | | | | | | | |
| 3.00 | Afternoon tea | | 15 minutes | | | | | | | | | | | | | | |
| 3.15 | Development of a Grading Flow chart and Grading Index | Chris Sue Sue/Brad John/Brad | 35 minutes AIM - To identify if the group consider a grading index as an option for the fishery <ul style="list-style-type: none"> Run through existing flow chart developed during day by Sue Identify types of indexes available – blue sky <ul style="list-style-type: none"> Wine scale QI seafood Sashimi grading Beef/lamb/wagyu etc A, B, C grade current Other options - premium, standard, export, domestic etc..... Whichever grade chosen – where do we put the line(s) for the grades Challenge will be around transitions between grades (if disagreement start at extremes and move in). Transitions will never be straight lines. <table border="1" data-bbox="758 1247 1556 1357"> <thead> <tr> <th>1st GRADE</th> <th>Transition 1 to 2</th> <th>2nd GRADE</th> <th>Transition 2 to 3</th> <th>3rd GRADE</th> <th>transition</th> <th>GRADE</th> </tr> </thead> <tbody> <tr> <td>Hard both sides nice clean Legs etc</td> <td></td> <td>Maybe one side hard Some damage Missing legs etc</td> <td></td> <td>Soft both sides Scared/scaly Badly damaged etc</td> <td></td> <td></td> </tr> </tbody> </table> <ul style="list-style-type: none"> Grade all crabs – mark appropriately (shell and claws) and place on grading scale to allow participants to discuss. | 1 st GRADE | Transition 1 to 2 | 2 nd GRADE | Transition 2 to 3 | 3 rd GRADE | transition | GRADE | Hard both sides nice clean Legs etc | | Maybe one side hard Some damage Missing legs etc | | Soft both sides Scared/scaly Badly damaged etc | | |
| 1 st GRADE | Transition 1 to 2 | 2 nd GRADE | Transition 2 to 3 | 3 rd GRADE | transition | GRADE | | | | | | | | | | | |
| Hard both sides nice clean Legs etc | | Maybe one side hard Some damage Missing legs etc | | Soft both sides Scared/scaly Badly damaged etc | | | | | | | | | | | | | |

| | | | |
|------|---|-------|---|
| 4.50 | Recap day 1 and set direction for Day 2 | Chris | <ul style="list-style-type: none"> • Get agreement 10 minutes <ul style="list-style-type: none"> • Identify where we got to • Clarify what will happen next day <ul style="list-style-type: none"> ○ SFM tour etc – where and when to meet ○ John to cook sample of crabs for testing (check with participants for any special requests) ○ Final discussions ○ How will we get the system out there • Provide information on dinner, venue, meal, beverages etc |
| 6.30 | Refreshments - Dinner – venue to be advised | | <ul style="list-style-type: none"> • Ordered meal – banquet style • Will need to have gotten crab to them • Pre dinner drinks |

DAY 2 – 1st Feb Work Sheet: Australian Industry - Live Mud Crab Grading System Workshop

| Time | Item | Facilitator | Key Issues |
|-------|---|-------------|--|
| 6.00 | Sydney Fish Market Auction Tour | Erik | 120 minutes AIM – to provide participants with an understanding of how the SFM operates and to get scale of product flow and distribution along supply chain <ul style="list-style-type: none"> • Participants to attend • Finish up in time for breakfast in meeting room |
| 8.30 | Breakfast – meeting room | Brad | 30 minutes AIM – to allow participants to discuss SFM tour and previous days meetings over breakfast <ul style="list-style-type: none"> • Get participants refocused on forum issues • Pass on to Chris |
| 9.00 | Recap Q&A from Day 1 | Chris | 20 minutes AIM – ensure participants are aware of agreed outcomes from Day 1 and no one has been left behind) and set direction for rest of day <ul style="list-style-type: none"> • Summarised agreed outcomes • recap any areas of dispute – can they be resolved now? • Check with group if happy with process to date – if not • Run a Q&A session if required • Refocus if necessary • Pass on to John |
| 9.30 | Cooked Crab Visual evaluation | John | 20 minutes AIM – provide participants an opportunity to compare graded crabs against cooked crabs to test assumptions day 1 <ul style="list-style-type: none"> • Cooked crabs with cracked claws laid out as per day 1 grading scale • Explain process • Seek reconfirmation of grading system • Pass on to Chris |
| 10.15 | Final Grading Discussions and Resolutions | Chris | 45 minutes AIM – to confirm forum outcomes <ul style="list-style-type: none"> • Address any inconsistencies identified or unresolved issues • Confirm agreed outcomes |

| | | | |
|-------|---|---------------------------|--|
| | | | <ul style="list-style-type: none"> • Identify any side issues – parking lot • Pass on to Chris |
| 11.30 | What Happens From Here <ul style="list-style-type: none"> • production • distribution • education • adoption | Chris Brad Sue John | <p>90 minutes AIM – to determine best extension materials, methods and requirements</p> <ul style="list-style-type: none"> • clarify material that will/can be produced <ul style="list-style-type: none"> ○ video ○ you tube ○ CD ○ Grading booklet ○ One/two page summary document for distribution ○ Final report ○ Smartphone app? • What type of material best suits their networks (and numbers) • What are their networks – we need to document this • Where we thought to place the information <ul style="list-style-type: none"> ○ web based (words, picture and video) - Industry associations, sectors and groups, SeaNet, SFM, SSA, FRDC, State/Territory Agencies ○ relevant newsletters and magazines ○ TV media representatives ○ Your networks ○ personal letter to all mud crabbers and identified marketers. • How do we measure adoption and take up? <ul style="list-style-type: none"> ○ discuss with SFM means to measure downgraded to assess success of adoption ○ what others? • Are there any other projects/issues that need to be developed or addressed? • How do we keep engaged as a group? – LinkedIn mud crab group |
| 1.00 | Forum Close | Chris | <p>10 minutes AIM - To thank participants for their attendance and input</p> <ul style="list-style-type: none"> • Thank people for attendance and input |

ATTACHMENT 4 Sample Industry Feedback on Forum

Participant 1 *Hi Chris, On behalf of Eastcoast Crabbers I would like to thank all who were involved in the mud crab workshop, I don't think I can recall a workshop or even meetings in general, where there has been solid, sensible and workable outcomes. A big thanks to FRDC, and yourself Chris, every aspect was taken care of.*

Participant 2 *Chris I think it was a job well done and everything was easy*

Participant 3 *Good workshop – much more successful than I expected. The networking was equally beneficial*

Participant 4 *A special thank you for organising the event - I know the mud crab industry has been close to your heart for years and to get people together from all parts of the supply chain exchanging ideas was great and I personally have come away with a better understanding of the industry as a whole.*

Any time I am able to extricate myself from my business for a couple of days Chris is always very relaxing even more so when you are taken out to a lovely Chinese restaurant and eat mud crabs and exchange ideas with the other interesting people .Accommodation was good - nice to be able to have a shower and relax in a quiet environment.

I have always been interested in the workings of the SFM and I now have a much deeper understanding how to interpret the crab prices! It's certainly an eye-opener - the NSW crabbers do things a bit differently .

Through your efforts Chris I think we all realise (I certainly do) correct grading of crab along national guidelines is the central issue and that B grade crabs (let along CUC'S) are the bane of the industry.

It was good to have Erik and Beni on board to not only organise the food and tour but to provide some serious input to the whole discussion and to hear what QA standards they have in place.

I was most impressed with Brad Warren and Sue and John's work always interests me and adds that technical/scientific touch. The whole room was full of diverse and interesting ideas.

All my travel arrangements went without a hitch.

ATTACHMENT 5: Guide to Using the Australian Live Mud Crab Grading Scheme

Guide to Using the Australian Industry Live Mud Crab Grading Scheme

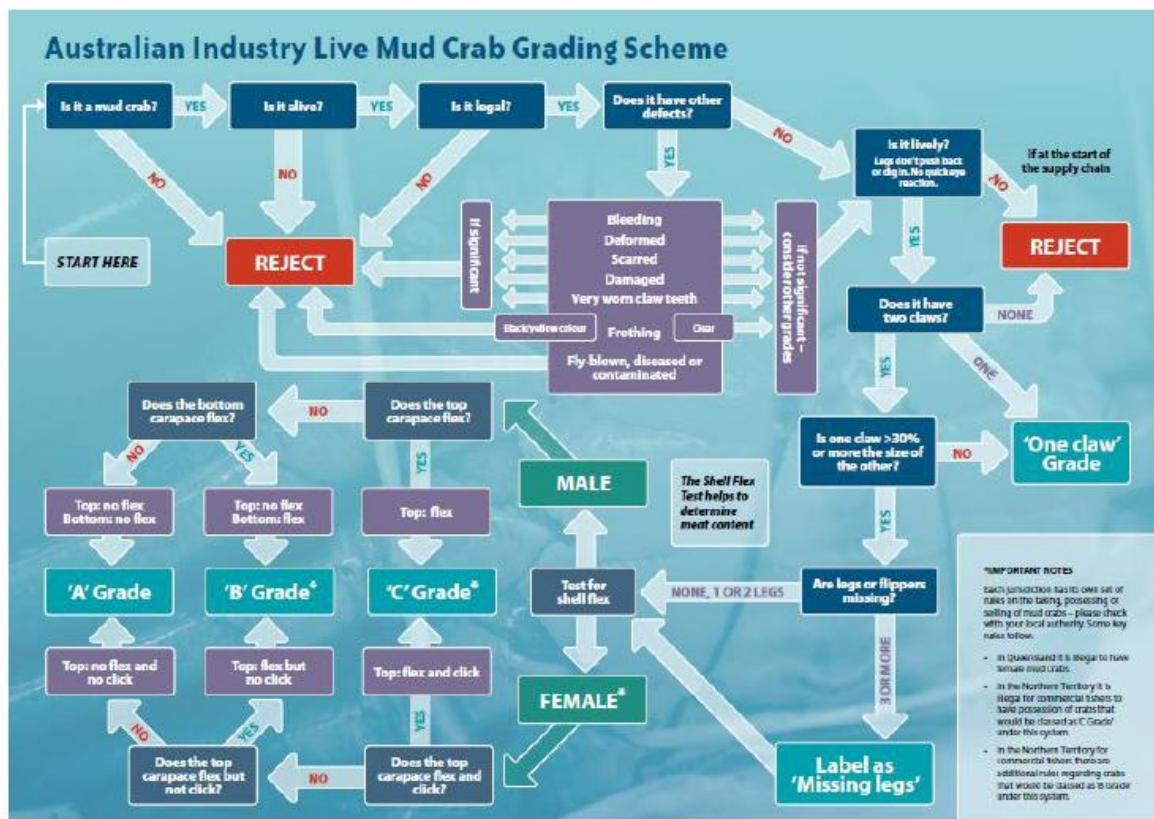
Developed by the National Mud Crab Industry Reference Group - 2012

This booklet provides a step by step guide to assist you in making decisions about how to grade your live mud crabs in line with the Australian Industry Live Mud Crab Grading Scheme. It is designed to accompany and assist you when using the grading scheme flow chart (see below).

The scheme was developed under a Fisheries Research and Development Corporation (FRDC) project (2011-225) which brought together industry representatives from throughout the supply chain and across Australia. This group, the National Mud Crab Industry Reference Group (NMCIRG), developed these industry-driven, objective and mutually-agreed Australian minimum standards for a national grading scheme for live mud crabs to provide a consistent grading process across the nation and supply chain.

The simple to use decision process on the following pages provides people all along the supply chain with an easy to use guide to the Australian Industry Live Mud Crab Grading Scheme. To provide guidance in some instances informative diagrams and pictures have been added.

Before you start grading please note this advice - Always handle crabs gently, hold both sides, not just by one claw or limb as this can cause the crab to 'drop' the claw or limb, with a subsequent decrease in value. Also, mud crabs have very powerful claws and they can cause major damage if they latch on to you. Always take care when handling them and at all times keep your body and hands away from the nipper. If the crab is untied and you try to handle the crab, remember the claws can reach a long way – only put your hands in the areas where you can't be reached. If you are in doubt, don't touch!!!



Is it a mud crab - *Scylla* species?



The colour of the shell can vary greatly in live mud crabs, ranging from pale green to blue/purple, to dark brown. Most people with even limited expertise will be able to tell if it is a mud crab.

The definitive way to identify a mud crabs however is to count the number of spines on each side of the carapace. A mud crab has 9 similarly sized spines on each side of the carapace (see diagram). If not it must be rejected.

Is the mud crab alive?

A live mud crab will move its legs, claws and eyes. If the legs and claws hang loosely and the eyes don't move if there is any activity near them, the crab is dead and must be rejected.

Is the mud crab legal?

Each State and Territory has its own set of rules that apply to the taking, or selling, of mud crabs, such as; minimum size requirements, sex that can be retained, whether females are carrying eggs, or the degree of shell hardness. Check your local laws - if it is not legal, reject it.

There are a range of other defects that could devalue the product or lead to product rejection.
The following defects can lead to the need to reject a crab or consider downgrading the grade.

Is the mud crab bleeding?

Blood is a thick liquid ranging from clear to blue and even orange and can be evident if there is damage to the crab, such as the leg tips being broken off, or if legs, claws or the body are crushed. A bleeding crab is more likely to die.

If there is a significant amount of blood, reject the crab.



Is the shell of the mud crab deformed or damaged?



Damaged or deformed shells can be caused by a number of factors. It may influence the way buyers and consumers purchase.

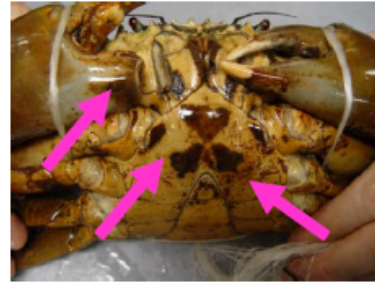
If damage is significant reject the crab. If damage is slight, consider downgrading to another grade.



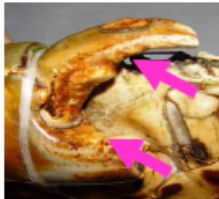
Is the shell of the mud crab badly scarred?

As crabs get older their shell can get wear and tear marks from feeding, fighting and mating. Excessive scarring indicates the crab has not moulted recently and could potentially have little meat content.

If scarring is significant, reject the crab. If it's slight, consider downgrading to another grade.



Does the mud crab have very worn claw teeth?



Very worn claw teeth indicate the crab has not moulted recently and may have little meat content.

If it is significant, reject the crab. If it's slight, consider other grades.

Is the mud crab frothing from its mouth?

Frothing around the mouth is an indicator of poor condition and stress and may mean the crab will not survive long.

If the froth is black or yellow, reject the crab. If it is clear, calculate the time left in the supply chain and consider its chances of surviving.



Is the mud crab fly blown?

If insect larvae are present reject the crab.

Is there any noticeable parasite/disease present?

There is only one known parasite to mud crabs that could lead to them being rejected – it isn't harmful to humans but could affect quality. The parasite is called *Loxothylacus ihlei* (Loxy) and appears as a mass under the flap (see diagram) which at times it can be confused for an egg bearing female.

If Loxy is evident, reject.



Is there any noticeable contamination?

Through the supply chain it is possible, but not probable, that crabs may come in contact with contaminants such as fuel or some chemical. Look, smell and feel for any contamination and if evident, reject.

Is the mud crab lively?

A lively mud crab is very desirable in the market and generally equates to longer life expectancy as it is a 'stronger' animal.

A lively mud crab will try and nip you with its claws, the legs try and push back against you, the tips of the legs try and dig in (see diagram), it tries to walk away, or if there is movement near the eye stalks the eyes react quickly.



If the crab doesn't exhibit these characteristics it is often called 'slow' and based on the amount of time still left in supply chain it may be best to reject it or consider another grade.

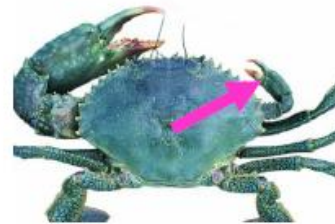
Does the mud crab have one, two or no claws?

Mud crabs have two claws, but for a range of reasons, crabs sometimes lose one or both claws. If it only has one claw, grade as a SINGLE CLAW. If it has NO claws, it should be rejected.

Is one of the claws less than 30% the size of other?

Sometimes the claws of mud crabs are markedly different in size.

If one claw is 30% or less the size of the other, it should be graded as SINGLE CLAW.



Are legs or flippers missing?

For a range of reasons, crabs sometimes lose legs or flippers. If more than a total of 3 legs or flippers are missing, the packaging should be labelled as having 'MISSING LEGS'.

Shell flex, or the lack of it, is one of the key means to determine the potential meat quantity of a mud crab.

The shell flex test is done in different ways for males and female crabs, so you need to be able to determine the sex of a mud crab before being able to test the level of shell flex.

How to tell the sex of a mud crab

To tell the sex of a mud crab, turn the crab over and grade into male or females. Be very wary and careful of the crab's nippers when doing this.

Male mud crabs have a narrow triangular shaped flap



Females have a large, rounded, pigmented abdominal flap



Male Shell Flex

The amount of flex evident in male mud crabs is measured on the top of the carapace and on the underside through two separate tests.

At all times be careful that the crabs claws cannot nip you when you are doing these tests as the claws can reach a long way.

Male Mud Crab Top Carapace Test

To test if the top carapace flexes on a male mud crab, hold the crab in your palms (abdominal flap facing down) and then place your thumbs on the carapace in line with the widest part of the carapace and where the string is (or would be if the crab was tied up) and press gently. If the shell has no give you can then press more firmly to see if there is any shell flex.



If the shell flexes at all it should be graded as **C GRADE**.

(Note this grade is illegal in the NT and will also not be accepted by many traders).

Male Mud Crab Underside Carapace Test

The standard way to test shell flex on the underside (bottom carapace) in male mud crabs, is to hold the crab in both hands, with your palms facing upwards and the abdominal flap of the crab facing upwards (see diagram).

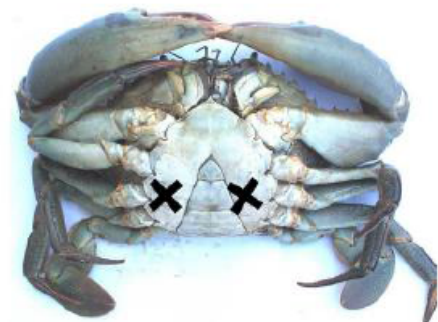
Place your thumbs on the middle segments (next to the 2nd walking legs and either side of the flap) and press gently (see **X** on diagram). If the shell has no give you can then press more firmly to see if there is any shell flex on either side.



If you wish you can test each of the six segments, but the middle segment (marked **X** on diagram) is the last one to harden up and if it is solid the others will also be (unless they have been damaged by previous thumb tests)

If the shell flexes at all on any segment it should be graded as **B GRADE**. *(Note in the NT it is illegal to sell a male mud crab if both of the middle segments flex).*

If there is no flex on the top or any bottom segments of the carapace the crab can be graded as **A GRADE**.



Female Shell Flex

The amount of flex evident in female mud crabs is measured only on the top of the carapace. When you press the carapace, if it is very recently moulted, sometimes there is also a very audible 'click' sound.

At all times be careful that the crabs claws cannot nip you when you are doing these tests as the claws can reach a long way.

Female Mud Crab Top Carapace Test

The standard way to test shell flex on the top carapace in a female mud crab, is to hold the crab in both hands, palms facing upwards and abdominal flap facing down (see diagram).



Place your thumbs on the carapace, in line with the widest part of the carapace and where the string is (or would be if the crab was tied up), and press gently (see X on diagram). If the shell has no give you can then press more firmly to see if there is any shell flex and an associated 'clicking' noise.

If clicking occurs the crab should be graded as **C GRADE**. (Note in the NT it is illegal to sell a mud crab if both sides click. It will also not be accepted by many traders).

If the shell has no give you can then press more firmly to see if there is any shell flex on either side.

If the shell flexes (but doesn't click), grade as **B GRADE**.

If the shell has no flex on the top carapace and doesn't click, the crab can be graded as **A GRADE**.



Further Information

Contact:

- C-AID Consultants – www.c-aid.com.au
- DAFF Queensland – www.daff.qld.gov.au
- Sydney Fish Market – www.sydneyfishmarket.com.au
- Your local industry body representative

ATTACHMENT 6: Information Brochure Outlining Grading Scheme

Live Mud Crab Grading Scheme

The Australian Industry Live Mud Crab Grading Scheme was developed by the National Mud Crab Industry Reference Group.

This project was supported by the Australian Government through the Fisheries Research Development Corporation (FRDC) under FRDC project 2011/225 'Using Industry Expertise to Build a National System for Grading of Live Mud Crabs'.

The project was only possible through the attendance, participation and input of industry members at the Forum, who now comprise the National Mud Crab Industry Reference Group, C-AID Consultants, Queensland Department of Agriculture, Fisheries and Forestry (DAFF Qld), OceanWatch with logistical support from Sydney Fish Market.

A video showing how to undertake the grading, electronic copies of the brochure and other information will be available at the following websites:

C-AID Consultants
www.c-aid.com.au

DAFF Qld
www.daff.qld.gov.au/food

Sydney Fish Market
www.sydneyfishmarket.com.au

OceanWatch
www.oceanwatch.org.au

DESIGN AND LAYOUT FIRST CLASS IN GRAPHIC DESIGN

Background to the Live Mud Crab Grading Scheme

Mud crabs provide a valuable commercial fishery in Australia and generate at least \$100 million in retail and restaurant sales every year. They are also a highly prized recreational catch and a source of food for many indigenous Australians. From a commercial perspective, many people are involved in the process of putting a mud crab on the consumer's plate – from catchers to transport operators to wholesalers to retailers to restaurant chefs. Most mud crabs travel to their final point of sale alive and the quality of the crab at its final destination has a major impact on price and desirability.

Historically, there have been different interpretations of quality grading between crabbers and wholesalers across Australia. What make a "top quality" mud crab and importantly what constitutes a "poor quality" crab has been open to a wide range of personal views and this has impacted on revenue and relationships

throughout the supply chain. Through two Fisheries Research and Development Corporation (FRDC) projects and via Industry comment this has been identified as a major problem.

With the support of FRDC a forum was held to develop a national system to ensure catchers, buyers and marketers had a consistent, workable grading system for the entire industry – from trap to plate. The forum, "Using Industry Expertise to Build a National System for Grading of Live Mud Crabs" brought together people from throughout the supply chain and from across Australia to develop this industry-driven, objective and mutually-agreed Australian minimum standards for a national grading system for live mud crabs. The decision chart developed by the group provides all people throughout the supply chain with an easy to use guide to the Australian Grading Scheme for live mud crabs.

Each jurisdiction has different rules on the taking of mud crab – make sure you know your local rules.

Key handling recommendations for crabbers

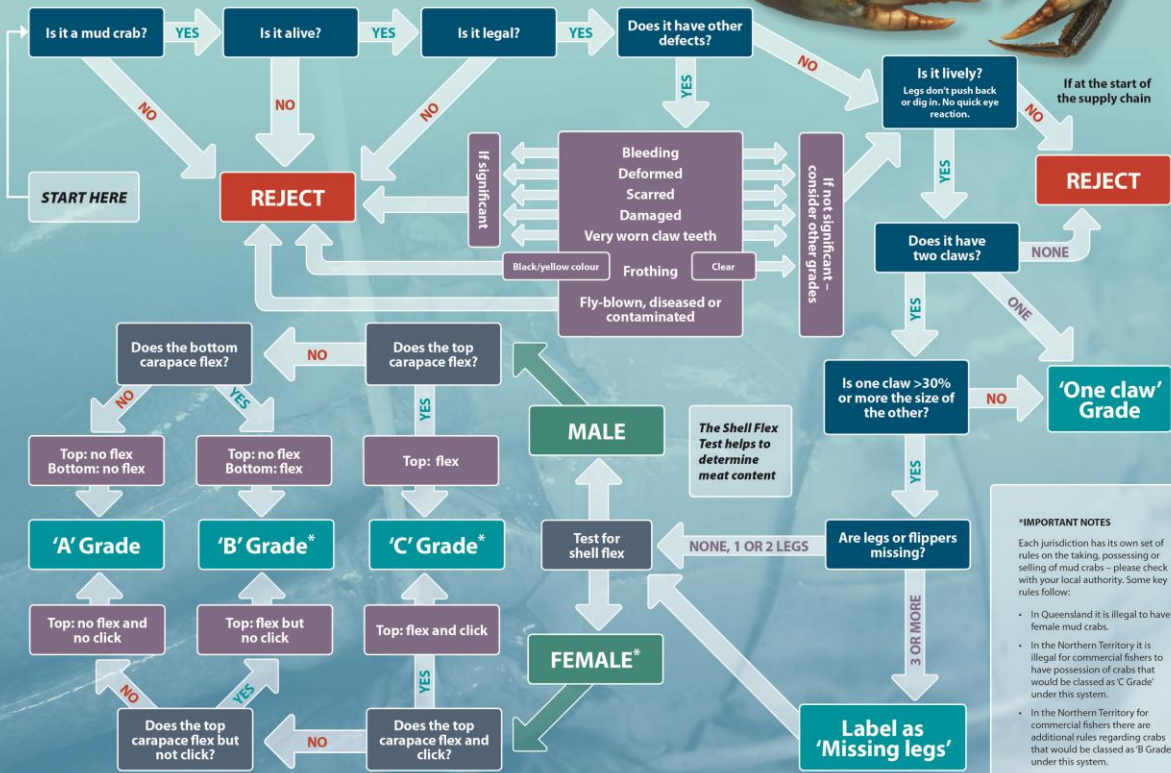
After you have confirmed that your crab is the legal size and complies with sex and other controls as per state and territory regulations, research has shown the following tips will help keep your live muddies in the best condition:

- Tie claws hard against the body as soon as possible – if you can, or ensure crabs can't injure each other
- If keeping crabs alive, hold them in clean, damp, insect proof, hessian-lined and covered crates
- Keep the temperature constant
- Avoid direct sunlight, wind or breeze
- Limit any loud noises, vibrations or impacts
- Disturb the crabs as little as possible and handle gently.

Mud crabs must change their shell to grow to a larger size – this is called moulting. Recently moulted crabs have softer, thinner shells with little meat inside, but lots of fluid – these are often called empty crabs. If these crabs are returned to the water at point of capture, over a relatively short time of 2 to 4 weeks, as the crab feeds that fluid transforms to juicy and succulent meat.



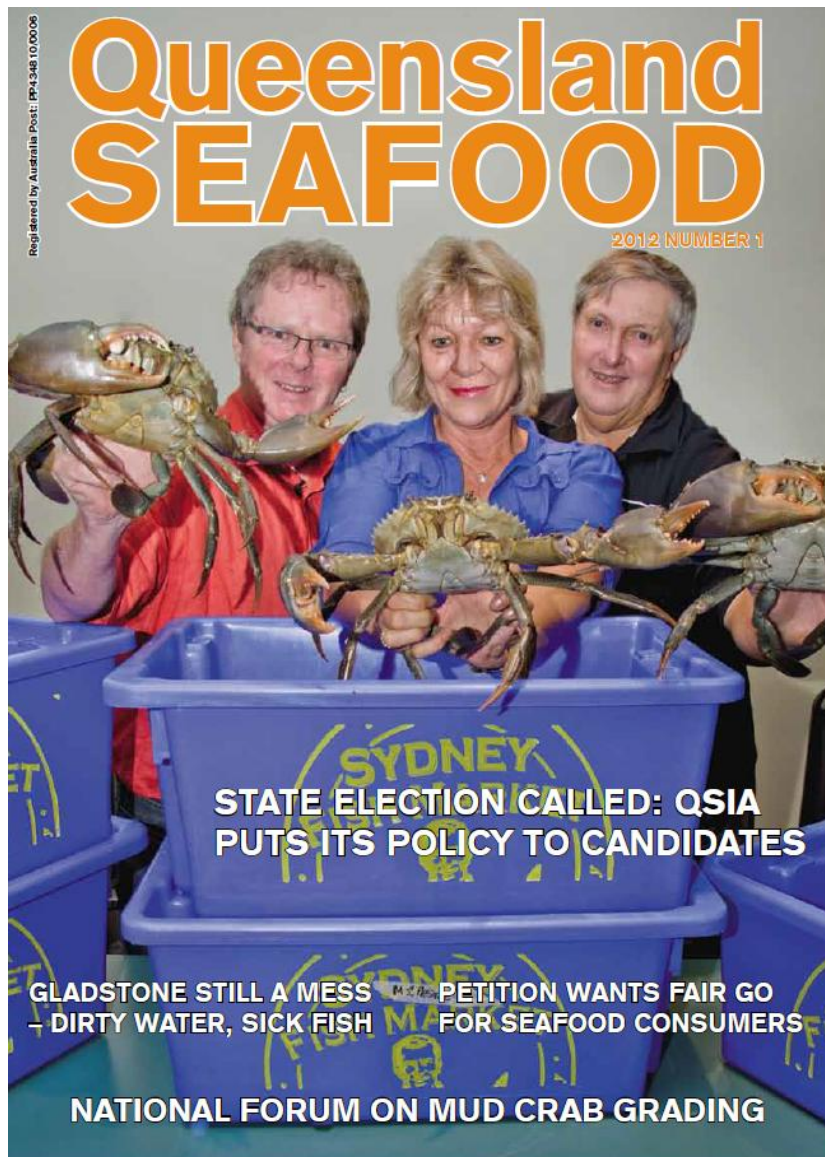
Australian Industry Live Mud Crab Grading Scheme



***IMPORTANT NOTES**
Each jurisdiction has its own set of rules on the taking, possessing or selling of mud crabs – please check with your local authority. Some key rules follow:

- In Queensland it is illegal to have female mud crabs.
- In the Northern Territory it is illegal for commercial fishers to have possession of crabs that would be classed as 'C Grade' under this system.
- In the Northern Territory for commercial fishers there are additional rules regarding crabs that would be classed as 'B Grade' under this system.

ATTACHMENT 7: Sample Media



By Chris Calogeras

FRDC Research Codes: 2003/240, 2010/302, 2011/225

More information: Chris Calogeras, C-AID Consultants, calogeras@inet.net.au

SUPPLY CHAIN 31

National grades agreed for mud crabs

Mud crabs provide a valuable commercial fishery in Australia, generating somewhere in the order of \$150 million in retail and restaurant sales every year. Many people are involved in the process of putting a mud crab on the consumer's plate, from catchers to transport operators to wholesalers, retailers and restaurant chefs.

Most mud crabs travel to their final point of sale alive. Grading is based on a range of subjective attributes including meat quality and quantity and level of 'liveliness', which determines the price at their final destination.

Historically, quality grading has been subject to vastly different interpretations along the supply chain across Australia. Just what makes a 'top quality' mud crab and, more importantly, what constitutes a 'poor quality' mud crab that buyers do not want? This has been highly emotive and has greatly impacted on revenue and relationships throughout the supply chain.

Recently it was decided that it was time to do something about this situation and industry players came together to agree on a national quality grading system for live mud crabs.

The problems with varying mud crab gradings were highlighted through two research projects funded by the FRDC. These projects aimed to first determine best-handling practices for live mud crabs (FRDC Project 2003/240) and second to inform those in the entire Australian supply chain about the best-handling practices (FRDC Project 2010/302).

These two projects indicated that industry members in the various jurisdictions graded their live crabs in different ways, each had their own perceptions. To address this, a national system was proposed to ensure catchers, buyers and marketers had a consistent, workable grading system for the entire industry - from trap to plate.

The FRDC supported an independently facilitated national forum through a Tactical

Research Fund Project (2011/225), 'Using Industry Expertise to Build a National System for Grading of Live Mud Crabs'. It brought together people from throughout the supply chain and from across Australia, to develop an industry-driven, objective and mutually agreed Australian grading system for live mud crabs.

Twenty-two participants from the major state and territory key industry groups, some regional centres and key supply chain participants - catchers, distributors and buyers - attended the forum at Sydney Fish Market in January 2012. Through a process of consensus, a national grading system was developed.

Peter Jackson, the president of the East Coast Crabfishers Industry Network, said the workshop achieved "solid, sensible and workable outcomes".

An easy-to-use grading system was developed and is currently being distributed throughout the supply chain. An industry-focused, easy-to-use instructional video, booklet and ready reckoner pamphlet are almost complete.

A YouTube video is also in production so that the recreational fishers can make sure they only take home nice full mud crabs. Many people do not know that crabs continue to grow to fill their shells and 'empty crabs', if returned to the water, will be full of juicy, firm meat within a couple of weeks. F



John Mayze (Queensland Department of Agriculture, Fisheries and Forestry), Spencer Wilkinson (Melbourne mud crab wholesaler) and John Harrison (Professional Fishermen's Association) examine meat content of a range of mud crabs assessed using the new grading system.

All aspects of the supply chain were represented at a forum that has developed national grading standards for mud crabs.



Participants at the 'Using Industry Expertise to Build a National System for Grading of Live Mud Crabs' Forum, Sydney 2012.

PHOTOS: SCOTT BILKEMAN

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Monday, 3 December 2012



MEDIA INFORMATION



THE NEW NATIONAL LIVE MUD CRAB GRADING SCHEME

Sydney Fish Market (SFM) is excited to join industry in adopting the new national live Mud Crab grading scheme today, Monday, 3 December 2012.

As SFM's top seafood species (by value) for the 2011/12 financial year, Mud Crab is extremely important to the annual turnover of the wholesale seafood auction. Therefore introduction of a national standard for grading SFM's most valuable seafood species is promising for future growth of SFM's wholesale auction.

Supported by Fisheries Research and Development Corporation (FRDC) and the Department of Agriculture, Fisheries and Forestry (DAFF) Queensland, the scheme is a win-win for the entire industry from trap to plate.

A trial period of the national scheme was conducted earlier this year through the SFM wholesale auction and positive outcomes were confirmed by the SFM quality assurance staff team. These included; clarity of grading between suppliers and buyers (retail and wholesale business owners), that the majority of suppliers were accurately adhering to the scheme, and that there was also increased buyer confidence resulting in higher price averages.

Chris Calogeras (an independent consultant who works closely with SFM suppliers), Benioni Iakoba (SFM's quality assurance officer) and David Chung (a wholesale business owner who buys through SFM's auction), are just three people from industry who helped develop the scheme.

By including expertise along the whole supply chain including catchers, transporters, wholesalers, suppliers, researchers, quality assurance and buyer's it was possible to develop a consistent workable grading scheme applicable along the whole supply chain for one of Australia's most valuable seafood products.

Mud Crab is estimated to generate over \$100 million in retail and restaurant sales every year. They are caught from northern WA all the way across the tropics to northern NSW.

Information packages detailing the scheme have been sent to the whole supply chain Australia wide, from commercial Mud Crab fishermen to the retailers, distributors and wholesalers. This includes SFM buyers.

Further details about the scheme can be obtained at www.c-aid.com.au, www.daff.qld.gov.au or www.frdc.com.au - see research projects - project number - 2011/225, 'Tactical Research Fund: using industry expertise to build a national standard for grading of live mud crabs'. Live Mud Crab information, developed as part of the scheme can also be found [here](#).

If media would like to obtain a pack or interview with Chris, Benioni or David please contact SFM's public relations and media executive, Jessica Harding on 02 9004 1146 or jessicah@sydneyfishmarket.com.au

SFM adopts the new national live Mud Crab grading scheme

From the beginning of December the Sydney Fish Market adopted the new national live Mud Crab grading scheme.

Supported by Fisheries Research and Development Corporation (FRDC) and the Department of Agriculture, Fisheries and Forestry (DAFF) Queensland, the adoption of the scheme is seen as a win for the entire seafood industry

Mud Crabs have been the SFM's top seafood species (by value) for the 2011/12 financial year and are extremely important to the annual turnover of the wholesale seafood auction. The introduction of a national standard for grading

SFM's most valuable seafood species is equally important for future growth of SFM's wholesale auction.

A trial period of the national scheme was conducted earlier this year through the SFM wholesale auction and the positive outcomes were confirmed by the SFM quality assurance staff team. Outcomes included; clarity of grading between suppliers and buyers (retail and wholesale business owners), the majority of suppliers were accurately adhering to the scheme, and an increase in buyer confidence which resulted in higher price averages.

The three members of the seafood industry which

helped to develop the scheme are, Chris Calogeras (an independent consultant who works closely with SFM suppliers), Benioni Iakoba (SFM's quality assurance officer) and David Chung (a wholesale business owner who buys through SFM's auction).

Mud Crabs are caught from northern Western Australia across the tropics to northern New South Wales and generate over \$100 million in retail and restaurant sales every year.

Information packages detailing the scheme have been sent Australia wide, to commercial Mud Crab fishermen, retailers, distributors and wholesalers.

To be distributed state-wide this afternoon

**Queensland Government
Department of Agriculture, Fisheries and Forestry**

6 December 2012

Mud crabs make the grade

A new national system to grade live mud crabs will provide a consistent, practical scheme for industry and ensure better quality product for Australian crab eaters.

Developed by the Department of Agriculture, Fisheries and Forestry (DAFF), the scheme is supported by industry, with the Sydney Fish Markets already adopting the scheme.

DAFF Principal Seafood Technician John Mayze said mud crabs were a valuable commercial fishery in Australia, generating at least \$100 million in local retail and restaurant sales every year.

“Mud crabs are also a highly prized recreational catch and source of food for many indigenous Australians,” Mr Mayze said.

“Many people are involved in the process of getting a mud crab to the plate, from catchers to transport operators to wholesalers to retailers to restaurant chefs.

“Most mud crabs travel to their final point of sale alive and the quality of the crab at its final destination has a major impact on price and desirability.”

Mr Mayze said the new system was a collaboration between DAFF, Sydney Fish Markets, C-AID consultants and with funding support from FRDC.

“Any reduction in downgraded live mud crabs will improve the revenue return along the supply chain,” he said.

“Consumers will be better informed about the quality of the product they are choosing, leading to a greater consumer confidence to buy premium quality, live mud crabs.”

The project group has formed the new National Mud Crab Industry Reference Group (NMCIRG), which will also drive future directions and opportunities for the Australian mud crab industry.

Each state has different rules on the taking of mud crab – make sure you know your local rules.

More information at www.daff.qld.gov.au

Media: Caroline Dalton 3087 8563

ATTACHMENT 8: Industry Feedback on Grading Scheme

NT MC Licensee Committee

From: Douglas Neville [mailto:douglasneville@bigpond.com]

Sent: Monday, 19 November 2012 3:44 PM

To: Chris Calogeras

Subject: Live Mud Crab Grading

Hi Chris

Just some feedback on the Project for you.

I thought the forum held in Sydney was a masterstroke as it allowed producers from the three states and buyers to firstly share thinking about the grading issues and finally reach a consensus on what a single (national) scheme should look like.

Initially I did not expect that a common view would be the outcome. The guidance provided by the researchers and yourself was the key to its success.

I expect that because we now have a defined scheme for grading it will be adopted and used as the basis for discussing live mud crab quality across the country. The states will still have differing standards in relation to minimum sizes and the male/female thing and no doubt the NT will continue to enforce its self imposed CUC rules in some form but these differences are not inconsistent with the Grading Scheme as it has now been developed.

To date I have not had any feedback from the NT industry as the promotional material has only just been distributed and our season has all but finished for 2012. I think the benefits will flow in 2013 and include less dissatisfaction amongst buyers who will now be able ask that crabs they purchase be graded according to the Standard. If the regular buyers ask for crabs to be graded accordingly and support this with their wallets I expect that producers will respond accordingly.

It might be a step too far right now to expect retailers across Australia to label and sell their crabs as A, B or C grade in their shops and for restaurants to do likewise. It will take a more knowledgeable consumer to drive this process, but some of the more discerning fish mongers may take the opportunity to sell differentiated product and pricing.

I expect that the NT will continue to send mainly A Grade product to the southern markets.

Cheers

Doug Neville

Chair NT MC Licensee Committee

Coffs Harbour Fishermans Co-op

From: Shane [mailto:shane@coffsfishcoop.com.au]

Sent: Thursday, 22 November 2012 9:29 AM

To: 'Chris Calogeras'

Subject: RE: Seeking Support from Industry for Grading Scheme for Live Mud Crabs

Hi Chris

Letter writing is not one of my best skill sets so I have just put together a few points on what myself and the Co-op took out of the scheme.

Firstly I thought the makeup of attendees for the forum cover all relevant states/territories with a broad range of knowledge right through from fisher, processor, wholesaler, to retailer.

The Co-op supports the scheme as the basis for the Australian live mud crab industry.

The Co-op has already implemented the scheme into its operations and is using it to educate and encourage its fishers to return C grade mud crabs back to the water which in most cases would end up in the SFM dump bin, and it is also providing buyers with a more consistent grade of mud crab which in turn in most cases provides a better return to the fisher.

The Co-op is also utilising the distribution material it received, the DVD has been added to our playlist in our retail shop for customers to view.

Overall I think with this scheme being delivered to both the commercial and recreational sectors we should see less wastage and better usage of our fantastic Mud Crab Resource.

Cheers,
Shane

Chris

After attending the grading forum in Sydney in which I must congratulate yourself and the team our Company has implemented the Grading system in which our B Grade are probably 70% Meat content .

I personally would rather see the whole B Grade made a no take product and in saying that this would have to flow across to the Recreational sector as well, as you well know when one lot of stake holder are releasing another Sector that is benefitting from that so please lets not stop here lets make this inferior product no take for everybody and we can enjoy that product how it meant to be consumed.

Well done to all involved.

Regards,
David Caracciolo
Mackay Reef Fish Supplies and NT Fish Pty Ltd

S H WILKINSON PTY LTD

ABN 55 006 288 026

SEAFOOD DISTRIBUTORS

PO BOX 28

NORTH MELBOURNE VIC 3051

22nd November 2012

TELEPHONE 03 9329 5466

FAX 03 9329 5688

MOBILE 0416 187641

EMAIL sh.w@bigpond.com

Dear Chris

In general terms the crab forum held in Sydney on the 31st January and 1st February 2012 provided an excellent opportunity for all relevant parties involved in the commercial mudcrab fishery nationally to air their views , exchange ideas and ultimately develop a grading and best practices handling system .

The makeup of the forum attendees was wide-ranging from crabbers right through the supply chain to the wholesalers/retailers covering all the main states. It was agreed by all participants that a national grading system and the development of best handling practices was very important for the industry which up until now had been very loosely organised (with the exception of the NT fishery) and as a result impacted negatively on the industry as a whole.

The forum reinforced to me as a supplier to Chinese restaurants in Melbourne the difference it makes to my business when crabs are properly graded – these new guidelines have continued to impact favourably on my customer base and it has made me increasingly aware of the importance of proper handling with crab which impacts on improved longevity of the animal.

I am sharing a lot of the information out of the forum with many of my customers and this adds greater transparency in the marketing of the crab something which has been sadly lacking over the last 30 years or so since I have been involved in the industry.

This transparency has led to a building of greater trust through my customer base reflected in ever increasing sales . Specifically on this issue the clear distinction drawn between A and B grade crabs at the forum has addressed an issue which has been the bane of the industry and the cause of innumerable disputes over the years.

The quality and variety of the material developed at the forum is excellent . The visual presentation runs through the grading system and best handling in a comprehensive and easy to understand format. This material is also available on You Tube.

The continuing education of stakeholders in the industry can only lead to increased benefits throughout the supply chain – less wastage of the resource and greater consumer confidence in the product

Once again I congratulate you, John and Sue on the excellent work that has come out of this project the results of which are already tangible in the market place

Regards

Spencer Wilkinson
Director



Mr Chris Calogeras
C-AID Consultants
38 Lake Ridge Court
Lake Macdonald Qld 4563

Dear Chris

Thank you for the opportunity to comment on the recent FRDC project 'Using Industry Expertise to Build a National Scheme for Grading of Live Mud Crabs'.

The project had some very ambitious objectives however the outcomes have gone a long way in achieving these objectives. This is a major achievement given the difficult audience who have entrenched views on best practise and a reluctance to engage in change.

The port workshops held along the coast had varying success and varying attendance levels. Some workshops were well attended while others were poorly attended. Some although well attended were hindered by negative fishers attitudes however having said that we need to continue to try and get the message to fishermen.

The National Workshop held at Sydney Fish Market early in 2012 showed that research can contribute to best handling practises and relevant standards. The distribution of the results is paramount to the investment in the project and while already undertaken needs to continue beyond the timeframe of this project.

The full supply chain was covered at the workshop with a lot of positive interaction which in turn lead to a better understanding of the required steps in the processes. The forum was very interactive and provided the opportunity for and indeed encouraged everyone to speak. This can only be encouraged for future projects/experiences, to develop the full value for the mud crab fishery to ensure they are maximising their return for effort.

The video produced as a DVD for the best handling practices project was very informative and easy to follow.

We recommend that further work is undertaken to reinforce with fishers in particular how they should assess mud crabs for quality and return noncompliant specimens to their habitat due to not attracting desired prices, etc.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Rhonda Farlow', is written over a light blue horizontal line.

Rhonda Farlow
On behalf of
Committee of Management
22 November 2012

PFA providing effective representation on NSW commercial wild harvest fishing to all levels of government and other key stakeholders

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ATTACHMENT 9: Impact of the National Live Mud Crab Grading Scheme - SFM.**Impact of the National Live Mud Crab Grading Scheme**

The live mud crab trade is a major factor of the Australian Seafood Industry. The Sydney Fish Market (SFM) has listed mud crabs as its number one species by value for the 2011/12 financial year with sales exceeding \$9.7m, which is an increase of over \$1.1m from the previous year. The price per kilo had risen from the 2011 average of \$21.94 to \$23.31 and the quantity supplied increased by approx. 27,000 tonne during the same period. These statistics confirm that both value and quantity supplied of mud crabs have reached new highs and the SFM attributes this success to three key points;

1. Long established operation systems and trading platform
2. Quality Assurance staff (QAs) vigilantly communicating with crabbers and enforcing grading standards
3. Creation and adoption of the new National Live Mud Crab Grading Scheme

SFM has been a dominant figure within industry since the mid sixties and its quality guidelines for grading aquatic species for human consumption has evolved over time with changes to legislation, regulations, industry advancements and expectations of the broader community. As an industry leader, the SFM is proactive in adopting new systems, methods, technology and grading schemes into its operation to ensure that it remains at the top for both quality and value. This stance led SFM to contributing to the development, trialing and eventual adoption of the National Live Mud Crab Grading Scheme.

Prior to the national scheme, grading live mud crabs varied from state to state and even varied depending on regions within states. The SFM used an internally developed grading system that SFM suppliers and buyers adhered to. This system often led to friction between parties on all sides of the trade because of the multiple grading methods that existed at points of the crab's origin and destination. It was clear that a universal grading scheme needed to be established and implemented nationally, to satisfy the needs of suppliers, buyers and ultimately the end consumer.

The selection of participants involved in developing the new scheme allowed for a well-rounded final product. Since its development in January, SFM's QAs have communicated the scheme to suppliers and buyers and initiated trialing the scheme throughout the company's operations. As suppliers and buyers became aware of a national system, attitudes and behaviours related to mud crab grading, harvesting and trading began to be noticed by SFM's QAs. Positive outcomes confirmed by the QAs during trial stages include; clarity of grading between suppliers and buyers, majority of suppliers accurately adhering to the scheme and increased buyer confidence resulting in higher price averages (including periods of peaks and troughs of supply and demand). David Chung known as 'Silverlake', who is a major buyer of mud crabs and frequently sets the daily average price for mud crabs at the SFM's auction, has stated to Benioni Iakoba (SFM's QA responsible for mud crab quality control), quote: *"Price isn't an issue, if you QAs can guarantee the quality, the buyers will pay the price. I always tell the other buyers if you can follow me to \$50/kg feel free, but the quality has to be there. I believe that if the grading continues like this; the crabbers, buyers and end consumers will be very happy moving forward."*

(Silverlake has bought live mud crabs from W.A., N.T., QLD and NSW for more than 15 years, he was a key participant in developing the new grading scheme and he also holds the all time record of paying \$68/kg for mud crabs via the SFM in 2009).

As the grading scheme is less than 12 months old, it is not yet possible to correlate positive outcomes of its implementation with SFM's data and statistics. However, SFM's QAs confirm that implementing the National Live Mud Crab Grading Scheme into SFM's operations has positively impacted the mud crab trade between its suppliers and buyers, resulting in increased price averages due to suppliers grading and utilising best practices for handling, packaging and transporting live mud crabs as prescribed in the scheme.

Furthermore, SFM's practices and prices are referenced throughout Australia and is frequently used as a benchmark by suppliers, buyers, wholesale distributors and fishing Co-operatives as the standard to achieve. This flow-on effect has led to higher prices being realised by suppliers within their local market.

(Media references:

<http://www.abc.net.au/rural/news/content/201211/s3624284.htm>

<http://www.abc.net.au/rural/qld/content/2012/11/s3623681.htm>)

