24th MEETING OF THE PZJA TORRES STRAIT TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG 24)

Thursday 18 October 2018 (8:00 AM – 4:00 PM)
Friday 19 October 2018 (8:00 AM – 12:00 PM)

Cairns (Northern Fisheries Centre, 38-40 Tingira Street, Portsmith)

DRAFT AGENDA

1 PRELIMINARIES

1.1 Welcome and apologies

The Chair will welcome members and observers to the 24th meeting of the RAG.

1.2 Adoption of agenda

The RAG will be invited to adopt the draft agenda.

1.3 Declaration of interests

Members and observers will be invited to declare any real or potential conflicts of interest and determine whether a member may or may not be present during discussion of or decisions made on the matter which is the subject of the conflict.

1.4 Action items from previous meetings

The RAG will be invited to note the status of action items arising from previous meetings.

1.5 Out-of-session correspondence

The RAG will be invited to note out of session correspondence on RAG matters since the previous meeting.

2 UPDATES FROM MEMBERS

2.1 Industry and scientific members

Industry and scientific members and observers will be invited to provide an update on matters concerning the Torres Strait TRL Fishery.

2.2 Government agencies

The RAG will be invited to note updates from AFMA, TSRA and QDAF on matters concerning the Torres Strait TRL Fishery. AFMA will provide a summary of management arrangements for the 2017/18 fishing season, including the outcomes of the Federal Court case.

2.3 PNG National Fisheries Authority

The RAG will be invited to note an update from the PNG National Fisheries Authority.

2.4 Native Title

The RAG will be invited to note an update from Malu Lamar (Torres Strait Islander) Corporation RNTBC.

3 CATCH SUMMARY FOR THE 2017/18 FISHING SEASON

The RAG will be invited to note Australian and PNG catch data for the 2017/18 fishing season.

4 CATCH AND CPUE ANALYSES FOR THE 2017/18 FISHING SEASON

The RAG will be invited to consider updated catch and catch per unit effort (CPUE) data analyses for the 2017/18 fishing season.

5 RESULTS OF THE 2018 MID-YEAR SURVEY

The RAG will be invited to consider the results of the 2018 mid-year survey, including length frequency analyses.

6 COMPARISON OF CPUE ANALYSES AGAINST RESULTS OF THE 2017 PRE-SEASON AND 2018 MID-YEAR SURVEYS

The RAG will be invited to consider:

- Implications for logbook data and how we interpret CPUE data?
    - To include how to best progress improvements to catch and effort data for the TRL Fishery, including discussions needed regarding historical fishing power changes (e.g. workshop with industry, or through other methods).
- Implications for future survey design?
    - To include identification of any changes to be included in call for research for the survey and stock assessment project?
    - Use of industry vessels.
- Implications for the draft Harvest Strategy?
- What are the costs/benefits of an independent review of the survey design, stock assessment and draft Harvest Strategy?

7 PLANNING AND DESIGN OF FUTURE SURVEYS AND ASSESSMENTS

The RAG will be invited to consider preparations for the 2018 pre-season survey.

8 BETTER ALIGNING THE TAC SETTING PROCESS WITH THE FISHING SEASON FOR THE 2018/19 SEASON AND FUTURE SEASONS

The RAG will be invited to consider the TAC setting process and analyses on issues and process to better align this process with the fishing season.

9 DRAFT FIVE-YEAR RESEARCH PLAN FOR 2019/20 TO 2022/23

The RAG will be invited to consider the new research planning framework for Torres Strait fisheries and research priorities for the Torres Strait TRL Fishery.

10 OTHER BUSINESS

The RAG will be invited to raise other business for consideration.

11 DATE AND VENUE FOR NEXT MEETING

The next RAG meeting is proposed for 11-12 December on Thursday Island.

The Chair must approve the attendance of all observers at the meeting. Individuals wishing to attend the meeting as an observer must contact the Executive Officer – Natalie Couchman (natalie.couchman@afma.gov.au)

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
PRELIMINARIES **Welcome and apologies**	**Agenda Item 1.1** **For Information**

RECOMMENDATIONS

1. That the RAG **NOTE**:
   a. an opening prayer;
   b. an acknowledgement of Traditional Owners;
   c. the Chair's welcome address; and
   d. apologies received from members unable to attend and written comments provided for consideration at the meeting (**Attachment 1.1a**).

BACKGROUND

2. Apologies have been received from Dr Ray Moore (Industry Member) and Mr Terrence Whap (Industry Member).
3. Dr Moore has provided comments for consideration under Agenda Items 4-6 (**Attachment 1.1a**).

TRL 2018 SEASON SOME NOTES ON THE DISPARITY BETWEEN THE SURVEY RESULTS AND ACTUAL CATCHES

EFFECTS OF LOBSTERS FORMING DENSE AGGREGATIONS

It is well known that ornatus forms dense concentrations on shell beds while the surrounding areas may have very poor concentrations of lobsters. The food sources are generally short lived so that the position of the concentrations varies from season to season.

Early in the 2018 season good catches were made North of Maubiag, very poor elsewhere. The Pre-season survey did not pick up these stocks. Although an additional 6 sites were surveyed in this area during the midyear survey there was no improvement in the estimated lobster abundance. However the fishery was still maintaining very good catches in this area. This demonstrates that these concentrations can be in very small areas and, if located, fisherman can maintain good catches when stocks in the surrounding area are poor.

A good example of this is the 2013?season which started quite poor and the fleet was spread out over the whole fishing area. A patch of shell was then located in 20-30m just to the NE of Dungerness reef and some excellent catches were made. Eventually the whole fleet moved into this area and the catch for the season changed from poor to good. The area involved was just a few square miles. Surrounding areas that had no shell beds had non-commercial stocks of lobsters.

This aggregating nature of ornatus could explain the disparity between the survey and catches in the Maubiag area in 2018. However in general, this aggregating nature would mean that the survey would underestimate the lobster population (or if in fact a survey transect went through a hot spot, dramatically overestimate it). But only in one year(2011) has the dive fishery exceeded the RBC. Usually the fishery struggles to take the RBC. If the fishing mortality is only 15% and the survey is underestimating stocks then the fishery should easily take the RBC, but it doesn't. Why was 2018 so different?

MOVEMENT OF LOBSTERS FROM OUTSIDE OF THE SURVEY AREA

After the 2018 season was reopened good catches were made in the eastern areas. The RAG needs to get as much information as possible on the location and extent of these catches. These stocks were not located by either surveys and this is of great concern. Is it possible that these stocks have moved in from outside of the survey area?

1)From the northern part of the East Coast

Good stocks of lobsters are often located in the deeper waters in the East: Kirkaldie ,East of Sassie, East of Dungerness, East of Warrior etc. There is very little larval settlement in these deeper waters. When fishing lobster concentrations on food sources in these areas you are not fishing a standing stock, there is continual movement of lobsters into the area. Lobsters tend to move in small pods, stopping on food sources to form large concentrations. These stocks tend to remain in the deeper water. It appears that there is a general movement from the South, through the Kirkaldie area to the Dungerness/Warrior area and then into the Great North East Channel. Lobster concentrations along this route will form around food sources, which will vary from year to year. So if Kirkaldie has good shell beds good catches will be made here. In some years Kirkaldie has no shell beds and catches are poor. However in these years the lobster concentrations are often located on shell beds further North. The origin of these stocks in deeper water is not known. Most likely the Kirkaldie areas receives lobsters from further South. The Torres Strait surveys extend south to Wyborn reef, and usually there are good stocks of 1+ in this SE corner. My observations from working on the northern part of the East Coast, particularly around Christmas Reef, is that there are substantial migrations of lobsters in this area early in the year. In Feb a large proportion of these lobsters would be undersized. The population structure of the lobsters in this area of the East Coast is similar to that of Torres Strait. It is possible that there is significant recruitment into the Torres Strait from this area, which would not be picked up by the TS surveys.

Of importance is the fact that there are no survey sites in this deeper water. Could the catches later in the 2018 season be part of this movement, which would not have been detected by the survey.

2)Lobsters returning from spawning in Eastern Torres Strait.

In February and March some post spawning lobsters have been observed in areas such as Warrior reef. These are females that have residual tar spots and enlarged spent ovaries. It is thought, but not proven, that some of the Torres Strait lobsters may move out to the deeper Eastern areas to spawn and not migrate into the Gulf of Papua. These spent lobsters would represent a return to the fishery similar to that of the East Coast. These would be 3+ lobsters available to the fishery in February/March. They would not be picked up in a pre-season survey. As catches in the Eastern part of the fishery were poor early in the 2018 season, this was not a contributing factor to the disparity with the survey.

3)Lobsters moving in from further West

A number of people have suggested that the good catches in the Maubiag area could be from lobsters migrating in from further West. Studies on the water circulation in the Coral Sea indicate that large numbers of larvae would be swept into the Arafura Sea and of course there are populations of Ornatus in the Gulf of Carpentaria and coastal areas of Irian Jaya. Australian divers now work as far west as the PNG border allows them. At times this area holds good stocks of lobsters . Good catches have also been made around Deliverance Island.

Apart from pearling surveys there has been very little research in the area further to the West. Jim Prescott did some dive surveys with the PNG vessel Kalasi in 1987 but did not encounter any stocks of ornatus. Discussions with Japanese prawn trawl operators who had trawled lobsters in the Gulf of Papua and also worked out of Merauke in Irian Jaya, stated that they had never encountered migrations of ornatus In Irian Jaya. Some ornatus are taken by local fishermen based at Merauke but,as far as I am aware, catches are quite small. So we have no evidence of lobster concentrations further West that could migrate into the Australian fishery but there is insufficient information to dismiss this possibility.

INCREASED EFFICIENCY OF THE FISHERY

Over the years there has been an increase in both the efficiency of operators and the area of the fishery that is accessed. In the early 1980’s mainly the shallow reefs, reef edges and some shallow open bottoms were fished. Today virtually all the open bottoms are fished including the deeper waters to 25metres. A good example is the extensive Kirkaldie area that was not fished and these stocks would probably remain in the deeper water and migrate into the Great NE channel, and not be accessed by the dive fishery.

The increased technology, greater mobility and individual efficiency of operators enables them to locate aggregations of lobsters and maintain good catches when overall stocks may be quite poor. For this reason caution should be used when using CPUE as a measure of stock density. Obviously there will be large natural fluctuations in recruitment from year to year .But if we are getting similar recruitment levels to earlier years then the increased efficiency and area fished should lead to an overall increase in catches. This is not the case .

WHERE ARE WE AT NOW?

Whether we continue to use the existing model or Harvest Strategy the most important information comes from the survey. Since 1989 the survey appears to have given us reasonable results, but in 2018 something has gone wrong and we need to be able to identify the problem to prevent such a disaster in the future.

As Ian has suggested we first need to get all the data on catches, CPUE and analyse this. We also need to get fishermen's reports to gain as much information as possible. Were just a few hot spots were being fished or were stocks distributed over a wider area.

Trent has suggested perhaps another Benchmark survey to determine if the reduced number of sites is in fact representative. Certainly with fewer sites there is the danger of not getting a true estimate of the population. I think in the pre-season survey a total of 144 lobsters were counted for the 77 transects. In a hot spot area a diver would take this number of legal sized lobsters from a single crack or small wonky hole. How many sites would be adequate?. We doubled the number in the Marakai area of Maubiag but still failed to locate the main stocks of lobsters.

The shell beds tend to be on sandy bottoms with minimal cover, often in deeper water. Their extent and location varies from season to season, and without a huge number of transects it is unlikely that a survey would encounter them. We assume that there will be aggregations of lobsters on food sources and lower densities throughout other areas of the fishery. As noted the lobsters on the food sources are not a standing stock, there are continual migrations into the area. So the survey measures the population density throughout the fishery to give us the overall stock size. Depending on the season, there may be several hot spots where lobsters are concentrated. If located this allows the fishery to obtain higher catches than would be expected. However, as the fishery usually fails to take the conservative RBC, this concentrating effect does not negate the survey estimates.

We could explain the disparity in the Maubiag area by assuming that the stocks were generally very low in this region with a concentration in a relatively small area that the survey did not detect, but fishermen did. However the survey indicated that the stocks throughout the fishery were poor. But later in the season fishermen were obtaining good catches over a wide area of the fishery contrary to the survey results.

Sorry I was not fishing and don't have enough information to comment on this, but obviously the RAG needs to resolve this disparity if we are to use the survey as our main management tool. This is a very important Rag and my apology for not being able to attend. I have added some of my thoughts above.

Ray moore

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
PRELIMINARIES **Adoption of agenda**	**Agenda Item 1.2** **For Decision**

RECOMMENDATIONS

1. That the RAG consider and **ADOPT** the agenda.

BACKGROUND

2. A draft agenda was circulated to members on 12 September 2018. Minor comments received have been incorporated.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	MEETING 24 18-19 October 2018
PRELIMINARIES **Declaration of interests**	**Agenda Item 1.3** **For Decision**

RECOMMENDATIONS

1. That RAG members and observers:
    a. **DECLARE** all real or potential conflicts of interest in the Torres Strait Rock Lobster Fishery at the commencement of the meeting (**Attachments 1.3a** and **1.3b**);
    b. **DETERMINE** whether the member may or may not be present during discussion of or decisions made on the matter which is the subject of the conflict;
    c. **ABIDE** by decisions of the RAG regarding the management of conflicts of interest; and
    d. **NOTE** that the record of the meeting must record the fact of any disclosure, and the determination of the RAG as to whether the member may or may not be present during discussion of, or decisions made, on the matter which is the subject of the conflict.

BACKGROUND

2. Consistent with the *Protected Zone Joint Authority (PZJA) Fisheries Management Paper No. 1* (FMP1), which guides the operation and administration of PZJA consultative forums, members are asked to declare any real or potential conflicts of interest.
3. RAG members are asked to confirm the standing list of declared interests (**Attachments 1.3a** and **1.3b**) is accurate and provide an update to be tabled if it is not.
4. FMP1 recognises that members are appointed to provide input based on their knowledge and expertise and as a consequence, may face potential or direct conflicts of interest. Where a member has a material personal interest in a matter being considered, including a direct or indirect financial or economic interest; the interest could conflict with the proper performance of the member's duties. Of greater concern is the specific conflict created where a member is in a position to derive direct benefit from a recommendation if it is implemented.
5. When a member recognises that a real or potential conflict of interest exists, the conflict must be disclosed as soon as possible. Where this relates to an issue on the agenda of a meeting this can normally wait until that meeting, but where the conflict relates to decisions already made, members must be informed immediately. Conflicts of interest should be dealt with at the start of each meeting. If members become aware of a potential conflict of interest during the meeting, they must immediately disclose the conflict of interest.
6. Where it is determined that a direct conflict of interest exists, the forum may allow the member to continue to participate in the discussions relating to the matter but not in any decision making process. They may also determine that, having made their contribution to the discussions, the member should retire from the meeting for the remainder of discussions on that issue. Declarations of interest, and subsequent decisions by the forum, must be recorded accurately in the meeting minutes.

TRLRAG Declarations of Interest from most recent meetings

Name	Position	Declaration of interest
Members		
Dr Ian Knuckey	Chair	Chair/Director of Fishwell Consulting Pty Ltd and Olrac Australia (electronic logbooks). Chair/member of other RAGs and MACs. Conducts various AFMA and FRDC funded research projects including FRDC Indigenous Capacity Building project. Nil interests in TRL Fishery and no research projects in the Torres Strait. Full declaration of interests provided at **Attachment 1.3b**.
Selina Stoute	AFMA Member	Nil.
Allison Runck	TSRA Member	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them.
Danielle Stewart	QDAF Member	Nil.
Dr Eva Plaganyi	Scientific Member	Project staff for PZJA funded TRL research projects.
Dr Andrew Penney	Independent Scientific Member	Research consultant (Pisces Australis), member of other RAGs. Nil pecuniary or research interests in the Torres Strait.
Aaron Tom	Industry Member	Nil. Traditional Inhabitant Gudumalulgal and TIB licence holder.
Mark David	Industry Member	Industry representative, TRLWG Industry member, Traditional Owner and TIB licence holder.
Les Pitt	Industry Member	Nil. Traditional Inhabitant Kemer Kemer Meriam and TIB licence holder.
Phillip Ketchell	Industry Member	Nil. Traditional Inhabitant Kaiwalagal and Traditional Owner.
Daniel Takai	Industry Member	Pearl Island Seafoods, Tanala Seafoods, TIB licence holder and lessee of TSRA TVH licence.
Brett Arlidge	Industry Member	General Manager MG Kailis Pty Ltd. MG Kailis Pty Ltd is a holder of TVH licences.
Natalie Couchman	Executive Officer	Nil.
Observers		
Dr Robert Campbell	CSIRO	Nil pecuniary interests. Project staff for PZJA funded TRL research projects.

Dr Tim Skewes	CSIRO	Project staff for PZJA funded TRL research projects.
John Kris	Malu Lamar (Torres Strait Islanders) Corporation Registered Native Title Body Corporate (RNTBC)	Director of Malu Lamar and Goemulgaw (Torres Strait Islanders) Corporation RNTBC.
Joseph Posu	PNG National Fisheries Authority (NFA)	To be advised.
Ian Liviko	PNG NFA	To be advised.
Jerry Stephen	TSRA Deputy Chair, TSRA Member for Ugar and TSRA Portfolio Member for Fisheries	TIB licence holder and Native Title holder.
Suzannah Salam	Industry	To be advised.
Tony Salam	Industry	To be advised.
Trent Butcher	Industry	To be advised.
Patrick Mills	Torres Strait Fisheries Association	To be advised.

Declaration of interests

Dr Ian Knuckey – April 2018

Positions:

- Director – Fishwell Consulting Pty Ltd
- Director – Olrac Australia (Electronic logbooks)
- Chair / Director – Australian Seafood Co-products (seafood waste utilisation)
- Chair / Director – ASCo Fertilisers (seafood waste utilization)
- Chair – Northern Prawn Fishery Resource Assessment Group
- Chair – Tropical Rock Lobster Resource Assessment Group
- Chair – Victorian Rock Lobster and Giant Crab Assessment Group
- Scientific Member – Northern Prawn Management Advisory Committee
- Scientific Member – SESSF Shark Resource Assessment Group
- Scientific Member – Great Australian Bight Resource Assessment Group
- Invited scientific participant – SEMAC, SERAG

Current / Recent Projects and funding:

- Principal Investigator – FRDC Project 2017-069 Indigenous Capacity Building
- Principal Investigator – VFA Project 17-646976 – Ocean Scallop Biomass Survey – 2018
- Principal Investigator – FRDC Project 2017/122 - Review of fishery resource access and allocation arrangements across Australian jurisdictions
- Principal Investigator – FRDC Project 2016/116 - 5-year RD&E Plan for Northern Territory fisheries and aquaculture
- Principal Investigator – AFMA Project 2017/0803 - Analysis of Shark Fishery Electronic Monitoring data
- Principal Investigator – AFMA Project 2017/0807 - Resource Survey of the Great Australian Bight Trawl Sector – 2018
- Principal Investigator – AFMA Project 2016/0809 – Improved targeting of arrow squid
- Principal Investigator – AFMA Project 2018/08xx – Bass Strait and Central Zone Scallop Fishery – 2018 and 2019 Survey
- Principal Investigator – DPIPWE Project – Review of abalone dive rates
- Principal Investigator – FRDC Project 2015/204 – Realising economic returns of reducing waste through utilization of bycatch in the GAB Trawl Sector of the SESSF
- Principal Investigator – FRDC Project 2014/203 – Review of Monitoring and Assessment in the SESSF
- Principal Investigator – AFMA Project 2014/0809 – Fishery Independent Survey of shelf resources in the Great Australian Bight Trawl Fishery 2017
- Principal Investigator – Survey for Black teatfish in the Queensland Sea Cucumber Fishery.
- Principal Investigator – CRC Project 2013/748.40 – Improved understanding of economics in fisheries harvest strategies.
- Principal Investigator – FRDC Project 2014/207 – The social drivers and implications of conducting an ecological risk assessment of both recreational and commercial fishing - a case study from Port Phillip Bay
- Co-Investigator – Optimising processes and policy to minimise business and operational impacts of seismic surveys on the fishing industry and oil and gas industry.
- Co-Investigator – FRDC Project 2017/014 – SA Marine Scalefish Review

- Co-investigator – AFMA Project - SESSF 2018 Fishery Independent Survey
- Co-investigator – Bird mitigation in the SESSF trawl sector
- Researcher – Various fishing industry liaison projects for oil and gas industry
- Scientific Advisor – Atlantis, GABIA, Gulf St Vincent Prawn Fishery, Seafish JV, SETFIA, SSIA
- MSC Auditor – Falklands Is 2016 Surveillance Audit (Acoura), Macquarie Is Toothfish (SCS)
- Facilitator – WWF shark traceability workshop
- Facilitator – SPC Tuna Data Collection Committee
- Facilitator – Indonesian fishery training and development

Current / Recent Clients (>$5000):

- ABARES
- Acoura
- Atlantis Fisheries Consulting Group
- Australian Fisheries Management Authority (AFMA)
- CRC – Seafoods
- Department of Agriculture and Water Resources
- Department of Primary Industry - Victoria
- Dept. Primary Industry, Parks Water and Environment (DPIPWE) Tasmania
- Fisheries Research and Development Corporation (FRDC)
- Great Australian Bight Fishing Industry Association (GABIA)
- Gulf of St Vincent Prawn Boat Owners Association
- Monash University
- NT Fisheries
- Richey Fishing
- South Australian Rock Lobster Advisory Council (SARLAC)
- SARDI Aquatic Sciences
- SCS Global Services
- Seafood Industry Victoria
- Seafish JV
- SeaFresh
- Secretariat of the Pacific Community
- South East Trawl Fishing Industry Association (SETFIA)
- Southern Shark Industry Alliance (SSIA)
- Tasmanian Seafoods
- Victorian Fisheries Authority
- Western and Central Pacific Fisheries Commission
- World Wildlife Fund – Australia (WWF)

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	MEETING 24 18-19 October 2018
PRELIMINARIES **Action items from previous meetings**	**Agenda Item 1.4** **For Information**

RECOMMENDATIONS

1. That the RAG:
   a. **NOTE** the progress against actions arising from previous meetings (**Attachment 1.4a**).
   b. **NOTE** the final meeting records for TRLRAG 22 held on 27-28 March 2018 and TRLRAG 23 held on 15 May 2018 that were finalised out of session.

BACKGROUND

Actions arising

2. Updates are provided on the status of actions arising from previous TRLRAG meetings and relevant TRLWG meetings at **Attachment 1.4a**.

Meeting records

3. The draft meeting record for TRLRAG 22 held on 27-28 March 2018 was provided out of session for comment on 14 May 2018. Comments were received from Dr Ray Moore and the TSRA. A track-change version of the draft meeting record, detailing the comments received and how they have been incorporated, is provided at **Attachment 1.4b** for information.
4. The record was finalised out of session following the closure of the comment period and circulated to members on 5 July 2018. The final meeting record is provided at **Attachment 1.4c**.
5. The draft meeting record for TRLRAG 23 held on 15 May 2018 was provided out of session for comment on 17 July 2018. Comments were received from Dr Eva Plaganyi and Dr Robert Campbell. A track-change version of the draft meeting record, detailing the comments received and how they have been incorporated, is provided at **Attachment 1.4d** for information.
6. The record was finalised out of session following the closure of the comment period and circulated to members on 18 August 2018. The final meeting record is provided at **Attachment 1.4e**.

Action items from previous TRLRAG meetings

#	Action Item	Agenda	Agency	Due Date	Status
1.	AFMA to review the effectiveness of certain TIB licensing arrangements (in its 2016 licencing review) including: • TIB licenses should share a common expiry date • licences to last for longer than the current 12 month period.	TRLRAG14 (25-26 August 2015)	AFMA	2017	**Ongoing** AFMA has begun undertaking a review of licensing of Torres Strait Fisheries, this issue will be considered as part of this review. At present however, AFMA resources are focused on progressing the proposed legislative amendments as a matter of priority. • Administrative arrangements can be made to provide for licences held by the same person to expire on the same day. This change can be progressed when resources allow. • The *Torres Strait Fisheries Regulations 1985* currently provide for TIB and TVH licences to be issued for up to 5 years. Administrative arrangements can be progressed when resources allow.
2.	AFMA and CSIRO prepare a timeline of key events that have occurred in the Torres Strait Tropical Rock Lobster Fishery (e.g. licence buy backs, weather events and regulation changes) and provide a paper to TRLRAG.	TRLRAG14 (25-26 August 2015)	AFMA CSIRO	TRLRAG17 (31 March 2016)	**Ongoing** AFMA to complete further work. This has been difficult to action ahead of other priorities for the TRL Fishery.
3.	AFMA to prepare a summary of evidence that PNG trawl-caught TRL are a shared stock between Australia and PNG, including details such as the TRL biological characteristics, larvae dispersal, tag recapture data and catch and effort information.	TRLRAG19 (13 December 2016)	AFMA		**Completed** AFMA sent a letter to PNG NFA outlining concerns of trawlers retaining TRL on 8 March 2017. At TRLRAG 21 held from 12-13 December 2017, CSIRO presented the preliminary results of the research project titled '*Environmental update for the Torres Strait tropical lobster Panulirus ornatus*'.

	AFMA will circulate the paper to the RAG out-of-session for comment before sending to PNG NFA.				AFMA presented the key findings of the CSIRO larval advection model at the Fisheries Bilateral meeting held in Port Moresby on 5 February 2018. The bilateral meeting noted that the findings show the Australian and PNG TRL fisheries are based on a single stock. AFMA and CSIRO (Dr Plaganyi) met with PNG NFA officials, including the NFA Managing Director, John Kasu on 7 February 2018 at the NFA offices in Port Moresby. Dr Plaganyi presented the updated stock assessment results and larval advection modelling. There was agreement that the updated larval modelling together with past research provides strong evidence that TRL is a shared stock between Australia and PNG. These meetings have been followed up with teleconference between the PNG NFA Managing Director and AFMA CEO which included discussions on the importance of controlling catches so they do not exceed each jurisdiction's catch share of the recommended biological catch (RBC). CSIRO's final report, titled '*Environmental Drivers of variability and climate projections for Torres Strait tropical lobster Panulirus ornatus'*, will be provided with these meeting papers for reference. This report has not been sent to members previously. This report will also be made available on the PZJA website.
4.	Malu Lamar RNTBC to provide AFMA with the map of traditional boundaries and regional area and reef names for each of the Torres Strait Island nations and for CSIRO to examine possible revised naming conventions for survey sites	TRLRAG20 (4-5 April 2017)	Malu Lamar		**Completed** CSIRO advised at TRLRAG23 that they have received some maps with information on traditional names but that this is not complete. CSIRO will work with Malu Lamar if further information is needed.

5.	AFMA to liaise with Mr Pitt and Malu Lamar to provide agreed traditional names for the area around Erub.	TRLRAG23 (15 May 2018)	AFMA		**Ongoing**
6.	Dr Campbell's corrected paper to be circulated to the RAG following the meeting.	TRLRAG23 (15 May 2018)	CSIRO	TRLRAG24 (18-19 October 2018)	**Completed** Updated paper provided to TRLRAG members on 16 May 2018.
7.	South Fly River studies to be provided for consideration at the next TRL and Finfish RAG meetings.	TRLRAG23 (15 May 2018)	AFMA	TRLRAG24 (18-19 October 2018)	**Ongoing** To be provided out of session and for consideration at the next RAG and WG meetings if required.

Relevant action items from previous TRLWG meetings*

#	Action Item	Agenda	Agency	Due Date	Status
1.	TRLRAG to provide advice on any findings relating to the impacts of changing the season start date to provide industry with a longer TAC notice period.	TRLWG5 (5-6 April 2016)	AFMA to draft RAG paper	TRLRAG22 (27-28 March 2018)	**Ongoing** To be discussed under Agenda Item 8.

*TRLWG actions not relevant to TRLRAG have not been included in the above.

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Australian Government

Australian Fisheries Management Authority

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Meeting participants

Members

Name	Position	Declaration of interest
Dr Ian Knuckey	Chair	Chair/Director of Fishwell Consulting Pty Ltd and Olrac Australia (electronic logbooks). Chair/member of other RAGs and MACs. Conducts various AFMA and FRDC funded research projects including FRDC Indigenous Capacity Building project. No research projects in the Torres Strait. Full declaration of interests provided at **Attachment A**.
Dean Pease	AFMA Executive Officer	Nil
Selina Stoute	AFMA member	Nil
Charlie Kaddy	TSRA member (Fisheries Programme Manager)	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them
Tom Roberts	Queensland Department of Agriculture and Fisheries (QDAF) member	Nil
Dr Andrew Penney	Scientific member	Research consultant (Pisces Australis), member of other RAGs. No research projects in the Torres Strait
Dr Eva Plaganyi	Scientific member	Project staff for PZJA funded TRL research projects
Mark David	Industry member	Traditional Inhabitant Kulkalgal, TRLWG Industry member, Traditional Owner and TIB licence holder
Terrence Whap	Industry member	Nil. Traditional Inhabitant Maluialgal and Traditional Owner and TRLWG Industry member. Does not hold a TIB licence

Name	Position	Declaration of interest
Les Pitt	Industry member	Nil. Traditional Inhabitant Kemer Kemer Meriam and TRLWG Industry member
Phillip Ketchell	Industry member	Nil. Traditional Inhabitant Kaiwalagal, TRLWG Industry member, and Traditional Owner
Daniel Takai	Industry member	Pearl Island Seafoods, Tanala Seafoods and TIB licence holder
Dr Ray Moore	Industry member	Industry representative and Master Fisherman licence holder
Brett Arlidge	Industry member	General Manager MG Kailis Pty Ltd. MG Kailis Pty Ltd is a holder of TVH licences

Observers

Name	Position	Declaration of interest
Alexander Morison	TRLWG Chair	No pecuniary or other interest in the Tropical Rock Lobster Fishery or any other Torres Strait fisheries Fisheries Consultant. Chair of SERAG and SharkRAG. Scientific member on SEMAC. Contracted by government departments, non-government agencies and companies for a range of fishery related matters including research and MSC assessments of AFMA managed and other fisheries (by SCS Global Services)
Sevaly Sen	TRLWG Fisheries Economist member	Nil interest in Torres Strait fisheries. Conducts various FRDC research projects relevant to AFMA fisheries
Allison Runck	TSRA observer	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them

Name	Position	Declaration of interest
Jerry Stephen	TSRA Deputy Chair, TSRA Member for Ugar and TSRA Portfolio Member for Fisheries	TIB licence holder and Traditional Owner
~~Napau Pedro Stephen*~~	~~TSRA Chair, TSRA Member for Port Kennedy and TSRA Portfolio Member for Governance and Leadership~~	~~See note below~~
Patrick Mills	Chair of the Torres Strait Fisher's Association	TIB licence holder and Traditional Owner
Seriako Stephen	Representative for Malu Lamar (Torres Strait Islanders) Corporation Registered Native Title Body Corporate (RNTBC)	Nil
Sandie Edwards	Industry observer	Torres Straits Seafood Pty Ltd and buyer
Koro Samai	Industry observer	Fisher
Pala Rubu	Industry observer	Fisher
Yacoba Wena	Industry observer	Fisher
Ngukis Asse	Industry observer	Fisher
Dr Mark Tonks	CSIRO scientific observer	Project staff for PZJA funded TRL research projects
James Mills	Industry observer	TIB licence holder
Ted Whap	Industry observer	Fisher
Susamie Ketchell	Industry observer	Fisher
Kumi Bon	Industry observer	Fisher
Kumi Abua	Industry observer	Fisher
Karo Whap	Industry observer	Fisher
Muttie Assan	Industry observer	Fisher
Kevin Sabatino Snr	Industry observer	TIB licence holder and Traditional Owner
Thomas Nomoa	Industry observer	TIB licence holder and Traditional Owner
Thomas Mene	Industry observer	Fisher
Paul Ahmat	Industry observer	Fisher
Richard Takai	Industry observer	Fisher
Hideo Shibasaki	Industry observer	Fisher

Commented [TSRA1]: Chairperson was not in attendance at meeting and does not need to be listed as an observer. Minutes clearly note his attendance prior to the meeting opening on the second day and the statement given. He did not declare position or COI.

Commented [CN2R1]: Change accepted. Mr Stephen's attendance is noted in the notes at the bottom of this table and under the relevant agenda items.

Name	Position	Declaration of interest
Kevin Takai	Industry observer	Fisher
Kevin Sabatino Jnr	Industry observer	Fisher
Morgan Daniel	Industry observer	Fisher
Jack Bani	Industry observer	TIB licence holder and Traditional Owner
Natalie Couchman	AFMA observer	Nil
Steve Bolton	AFMA observer	Nil

Notes:

This list of observers may be incomplete as some observers attended at different times and some declined to complete the attendance form.

Napau Pedro Stephen (TSRA Chair) attended ~~the meeting~~ at the reopening of the meeting on the morning of 28 March 2018. Further details are provided under agenda item 1.2.

1 Preliminaries

1.1 Apologies

1. Mr Terrence Whap opened the meeting in prayer at 1:00 pm on 27 March 2018.
2. The Chair welcomed attendees to the 22nd meeting of the Torres Strait Tropical Rock Lobster Resource Assessment Group (TRLRAG22). The Chair acknowledged the Traditional Owners of the land on which the meeting was held and paid respect to Elders past and present.
3. Attendees at the RAG are detailed in the meeting participant tables at the start of this meeting record.
4. Apologies were received from Maluwap Nona (Chairperson, Malu Lamar (Torres Strait Islanders) Corporation RNTBC) and Aaron Tom (Industry member).

1.2 Adoption of agenda

5. The draft agenda was adopted without change (**Attachment B**). Agenda Items 1-4 were discussed on 27 March 2018. Agenda Items 4-10 were discussed on 28 March 2018.
6. On the morning of 28 March 2018, the Chair moved to open the meeting. A request was received for Mr Napau Pedro Stephen (Chairperson, TSRA) to provide a statement to the meeting prior to the commencement of meeting proceedings. The Chair granted this request. ~~attended the meeting prior to its official at the reopening of the meeting on the morning of 28 March 2018 and made a statement to the RAG, a~~A summary of the statement made by Mr Stephen ~~which~~ is noted for the record at **Attachment C**. Mr Stephen did not attend the remainder of the meeting and was not asked to declare conflicts of interest.

1.3 Declaration of interests

7. The Chair stated that as outlined in PZJA Fisheries Management Paper No. 1 (FMP1), all members of the RAG must declare all real or potential conflicts of interest in Torres Strait TRL Fishery at the commencement of the meeting. Given the number of meeting observers, it was decided it would be too time consuming to ask each participant to leave the room while a decision is made as to whether, for the relevant agenda items, they can participate in the discussion and in the making of recommendations, or remain absent from the meeting. The declarations of interests would be noted under each agenda item.
8. Declarations of interests were provided by each meeting participant. These are detailed in the meeting participant tables at the start of this meeting record.
9. Unrelated to this agenda item but noted for the record, an Industry observer, Mr Anthony Assan, made ~~the following~~a statement regarding recent comments made by the TSRA Chairperson in the Torres News ~~regarding~~concerning 100% Traditional Inhabitant ownership of the TRL F~~f~~ishery ~~in the Torres News~~ and the decision of the TSRA Board to lease out TVH licences in the F~~f~~ishery in the 2017/~~-~~18 fishing season. Mr Assan does not expect the ownership target to be reached. Further, Mr Assan expressed the opinion that some in the TIB sector do not support the leasing of the TVH licences as they feel it is putting more pressure on the TIB sector to compete.
    a. ~~The TSRA Chair, Napau Pedro Stephen, provided comment in the Torres News on the recent TRL industry meeting held on 27 February 2018 even though he did not attend.~~

Commented [TSRA3]: OK to document for the record but the detail is unnecessary considering it is wholly unrelated to RAG business.

Commented [CN4R3]: Reworded to capture all points below but in summarised form.

~~b. TSRA have made statements that they intend to achieve the 100 per cent Traditional Inhabitant ownership target for the TRL Fishery but this is unlikely to be realised as some in the TVH sector will not sell their licences.~~

~~c. The TIB sector want to see any TVH licences bought by the TSRA to be cancelled, not leased out each season. This is putting more pressure on the TIB sector to compete.~~

~~d. The TIB fishers were never consulted on the leasing arrangements for TVH licences bought by TSRA and the TSRA Board is not working for the TIB sector.~~

10. The TSRA Portfolio Member for Fisheries advised the meeting that he would look to organise a meeting with Mr Assan and the TSRA Chair to discuss this matter following the RAG meeting. The Chair noted it was not a matter for the RAG to be considering. The TSRA Portfolio Member for Fisheries noted that TSRA is currently conducting consultation on the Community Management Framework. ~~a review of the current licensing regime, including extensive community consultation, is currently being undertaken.~~

Commented [TSRA5]: AFMA review? Don't recall this being stated.

Commented [CN6R5]: This was a comment made with regards to the Community Management Framework – I have reworded to provide clarification.

1.4 Action items from previous meetings

11. The RAG noted the report provided by the Executive Officer advising of the status of actions arising from previous TRLRAG meetings (**Attachment D**).

12. With regards to Action Item 3, an Industry member raised concerns about Australian access to and quality of PNG catch data and whether any catch is being taken using trawl. The CSIRO Scientific member noted that at recent meetings with the PNG NFA there was some discussion and interest from the PNG NFA in undertaking a research project to survey catch landed in local PNG markets, noting there is uncertainty around PNG catches.

2 Updates from members

2.1 Industry and scientific

13. The RAG noted updates provided by Industry and Scientific members and observers on the recent performance and key issues affecting the TRL Fishery:

    a. An Industry member reported that there had been no large change in the Fishery.

    b. Another Industry member reported that compared to previous seasons, the 2017/18 season was fairly normal, if slightly below average, but not markedly so. Catches from December to February have been slightly higher than last season, but noting that last season was the poorest on record for them. The catches are coming from the West, more so than in previous season, but this may be driven by where fishers have chosen to operate and may not be a reflection of stock distribution. Sizes are what would be expected this season (average is less than 1.5 kg). The catch rates and sizes do not align with what is expected from the stock assessment.

    c. The CSIRO Scientific member noted that the results of the integrated stock assessment have been finalised and will be presented at this meeting. The indices are showing lower recruitment than previous seasons. Some anecdotal reports are also supporting this conclusion.

    d. Another Industry member reported that lobsters appear to be concentrated around Mabuiag island, with poor catches being experienced to the South East and around Thursday Island. The fishing around Mabuiag is concentrated about

8 nm off the island but is patchy. These fishing grounds have not fished well for a number of years, but have come good again this season. This may be attributed to sand incursions of past seasons clearing this season. Fishers are not seeing good numbers of 0+ nor 1+ lobsters on the Mabuiag fishing grounds.

e. Another Industry member reported that catches around Darnley island are slow (average of 10-20 kg of tails per fishing trip). In previous seasons there were more larger lobsters around.
f. An Industry observer reported that TVH fishers appear to be concentrated around Buru (Turnagain). There seems to be good number of larger lobsters (over 1.5 kg) around Mabuiag island.
g. Another Industry observer reported that catches around Tudu island have not been as good as they have in previous seasons, they have started slow and remained slow. Dungeness Reef is the same. The fleet is favouring the Western fishing grounds. Sizes are ok, about half are > 1 kg and half are < 1 kg.
h. Another Industry observer reported that there is food on the grounds around Thursday Island, but the lobsters are in low numbers.
i. An Industry member noted that it is unlikely that freshwater inflow would be affecting lobster numbers on the grounds. Around the outflow of the Fly River in PNG, lobsters have shown an ability to adapt their tolerance to freshwater. In past seasons, Deliverance Island had some very large lobsters and these may have migrated to the grounds around Mabuiag island. Something similar may be occurring this season.
j. An industry member noted that the catches from PNG are low but slightly higher than last season which was very poor. This is in the main due to a hookah closure being in place until 31 March 2018.

2.2 Government

14. The RAG noted an update provided by the AFMA member regarding management initiatives relevant to the TRL Fishery:
    a. Industry meeting - on 27 February 2018 AFMA held an industry meeting on Thursday Island. AFMA provided industry members information about the preliminary RBC and catch rates, explained the stock assessment process, explained the purpose of this RAG and the following Working Group meeting, to notify industry members that additional measures may be needed to regulate catch in the 2017/18 fishing season and to gather industry views.
    b. Draft TRL Management Plan - the TSRA has conducted further consultation with Traditional Inhabitant fishers about how quota allocations under a quota management system could be managed. Outcomes from this consultation as well as that on the draft TRL Management Plan and TRL Working Group advice will be tabled with the PZJA.
    c. Australia and PNG bilateral meeting - the Fisheries Committee met on 5 February 2018 and provided advice to the Joint Advisory Council (JAC). The JAC noted advice regarding the preliminary TRL RBC for the 2017/18 fishing season. The JAC also noted ongoing interest by the PNG prawn trawl industry to retain TRL and agreed that any departures from the current ban must be assessed in line with the Treaty. The JAC recognised the importance of the resource to Traditional Inhabitants noting that it is a shared stock and the potential for trawling to impact spawning migration pathways and biomass in the Torres Strait. PNG also agreed to provide data on catches. The AFMA CEO will be following up again with the NFA Managing Director on these matters.

    d. Australian National Audit Office (ANAO) - the ANAO has commenced a performance audit of Australian Government coordination arrangements in the Torres Strait. ANAO officers will be visiting the Torres Strait in April.

15. The RAG noted an update provided by the QDAF member regarding QDAF activities relevant to the management of the TRL Fishery:
    a. East Coast TRL Working Group – this group met for the first time since 2011 and will focus on developing a harvest strategy, to be implemented by 2020. The group will also review existing management arrangements.
    b. Catch to date – approximately 55 tonnes of the 195 tonnes TAC has been caught. Last season the TAC was reached by 1 July. Catch for the last month has slowed (3 tonnes in March) as the industry has decided to fish to higher market prices and catch per unit effort (CPUE) expected later in the season. The QDAF member advised that there is 5 tonnes allocated to the indigenous sector under indigenous fishing permits. The purpose of these permits is to provide the opportunity for indigenous fishers to trial commercial fishing. In order to access more quota, fishers would need to purchase it. QDAF are currently reviewing the policy detailing access arrangements to the 5 tonnes indigenous sector allocation.
16. An industry member noted that the East Coast TRL Fishery is able to fish to higher market prices due to the certainty provided by quota.
17. The RAG noted an update provided by the TSRA member regarding TSRA activities relevant to the management of the TRL Fishery:
    a. Fisheries Summit – planned for May 2018 to span 3 days. Further details to be provided closer to time but key fisheries projects and issues will be up for discussion as well as seeking nominations for Traditional Inhabitant positions on PZJA forums. These positions will be for a three-year term. AFMA will write to all licence holders with further details.
    b. Audit of infrastructure and services – a draft report has been considered by the TSRA Board and the report will be finalised shortly. The report will be made public on the TSRA website, and made available at the Fisheries Summit.
    c. Export and branding for Torres Strait seafood - a consultant has been engaged to assess the economic feasibility, regulatory requirements and infrastructure needs to export seafood directly from the Torres Strait and the potential value derived from creating a brand for Torres Strait seafood.
    d. Separate licence entity – broad consultation has been conducted on a project looking at the establishment of a corporate entity separate from the TSRA to hold in trust and manage commercial fishing licences on behalf of Torres Strait communities. There is general support for the entity and TSRA now need to complete further work on legal and governance structures.

2.2.1 Fish receiver update

18. In the interests of time, the RAG noted the update provided in the associated agenda paper as read.

2.2.2 TRL Fishery export approval

19. In the interests of time, the RAG noted the update provided in the associated agenda paper as read.

2.2.3 Legislative amendments update

20. In the interests of time, the RAG noted the update provided in the associated agenda paper as read.

2.3 PNG NFA

21. This item was not discussed as the PNG NFA invited participant was not in attendance.

2.4 Native Title

22. The RAG noted concerns raised by the representative for the Malu Lamar (Torres Strait Islanders) Corporation RNTBC. The Chairperson for Malu Lamar was an apology for the meeting. The Malu Lamar representative expressed concerns over the low RBC for the 2017/18 fishing season. The representative advised that the rights of Traditional Inhabitants to fish are protected under Article 10 of the Torres Strait Treaty and prescribed in the objectives of the *Torres Strait Fisheries Act 1984*. The representative stated that what remains of the RBC needs to be allocated to Traditional Inhabitants.

3 2017/18 TRL catch and effort information

23. The RAG noted an update provided by the AFMA Executive Officer on catch and effort in the TRL Fishery for the 2017/18 fishing season to date:
    a. As reported through the new mandatory fish receiver system implemented on 1 December 2017, the total landed catch reported for the TRL Fishery from 1 December 2017 to 21 March 2018 is 81,688 kg (**Table 1**).
    b. There are outstanding catch disposal records (TDB02) for the period 1 to 21 March 2018. Therefore, the landed catch reported for the March period may be under-reported.
    c. AFMA is awaiting an update from the PNG National Fisheries Authority on catches to date for the PNG TRL Fishery.

Table 1: Landed catch (kilograms whole weight) of tropical rock lobster by sector for the Torres Strait TRL Fishery for the period 1 December 2017 to 21 March 2018. Source: catch records from the Torres Strait Catch Disposal Record (TDB02).

Dates	TIB (kg)	TVH (kg)	Combined catch (kg)	Number of records
01/12/2017 to 31/12/2017	8,516.8	31.3	8,548.1	414
01/01/2018 to 31/01/2018	9,802.4	0.0	9,802.4	493
01/02/2018 to 28/02/2018	21,574.2	27,307.8	48,882.0	755
1/03/2018 to 21/03/2018	5,749.8	8,706.0	14,455.9	255
Total	**45,643.2**	**36,045.2**	**81,688.4**	**1,917**

4 Finalising the stock assessment update and recommended biological catch

24. The RAG noted a presentation provided by Dr Mark Tonks, CSIRO Scientific observer, detailing the results of the November 2017 pre-season survey. With regards to survey design, the RAG noted:

a. Dive surveys were conducted at 77 sites using 500 x 4 m belt transects. These sites have been repeated over the last two years. At each site the number of lobsters is counted and seabed habitat assessed. Some of the sites occur in currently fished areas.

b. Survey conditions were fair with good visibility and were similar to previous surveys. Noting this, weather is not considered to have impacted on the survey results.

25. The results of the survey show:

    a. 1+ lobster abundance index – 1.78 lobsters observed per transect. This is the lowest recorded for a pre-season survey, just 25% of the highest index in 2015. The index is the same as the 1998 mid-season survey and higher than the 2001 and 2005 mid-year surveys. Compared to previous surveys, it is looking similar to previous poor seasons.

    b. 1+ lobster abundance and distribution – low abundance around the Western survey sites (Thursday Island, Mabuiag, Buru (Turnagain)). The South East survey sites were up 250% from the 2016 survey. Distribution is similar to previous surveys but with an absence of 1+ lobsters around Buru.

    c. 0+ lobster abundance index – lowest ever recorded, just 20% of the 2016 survey index.

    d. 0+ lobster abundance and distribution – very low abundance around Mabuiag and Thursday Island and low across most other sites except the South East. The distribution is unusual compared to the 2016 survey.

    e. Certainty - CSIRO are confident about the 1+ lobster results, with a little less certainty about the 0+ lobster results because 0+ lobsters are harder to see.

    f. Size frequency – commercial size length frequency data provided by MG Kailis has been fairly consistent through time. However, the survey data is showing tail width size has decreased over the last 4 years.

    g. Seabed habitat – the seabed habitat has remained relatively consistent through time (1994-2014), with a slight downwards trend in rubble and coral, and a slight increase in algae and seagrass. There was a coral bleaching event recorded in 2010. Sand cover has been relatively consistent with the Southern sites experiencing some sand incursions in 2015.

26. The RAG noted the number of survey sites has decreased through time (from 144 to 77 sites). The biggest decrease has been in the last 3 years. A drop in precision was seen with the removal of some Eastern sites, however the existing sites are considered representative of the TRL Fishery.

27. RAG members discussed the value in increasing the number of sites in subsequent years. It was noted that increasing the number of sites will reduce the standard error, however the trend of abundance will remain the same. The CSIRO Scientific observer advised that new sites would need to randomly stratified and scaled on the basis of TRL stock distribution and previous surveys. Industry members suggested additional sites are needed at Warrior Reef. The RAG noted that there were more survey sites around Warrior Reef previously, and that surveys in this area may be able to indicate of any change to migration patterns.

28. The CSIRO Scientific member noted that tagging and larval convection studies look at developing a better understanding the TRL life cycle and may assist in understanding if there have been any changes to migration patterns through time.

29. RAG members discussed the utility of a mid-season survey to provide better precision in survey results. The CSIRO Scientific member advised that:

a. Pre-season surveys provide the best information about 1+ lobster abundance, but also provide abundance information on 0+ and 2+ lobsters.
b. Mid-season surveys provide good information 2+ lobsters. In the absence of a mid-season survey, CPUE data is used as an indicator of 2+ lobster abundance. When conducted in the past, the mid-season surveys showed a strong correlation with the CPUE data.
c. Pre-season surveys are more important for setting a TAC for the following fishing season. A mid-season survey would give independent information about the spawning stock. The Independent Scientific member noted however, as there is not a stable relationship between the spawning stock and recruitment, it is not possible to predict recruitment from this information. It is better to survey those lobsters that have already recruited into the fishery, that being the 0+ and 1+ lobsters.
d. Much remains uncertain as to where the sources of recruitment are for the TRL Fishery, the thinking is that there are many sources. Given this uncertainty, the TRL stock needs to be protected across its distribution.

30. In summary, the RAG noted that the November 2017 pre-season survey showed the lowest level of 1+ (high certainty) and 0+ (less certainty) lobsters in the TRL Fishery's history of pre-season surveys. This is the main factor causing the reduction of the RBC for the 2017/18 fishing season.
31. The RAG noted a presentation, titled *Draft Updated 2017 Integrated Stock Assessment to provide management advice on the Torres Strait rock lobster fishery*, provided by Dr Eva Plaganyi, CSIRO Scientific member, detailing the results of the updated integrated stock assessment and RBC calculations. The RAG noted the integrated stock assessment takes into account:
    a. Data from pre-season surveys – last 8 years, including that conducted in November 2017;
    b. Data from mid-year surveys – 1989-2014;
    c. Catch and effort information – TIB and TVH;
    d. Length frequency information – Australia and PNG;
    e. Historical information;
    f. Environmental information.
32. The RAG noted catch data for the period 1973-2017 and in particular 2017 catch against the RBC: Traditional Inhabitant Boat sector 106.4 tonnes; Transferable Vessel Holder sector 149 tonnes; PNG 113 tonnes. This accounted for 74% of the 495 tonnes RBC.
33. Industry observers requested further details on the TRL life cycle. The RAG discussed the TRL life cycle as presented by the CSIRO Scientific member (**Attachment E**). The life cycle that was presented is general in nature and it was noted that there will be exceptions. In the Western Torres Strait, females walk East to PNG in August-September and don't return. In the Eastern Torres Strait female lobsters walk out to deeper water and then return. The same is thought to occur in the East Coast TRL Fishery. Lobsters spawn and recruit within the Coral Sea gyre. The TRL larval phase lasts approximately 6 months.
34. The RAG discussed possible explanations for the low abundance of TRL around Thursday Island. The CSIRO Scientific member advised that the research shows TRL do not migrate far once settled in the Torres Strait, until they migrate to spawn. An Industry member noted that there have been some historical observations of 1+ lobsters moving from the Northern area of the East Coast TRL Fishery into the Torres Strait, but strong evidence for this is not available. Recruitment in the Torres Strait is primarily

through the settlement of juvenile lobsters. As such it is unlikely that TRL settled in the East Coast TRL Fishery migrate to the Torres Strait.

35. The RAG noted a summary the survey cycle (**Attachment F**).
36. The RAG noted the model used is an age-structured production model (ASPM) which integrates all available data and fits that data to calculate an RBC. The outputs of the model show:
    a. Abundance of TRL in each age class (0+, 1+ and 2+) – all age classes are lower than previous years. Model does not fit 0+ lobsters as the variability of the data is high.
    b. CPUE – the trend is down for 2017. This trend was also seen in other poor years (2004, 2008, 2011). If there are not a lot of 1+ lobsters growing into fishable size, then should see a drop in CPUE around March-April 2018. TRL generally reach legal size at 22 months, they are generally 18 months old at the time of the pre-season survey each November.
    c. Stock-recruitment residuals – recruitment in 2016 and 2017 is worse than average. There have been poor recruitment years in the past, but not for two consecutive years.
37. The RAG discussed the implications of the low abundance of 0+ and 1+ lobsters for the 2017/18 fishing season. 1+ lobsters surveyed during the November 2017 pre-season survey will grow out to fishable size around March/April 2018. 0+ lobsters will grow out to fishable size a year later in March/April 2019. If the abundance of 1+ lobsters is as low as the survey indicates, then fishing mortality for the 2017/18 fishing season needs to be decreased to allow for a sufficient spawning stock for subsequent seasons. A similar issue may arise for the 2018/19 fishing season, given the low abundance of 0+ lobsters during the pre-season survey, though there is less certainty around the estimates of abundance for this age class.
38. The CSIRO Scientific member advised that where there are low abundances of 1+ and 2+ lobsters, concentrations or 'hot spots' would be expected. There would not be high abundances spread across the fishery as has occurred in past years.
39. The RAG noted that the 2+ lobsters being caught now are likely larger males left over from the previous year. This is borne out by the length frequency data. It is expected that when the 2+ lobsters are mostly caught, which they generally are during a season, there will be a drop in CPUE as they are replaced by a low abundance of 1+ lobsters.
40. The Independent Scientific member advised that they have reviewed the results of the November 2017 pre-season survey and the outputs of the model and has confidence in the findings.
41. The RAG discussed the CPUE data in further detail (**Attachment G**):
    a. December 2017 and January 2018 CPUEs are higher than in recent years. February 2018 is looking to be on a par with the long-term average, maybe slightly lower. The effort for the TVH sector in 2018 is not particularly high compared to past years.
    b. The Chair noted that the effort information collected in catch disposal records may not always be accurate, for example in many cases dive hours are not recorded and fishing days where there has been zero catch or low catch may not be recorded. Given this, any trends extrapolated from this data may be impacted. There is also a need to update the CPUE standardisation with regards to fishing patterns and efficiency.
    c. An Industry member noted that if the survey is correct, and noting that in the past there has been a strong correlation between the survey results and CPUE data,

then it should be expected that the CPUE will drop markedly and as such are less likely to reach the Australian catch share of the RBC.

   d. Another Industry member noted that in order to get the best outcome for the Fishery and the industry this season, the fishers themselves have a responsibility to come together to participate in and support the making of decisions.

42. In summary, the RAG noted that the CPUE data for the 2017/18 season to date has not contradicted the results of the November 2017 pre-season survey nor the outputs of the integrated stock assessment.
43. Taking into consideration all of the above, the RAG recommended a final RBC for the 2017/18 of 299 tonnes for Australia and PNG inclusive.

Recommendation 1

The RAG recommended a final RBC for the 2017/18 of 299 tonnes for Australia and PNG inclusive.

44. With reference to FMP1, the RAG discussed the attendance of the large number of observers at the meeting, noting some were wearing protest shirts and the majority were in attendance without seeking the prior agreement of the Chair. The RAG noted that while observers are generally welcome to attend RAG meetings to observe the proceedings, their presence in large numbers, particularly at this meeting, may have had the potential to inhibit or disrupt members from freely contributing to discussions and recommendations. The Chair also noted that Agenda Item 5 involved fine-scale examination of individual fisher's catch and effort data. It was not considered appropriate that observers had access to this information. On this basis, the Chair thanked observers for the time taken to attend the meeting and advised that the next session of the meeting would be closed to observers.
45. ~~With the observers out of the meeting,~~Following observers leaving the meeting the members discussed the implications of having such a large group of observers at a meeting and whether it impacted on members' comfort in providing advice to the RAG. Members considered it was generally (two-way) a positive role that observers played in the RAG and that although there were large numbers at this meeting, they did not disrupt the meeting or behave in a manner inconsistent with the standard of behaviour expected under FMP1. It was noted that many of the observers, however, had not sought permission from the Chair to attend and that this should be addressed in the future. Members agreed that, in general, they would be comfortable with observers continuing to attend the meetings.

Commented [CN7]: Change accepted.

5 Data rules for using catch data reported in the Torres Strait Buyers and Processors Docket Book

46. RAG members discussed data rules for the use of TRL catch data reported in the Torres Strait Buyers and Processors Docket Book (TDB01). The RAG noted:
   a. The TDB01 was used in the TRL Fishery principally to record the catch and effort for fishers operating in the TIB sector of the fishery. The TDB01 was replaced on 1 December 2017 by the mandatory Torres Strait Catch Disposal Record (TDB02);
   b. Catch from the TRL Fishery is also reported through the Torres Strait Tropical Rock Lobster Fishery Daily Fishing Log (TRL04). Catch sold between processors can also be recorded in the TBD01. This can create duplicate catch records

making it difficult to accurately determining the true catch taken by the TIB sector of the fishery.

c. A number of mechanisms have been introduced in an attempt to reduce duplicate catch records, however a number of uncertainties still remain, including:
    i. The TDB01 “related-logs” field identifies if the catch has been reported elsewhere (e.g. TRL04). If the fisher or processor does not complete this field, duplicate records may not be identified.
    ii. The TDB01 “seller-type” field identifies the fisher by name/entity. This can be used to identify between TIB and TVH fishers. Seller names are often not included, misspelt or a nickname is used reducing the utility of this field.
    iii. The TDB01 “vessel-type” field is used to indicate whether the vessel-symbol detailed in the TBD01 corresponds to a vessel listed in the TVH database.

d. The recommended data rules are proposed to assign TDB01 records with unknown or missing information to either the TIB sector, TVH sector or as processor-to-processor trading.

47. The RAG agreed to adopt the data rules provided at **Attachment H**.

Recommendation 2
The RAG agreed to adopt the data rules provided at Attachment H.

6 TRL harvest strategy

48. The RAG noted an update provided by the AFMA member regarding the Harvest Strategy for the TRL Fishery:
    a. The TRLWG considered the draft TRL Harvest Strategy at its meeting on 25-26 July 2017.
    b. The WG recommended that further work be undertaken by the WG and RAG to examine possible options for including social and/or economic objective in the draft harvest strategy and applying a management trigger under the harvest strategy as the stock approaches the limit reference point to minimise the impacts on traditional inhabitant commercial fishers.

49. The RAG was asked to advise on the likely:
    a. Data and assessment requirements to support the proposed management trigger;
    b. Impediments, if relevant, to meeting the data and assessment requirements; and,
    c. Costs of any new data and assessment requirements.

50. The RAG agreed that a management trigger can be included that results in alternative management and catch sharing arrangements. However, the trigger level itself and proposed management response needs to be identified by the WG before the RAG can provide advice about how the Harvest Strategy should be modified to accommodate it. The RAG discussed that:
    a. Social and economic limits are often based on tonnage and not % biomass. Biomass based triggers are difficult to monitor and it is not practical for the TRL Fishery given the limitations of available data.
    b. Triggers that result in management changes part way through a season are complex to administer and require real time data and analysis which is expensive for the fishery. In the TRL Fishery in-season adjustments would be difficult under the current inputs.

c. If a new trigger is incorporated, the Harvest Strategy would need to undergo management strategy evaluation (MSE) testing. This is a costly exercise.

51. The RAG endorsed the draft TRL Harvest Strategy and recommended the WG further discuss and provide the RAG with details on the trigger level and proposed management response.

Recommendation 3

The RAG endorsed the draft TRL Harvest Strategy and recommended the WG further discuss and provide the RAG with details on the trigger level and proposed management response.

7 Justification for a January season start date for the QLD East Coast TRL Fishery

52. The RAG noted a summary provided by the QDAF Member regarding the 1 January season start date for the East Coast TRL Fishery:
    a. In 2014, QDAF changed the end date of the East Coast TRL Fishery's spawning closure from 31 January to 31 December. The start date of the spawning closure 1 October remained unchanged.
    b. The amendment to the closure date did not remove the closure over the peak spawning months of October-December, but reduced the length of the closure to allow industry to take advantage of a period of high demand in January.
    c. The limited data available indicates the peak spawning period for the East Coast TRL Fishery occurs in November and in deep water. The closure starts and finishes one month either side of the peak spawning period. Fishers are also restricted to shallower waters reducing their interactions with spawning lobsters in deep water. If spawning lobsters are encountered at any time whilst the fishery is open there is total protection on the take of berried and tar spot lobsters. A total allowable catch (TAC) also restricts the level of catch.
    d. Advice from CSIRO TRL scientists at the time of the change was supportive in bringing forward the start date of the new season to 31 December considering the East Coast TRL Fishery is managed under a TAC and the peak spawning period is in November.
    e. The Torres Strait TRL Fishery spawning closure is slightly different to the East Coast TRL Fishery with a closure from 1 October to 30 November and then a prohibition on the use of hookah gear from December-January.
53. The CSIRO Scientific member reinforced that there are no concerns about a season opening in January, as peak spawning occurs November in deeper water. This change is not considered to affect the Torres Strait TRL Fishery.
54. The RAG noted advice from some Industry members that there is little evidence that larger lobsters migrate from the East Coast to the Torres Strait. Therefore, it is considered to be minimal impact from this spawning closure on the Torres Strait. There is anecdotal evidence that 1+ lobsters migrate from the Northern area of the East Coast into the Torres Strait. But these lobsters would be undersize and only grow to a fishable size later in the fishing season.
55. The RAG noted that historically TIB fishers had access to areas of the East Coast TRL Fishery. It was advised that concerned fishers raise this matter with QDAF directly.

56. The QDAF member advised that they are seeking an indigenous member for their East Coast TRL Fishery and have sought nominations including from relevant native title bodies. No nominations have been received to date.

8 Setting of hookah closures

57. The RAG noted a proposal from the TSRA Portfolio Member for Fisheries regarding the setting of moon-tide hookah closures for the TRL Fishery. It was proposed that:
    a. A second hookah closure period be implemented each month in the TRL Fishery for the remainder of the 2017/18 fishing season, effective from 13 April 2018.
    b. Consideration be given prior to each fishing season as an additional effort control in years with a recommended biological catch set below historical catch averages.
58. The RAG noted that moon-tide hookah closures were originally introduced in 2005 as a temporary measure as a way to reduce fishing effort to levels recorded in 2002. This was at a time when the TRL Fishery was considered to be subject to overfishing. In 2013 the closures were removed following a buy-out of TVH licences. They were again reintroduced for the 2014/15 fishing season following agreement from both the TIB and TVH sectors.
59. It was highlighted that any changes in fishery management during 2018 to respond to the low TAC, could impact on or bias CPUE as an index of abundance for input into the next assessment or a harvest strategy.
60. The CSIRO Scientific member noted that a second hookah closure period would slow the rate of fishing which would prolong fishing and support the continuity of CPUE data for a longer period. This would be important particularly in a year where the fishery may close early as having continuous CPUE throughout a fishing season is important for informing calculations on spawning biomass.
61. The RAG recommended the proposal be put forward to the WG for further consideration.

Recommendation 4

The RAG recommended the proposal from the TSRA Portfolio Member for Fisheries regarding the setting of moon-tide hookah closures for the TRL Fishery be put forward to the WG for further consideration.

9 Other Business

62. There was no other business raised by members.

10 Date and venue for next meeting

63. The RAG noted that the next meeting is tentatively scheduled for December 2018, with a date to be decided out of session.
64. The meeting was closed in prayer at 12:00pm on 28 March 2018.

Declaration of interests
Dr Ian Knuckey – April 2018

Positions:

- Director – Fishwell Consulting Pty Ltd
- Director – Olrac Australia (Electronic logbooks)
- Chair / Director – Australian Seafood Co-products (seafood waste utilisation)
- Chair / Director – ASCo Fertilisers (seafood waste utilization)
- Chair – Northern Prawn Fishery Resource Assessment Group
- Chair – Tropical Rock Lobster Resource Assessment Group
- Chair – Victorian Rock Lobster and Giant Crab Assessment Group
- Scientific Member – Northern Prawn Management Advisory Committee
- Scientific Member – SESSF Shark Resource Assessment Group
- Scientific Member – Great Australian Bight Resource Assessment Group
- Invited scientific participant – SEMAC, SERAG

Current / Recent Projects and funding:

- Principal Investigator – FRDC Project 2017-069 Indigenous Capacity Building
- Principal Investigator – VFA Project 17-646976 – Ocean Scallop Biomass Survey – 2018
- Principal Investigator – FRDC Project 2017/122 - Review of fishery resource access and allocation arrangements across Australian jurisdictions
- Principal Investigator – FRDC Project 2016/116 - 5-year RD&E Plan for Northern Territory fisheries and aquaculture
- Principal Investigator – AFMA Project 2017/0803 - Analysis of Shark Fishery Electronic Monitoring data
- Principal Investigator – AFMA Project 2017/0807 - Resource Survey of the Great Australian Bight Trawl Sector – 2018
- Principal Investigator – AFMA Project 2016/0809 – Improved targeting of arrow squid
- Principal Investigator – AFMA Project 2018/08xx – Bass Strait and Central Zone Scallop Fishery – 2018 and 2019 Survey
- Principal Investigator – DPIPWE Project – Review of abalone dive rates
- Principal Investigator – FRDC Project 2015/204 – Realising economic returns of reducing waste through utilization of bycatch in the GAB Trawl Sector of the SESSF
- Principal Investigator – FRDC Project 2014/203 – Review of Monitoring and Assessment in the SESSF
- Principal Investigator – AFMA Project 2014/0809 – Fishery Independent Survey of shelf resources in the Great Australian Bight Trawl Fishery 2017
- Principal Investigator – Survey for Black teatfish in the Queensland Sea Cucumber Fishery.
- Principal Investigator – CRC Project 2013/748.40 – Improved understanding of economics in fisheries harvest strategies.
- Principal Investigator – FRDC Project 2014/207 – The social drivers and implications of conducting an ecological risk assessment of both recreational and commercial fishing - a case study from Port Phillip Bay
- Co-Investigator – Optimising processes and policy to minimise business and operational impacts of seismic surveys on the fishing industry and oil and gas industry.
- Co-Investigator – FRDC Project 2017/014 – SA Marine Scalefish Review
- Co-investigator – AFMA Project - SESSF 2018 Fishery Independent Survey

- Co-investigator – Bird mitigation in the SESSF trawl sector
- Researcher – Various fishing industry liaison projects for oil and gas industry
- Scientific Advisor – Atlantis, GABIA, Gulf St Vincent Prawn Fishery, Seafish JV, SETFIA, SSIA
- MSC Auditor – Falklands Is 2016 Surveillance Audit (Acoura), Macquarie Is Toothfish (SCS)
- Facilitator – WWF shark traceability workshop
- Facilitator – SPC Tuna Data Collection Committee
- Facilitator – Indonesian fishery training and development

Current / Recent Clients (>$5000):

- ABARES
- Acoura
- Atlantis Fisheries Consulting Group
- Australian Fisheries Management Authority (AFMA)
- CRC – Seafoods
- Department of Agriculture and Water Resources
- Department of Primary Industry - Victoria
- Dept. Primary Industry, Parks Water and Environment (DPIPWE) Tasmania
- Fisheries Research and Development Corporation (FRDC)
- Great Australian Bight Fishing Industry Association (GABIA)
- Gulf of St Vincent Prawn Boat Owners Association
- Monash University
- NT Fisheries
- Richey Fishing
- South Australian Rock Lobster Advisory Council (SARLAC)
- SARDI Aquatic Sciences
- SCS Global Services
- Seafood Industry Victoria
- Seafish JV
- SeaFresh
- Secretariat of the Pacific Community
- South East Trawl Fishing Industry Association (SETFIA)
- Southern Shark Industry Alliance (SSIA)
- Tasmanian Seafoods
- Victorian Fisheries Authority
- Western and Central Pacific Fisheries Commission
- World Wildlife Fund – Australia (WWF)

TORRES STRAIT TROPICAL ROCK LOBSTER

RESOURCE ASSESSMENT GROUP (TRLRAG) MEETING #22

TUESDAY 27 March 2018 1:00PM-5:30PM

WEDNESDAY 28 March 2018 8:30AM-12:00PM

THURSDAY ISLAND, TSRA CONFERENCE ROOM

AGENDA

1. Preliminaries
   1.1. Apologies
   1.2. Adoption of agenda
   1.3. Declaration of interests
   1.4. Action items from previous meetings

2. Updates from Members
   2.1. Industry and scientific
   2.2. Government
      2.2.1. Torres Strait Fisher Receiver System
      2.2.2. TRL Fishery Strategic Assessment
      2.2.3. Torres Strait legislative amendments
   2.3. PNG-NFA
   2.4. Native Title

3. 2017/18 TRL catch and effort information

4. Finalising the stock assessment update and recommended biological catch

5. Data rules for using catch data reported in the Torres Strait Buyers and Processors Docket Book

6. TRL harvest strategy

7. Justification for a January season start date for the QLD East Coast TRL Fishery

8. Setting of hookah closures

9. Other Business

10. Date and venue for next meeting

Summary of the statement made by Napau Pedro Stephen to the TRLRAG on 28 March 2018

Key points made by Napau Pedro Stephen:

- Noted the low recommended biological catch (RBC) of 299 tonnes for the Torres Strait TRL Fishery for the current season (2017/18 fishing season).
- Mr Stephen acknowledged that the TRL Resource Assessment Group (RAG) and Working Group are the appropriate bodies through which advice needs to be provided about the management of the TRL Fishery this season.
- The TSRA Board are of the view that in making decisions about the management of the TRL Fishery this season, noting aspirations for 100% ownership of Torres Strait fisheries, the benefits of any such decisions need to go to the Traditional Inhabitants of the Torres Strait.
- Mr Stephen has requested an urgent meeting with the Commonwealth and Queensland Ministers to discuss the outcomes of the meeting. Mr Stephen will represent the interests of Traditional Inhabitant fishers at this meeting.
- Mr Stephen's message to the meeting with Ministers will be that, in light of a low RBC, it should not be on Traditional Inhabitants to sacrifice this season. Traditional Inhabitant fishers from day dot have sacrificed to ensure the stock is sustainable. ~~. They have already sacrificed.~~ The TRL Fishery is critical in providing livelihoods for Traditional Inhabitants across the Torres Strait, and it is under threat this season. The only choice many Traditional Inhabitant fishers will have if the TRL Fishery is closed will be the Community Development Programme (CDP). This is no choice. Future decisions about the management of the TRL Fishery need to be made to the benefit of Traditional Inhabitants.
- Mr Stephen made himself available to any fishers that would like to meet with him.
- Mr Stephen noted that both the Management Plan and Harvest Strategy for the TRL Fishery had yet to be finalised. Regardless, action is needed now and this action needs to benefit Traditional Inhabitants.
- Traditional management of the TRL stock has been historically practised. These practices are in line with the science in ensuring that effort on the stock is controlled so the sustainability of the stock is not negatively impacted ~~beyond sustainable limits~~. ~~. The science does not tell us anything new regarding the management of the TRL stock.~~ The science does not tell us anything new regarding the management of the TRL stock.
- Mr Stephen noted that the TSRA Portfolio Member for Fisheries (and TSRA Deputy Chair), in attendance at the meeting, speaks for the TSRA Board. Mr Stephen requested AFMA consider the appointment of TSRA Portfolio Member for Fisheries as a member of the TRLRAG.
- There are already tensions between Traditional Inhabitant fishers and TVH fishers out on the fishing grounds and no one wants to see these tensions inflamed and ending up in front of the Court.

Commented [CN8]: Direct quote of statement made. Cross-checked with 2 sets of notes of the meeting.

Commented [CN9]: Direct quote of statement made. Cross-checked with 2 sets of notes of the meeting.

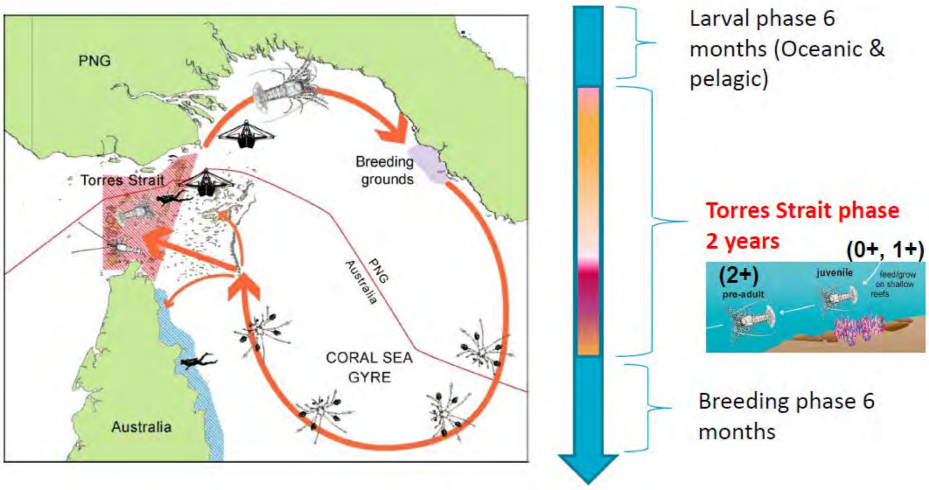
Action items from previous meetings

#	Action Item	Agenda	Agency	Due Date	Status
1.	AFMA to review the effectiveness of certain TIB licensing arrangements (in its 2016 licencing review) including: • TIB licenses should share a common expiry date • licences to last for longer than the current 12 month period.	TRLRAG14	AFMA	2017	**Ongoing** AFMA has begun undertaking a review of licensing of Torres Strait Fisheries, this issue will be considered as part of this review. At present however, AFMA resources are focused on progressing the proposed legislative amendments as a matter of priority.
2.	AFMA and CSIRO prepare a timeline of key events that have occurred in the Torres Strait Tropical Rock Lobster Fishery (e.g. licence buy backs, weather events and regulation changes) and provide a paper to TRLRAG.	TRLRAG14	AFMA CSIRO	TRLRAG17	**Ongoing** AFMA to complete further work. This has been difficult to action ahead of other priorities for the TRL Fishery.
3.	AFMA to prepare a summary of evidence that PNG trawl-caught TRL are a shared stock between Australia and PNG, including details such as the TRL biological characteristics, larvae dispersal, tag recapture data and catch and effort information. AFMA will circulate the paper to the RAG	TRLRAG19	AFMA		**Ongoing** AFMA sent a letter to PNG NFA outlining concerns of trawlers retaining TRL on 8 March 2017. AFMA presented the key findings of the CSIRO larval advection model at the Fisheries Bilateral meeting held in Port Moresby on 5 February 2018. The bilateral meeting noted that the findings show the Australian and PNG TRL fisheries are based on a single stock. AFMA and CSIRO (Dr Plaganyi) met with PNG NFA officials, including the NFA Managing Director, John Kasu on 7 February 2018 at the NFA offices in Port

	out-of-session for comment before sending to PNG NFA.				Moresby. Dr Plaganyi presented the updated stock assessment results and larval advection modelling. There was agreement that the updated larval modelling together with past research provides strong evidence that TRL is a shared stock between Australia and PNG. These meetings have been followed up with a phone call between the PNG NFA Managing Director and AFMA CEO which included discussions on the importance of controlling catches so they do not exceed each jurisdiction's catch share of the recommended biological catch (RBC).
4.	Malu Lamar RNTBC to provide AFMA with the map of traditional boundaries and regional area and reef names for each of the Torres Strait Island nations and for CSIRO to examine possible revised naming conventions for survey sites	TRLRAG20	Malu Lamar		**Ongoing** AFMA is awaiting advice from Malu Lamar and will assist where possible. Email reminders sent 20/12/2017 and 08/03/2018. CSIRO advised that they have received some maps with information on traditional names but that this is not complete. They will work with Malu Lamar if further information is needed.
5.	AFMA to investigate the potential cause of the TVH sector misreporting of fishing hours.	TRLRAG21	AFMA	TRLRAG22	**Complete** The missing data was tracked to logbooks returns from two vessel operators. The licence holder was notified.
6.	Lamp fishing data should be used for future TIB CPUE analyses	TRLRAG21			**Complete** TIB sector CPUE analysis will be updated to include lamp fishing.
7.	Torres Strait Docket Book (TDB01) data rules to be presented at the next RAG meeting scheduled for March 2018	TRLRAG21	CSIRO AFMA	Deferred to TRLRAG22	**Complete** Data rules to be considered at TRLRAG 22.

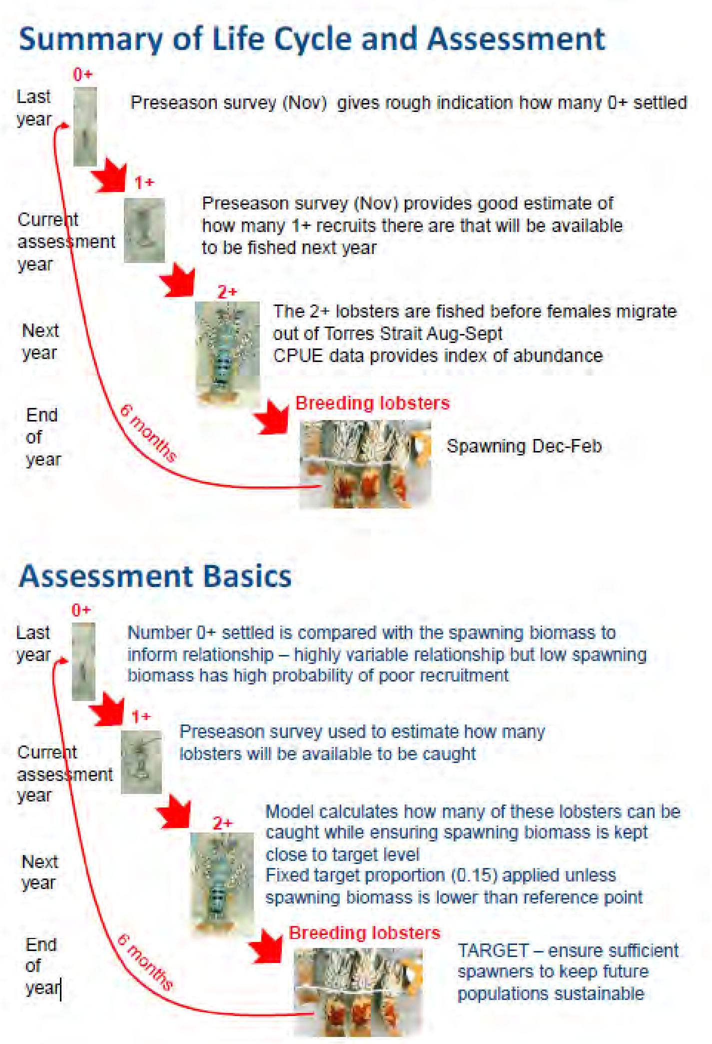
	The scientific observer recommended that RAG members and observers read the meeting paper prior to discussing this agenda item at the next meeting.				

***Panulirus ornatus* Life Cycle**



Source: : Éva Plagányi, Mark Tonks, Rob Campbell, Mick Haywood, Roy Deng (2018) Final 2017 Integrated Stock Assessment and RBC (2018) for the Torres Strait rock lobster fishery. Powerpoint presentation presented to the 22nd meeting of the Torres Strait Tropical Rock Lobster Resource Assessment Group held on 27-28 March 2018.

Summary of the Assessment Cycle for the Torres Strait Tropical Rock Lobster Fishery



Source: Éva Plagányi, Rob Campbell, Mark Tonks, Mick Haywood, Roy Deng, Nicole Murphy, Kinam Salee (2018) Torres Strait rock lobster (TRL) 2017 fishery surveys, CPUE and stock assessment: AFMA Project 2016/0822. March 2018 Draft Final Report.

Nominal CPUE for the Torres Strait Tropical Rock Lobster Fishery

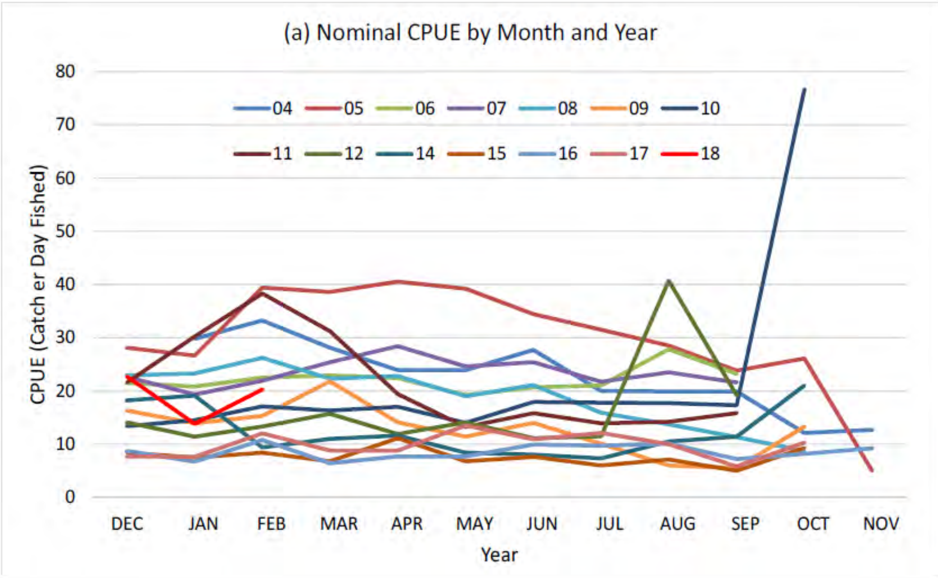


Figure1: Nominal CPUE for the Traditional Inhabitant Boat (TIB) sector per month and year.

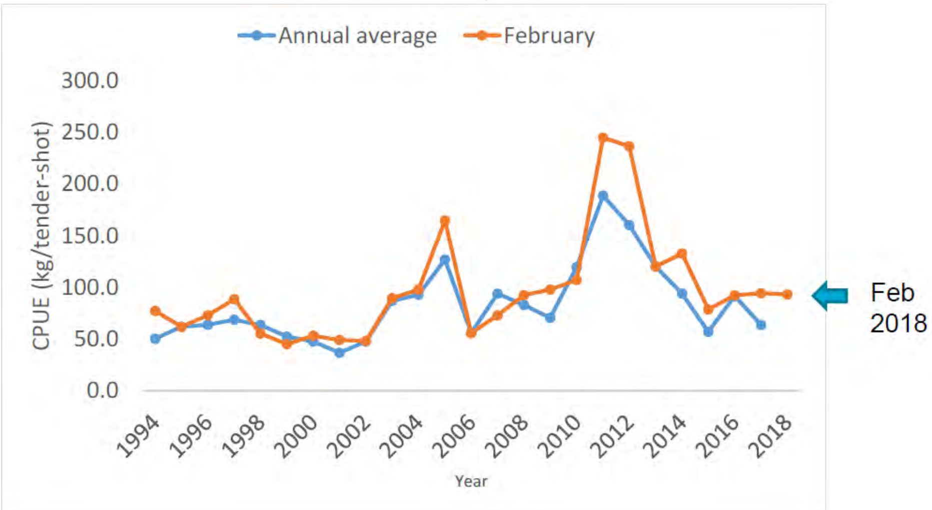


Figure 2: Nominal CPUE for the Transferable Vessel Holder (TVH) sector per year (annual average and February each year).

Source: : Éva Plagányi, Mark Tonks, Rob Campbell, Mick Haywood, Roy Deng (2018) Final 2017 Integrated Stock Assessment and RBC (2018) for the Torres Strait rock lobster fishery. Powerpoint presentation presented to the 22nd meeting of the Torres Strait Tropical Rock Lobster Resource Assessment Group held on 27-28 March 2018.

Data rules for using Tropical Rock Lobster catch data reported in the Torres Strait Buyers and Processors Docket Book (TDB01)

1. Where Seller-Type is identified as a processor then the corresponding catch record should be interpreted as a duplicate associated with a Processor-to-Processor trade and as such should not be included in the catch for the TIB sector. The DATA_TYPE associated with these records is therefore set to ‘PROCESSOR’.
    a. An exception is made for the records associated with Joseph Dai where DATA_TYPE=‘TIB’.
2. Where Seller-Type is identified as processor but the Seller-Name is a business name then the corresponding catch record should be identified with the fishery sector (TIB or TVH). The DATA-TYPE is listed as ‘TVH-TradeName’ or ‘TIBTradeName’ respectively.
3. Where Vessel-Type is identified as a TVH-vessel then the corresponding catch record should be interpreted as a duplicate associated with the TVH sector and as such should not be included in the catch for the TIB sector. The DATA-TYPE is listed as TVH.
    a. Note, whether or not the corresponding catch is contained in the TVH database needs to be checked.
4. Where Vessel-Type identifies the distinguishing symbol as an ‘F-symbol’ then the corresponding catch record should be included in the catch for the TIB sector and the DATA-TYPE is listed as ‘TIB’.
    a. An exception is made for the two vessels with the symbol FXYC or FWED which are TVH vessels and for these records the DATA-TYPE is listed as ‘TVH’.
5. Where Related-Log is blank then the corresponding catch record should be identified as a catch for the TIB sector and the DATA-TYPE is listed as ‘TIB’.
6. All other records should be attributed to the TIB sector and the DATA-TYPE listed as ‘TIB’.
    a. After fitting the five rules above, only 1055 records (of the 77,358 in total) remained un-assigned. Note: all but 3 of the 1055 (22 of the 25 vessels-symbols) occur in the Docket-Book database where the DATA-TYPE has already been assigned to the TIB sector.

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Meeting participants

Members

Name	Position	Declaration of interest
Dr Ian Knuckey	Chair	Chair/Director of Fishwell Consulting Pty Ltd and Olrac Australia (electronic logbooks). Chair/member of other RAGs and MACs. Conducts various AFMA and FRDC funded research projects including FRDC Indigenous Capacity Building project. No research projects in the Torres Strait. Full declaration of interests provided at **Attachment A**.
Dean Pease	AFMA Executive Officer	Nil
Selina Stoute	AFMA member	Nil
Charlie Kaddy	TSRA member (Fisheries Programme Manager)	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them
Tom Roberts	Queensland Department of Agriculture and Fisheries (QDAF) member	Nil
Dr Andrew Penney	Scientific member	Research consultant (Pisces Australis), member of other RAGs. No research projects in the Torres Strait
Dr Eva Plaganyi	Scientific member	Project staff for PZJA funded TRL research projects
Mark David	Industry member	Traditional Inhabitant Kulkalgal, TRLWG Industry member, Traditional Owner and TIB licence holder
Terrence Whap	Industry member	Nil. Traditional Inhabitant Maluialgal and Traditional Owner and TRLWG Industry member. Does not hold a TIB licence

Name	Position	Declaration of interest
Les Pitt	Industry member	Nil. Traditional Inhabitant Kemer Kemer Meriam and TRLWG Industry member
Phillip Ketchell	Industry member	Nil. Traditional Inhabitant Kaiwalagal, TRLWG Industry member, and Traditional Owner
Daniel Takai	Industry member	Pearl Island Seafoods, Tanala Seafoods and TIB licence holder
Dr Ray Moore	Industry member	Industry representative and Master Fisherman licence holder
Brett Arlidge	Industry member	General Manager MG Kailis Pty Ltd. MG Kailis Pty Ltd is a holder of TVH licences

Observers

Name	Position	Declaration of interest
Alexander Morison	TRLWG Chair	No pecuniary or other interest in the Tropical Rock Lobster Fishery or any other Torres Strait fisheries Fisheries Consultant. Chair of SERAG and SharkRAG. Scientific member on SEMAC. Contracted by government departments, non-government agencies and companies for a range of fishery related matters including research and MSC assessments of AFMA managed and other fisheries (by SCS Global Services)
Sevaly Sen	TRLWG Fisheries Economist member	Nil interest in Torres Strait fisheries. Conducts various FRDC research projects relevant to AFMA fisheries
Allison Runck	TSRA observer	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them

Name	Position	Declaration of interest
Jerry Stephen	TSRA Deputy Chair, TSRA Member for Ugar and TSRA Portfolio Member for Fisheries	TIB licence holder and Traditional Owner
Patrick Mills	Chair of the Torres Strait Fisher's Association	TIB licence holder and Traditional Owner
Seriako Stephen	Representative for Malu Lamar (Torres Strait Islanders) Corporation Registered Native Title Body Corporate (RNTBC)	Nil
Sandie Edwards	Industry observer	Torres Straits Seafood Pty Ltd and buyer
Koro Samai	Industry observer	Fisher
Pala Rubu	Industry observer	Fisher
Yacoba Wena	Industry observer	Fisher
Ngukis Asse	Industry observer	Fisher
Dr Mark Tonks	CSIRO scientific observer	Project staff for PZJA funded TRL research projects
James Mills	Industry observer	TIB licence holder
Ted Whap	Industry observer	Fisher
Susamie Ketchell	Industry observer	Fisher
Kumi Bon	Industry observer	Fisher
Kumi Abua	Industry observer	Fisher
Karo Whap	Industry observer	Fisher
Muttie Assan	Industry observer	Fisher
Kevin Sabatino Snr	Industry observer	TIB licence holder and Traditional Owner
Thomas Nomoa	Industry observer	TIB licence holder and Traditional Owner
Thomas Mene	Industry observer	Fisher
Paul Ahmat	Industry observer	Fisher
Richard Takai	Industry observer	Fisher
Hideo Shibasaki	Industry observer	Fisher
Kevin Takai	Industry observer	Fisher
Kevin Sabatino Jnr	Industry observer	Fisher
Morgan Daniel	Industry observer	Fisher

Name	Position	Declaration of interest
Jack Bani	Industry observer	TIB licence holder and Traditional Owner
Natalie Couchman	AFMA observer	Nil
Steve Bolton	AFMA observer	Nil

Notes:

This list of observers may be incomplete as some observers attended at different times and some declined to complete the attendance form.

Napau Pedro Stephen (TSRA Chair) attended at the reopening of the meeting on the morning of 28 March 2018. Further details are provided under agenda item 1.2.

1 Preliminaries

1.1 Apologies

1. Mr Terrence Whap opened the meeting in prayer at 1:00 pm on 27 March 2018.
2. The Chair welcomed attendees to the 22nd meeting of the Torres Strait Tropical Rock Lobster Resource Assessment Group (TRLRAG22). The Chair acknowledged the Traditional Owners of the land on which the meeting was held and paid respect to Elders past and present.
3. Attendees at the RAG are detailed in the meeting participant tables at the start of this meeting record.
4. Apologies were received from Maluwap Nona (Chairperson, Malu Lamar (Torres Strait Islanders) Corporation RNTBC) and Aaron Tom (Industry member).

1.2 Adoption of agenda

5. The draft agenda was adopted without change (**Attachment B**). Agenda Items 1-4 were discussed on 27 March 2018. Agenda Items 4-10 were discussed on 28 March 2018.
6. On the morning of 28 March 2018, the Chair moved to open the meeting. A request was received for Mr Napau Pedro Stephen (Chairperson, TSRA) to provide a statement to the meeting prior to the commencement of meeting proceedings. The Chair granted this request. A summary of the statement made by Mr Stephen is noted for the record at **Attachment C**. Mr Stephen did not attend the remainder of the meeting and was not asked to declare conflicts of interest.

1.3 Declaration of interests

7. The Chair stated that as outlined in PZJA Fisheries Management Paper No. 1 (FMP1), all members of the RAG must declare all real or potential conflicts of interest in Torres Strait TRL Fishery at the commencement of the meeting. Given the number of meeting observers, it was decided it would be too time consuming to ask each participant to leave the room while a decision is made as to whether, for the relevant agenda items, they can participate in the discussion and in the making of recommendations, or remain absent from the meeting. The declarations of interests would be noted under each agenda item.
8. Declarations of interests were provided by each meeting participant. These are detailed in the meeting participant tables at the start of this meeting record.
9. Unrelated to this agenda item but noted for the record, an Industry observer, Mr Anthony Assan, made a statement regarding recent comments made by the TSRA Chairperson in the Torres News concerning 100% Traditional Inhabitant ownership of the TRL Fishery and the decision of the TSRA Board to lease out TVH licences in the Fishery in the 2017/18 fishing season. Mr Assan does not expect the ownership target to be reached. Further, Mr Assan expressed the opinion that some in the TIB sector do not support the leasing of the TVH licences as they feel it is putting more pressure on the TIB sector to compete.
10. The TSRA Portfolio Member for Fisheries advised the meeting that he would look to organise a meeting with Mr Assan and the TSRA Chair to discuss this matter following the RAG meeting. The Chair noted it was not a matter for the RAG to be considering. The TSRA Portfolio Member for Fisheries noted that TSRA is currently conducting consultation on the Community Management Framework.

1.4 Action items from previous meetings

11. The RAG noted the report provided by the Executive Officer advising of the status of actions arising from previous TRLRAG meetings (**Attachment D**).
12. With regards to Action Item 3, an Industry member raised concerns about Australian access to and quality of PNG catch data and whether any catch is being taken using trawl. The CSIRO Scientific member noted that at recent meetings with the PNG NFA there was some discussion and interest from the PNG NFA in undertaking a research project to survey catch landed in local PNG markets, noting there is uncertainty around PNG catches.

2 Updates from members

2.1 Industry and scientific

13. The RAG noted updates provided by Industry and Scientific members and observers on the recent performance and key issues affecting the TRL Fishery:
    a. An Industry member reported that there had been no large change in the Fishery.
    b. Another Industry member reported that compared to previous seasons, the 2017/18 season was fairly normal, if slightly below average, but not markedly so. Catches from December to February have been slightly higher than last season, but noting that last season was the poorest on record for them. The catches are coming from the West, more so than in previous season, but this may be driven by where fishers have chosen to operate and may not be a reflection of stock distribution. Sizes are what would be expected this season (average is less than 1.5 kg). The catch rates and sizes do not align with what is expected from the stock assessment.
    c. The CSIRO Scientific member noted that the results of the integrated stock assessment have been finalised and will be presented at this meeting. The indices are showing lower recruitment than previous seasons. Some anecdotal reports are also supporting this conclusion.
    d. Another Industry member reported that lobsters appear to be concentrated around Mabuiag island, with poor catches being experienced to the South East and around Thursday Island. The fishing around Mabuiag is concentrated about 8 nm off the island but is patchy. These fishing grounds have not fished well for a number of years, but have come good again this season. This may be attributed to sand incursions of past seasons clearing this season. Fishers are not seeing good numbers of 0+ nor 1+ lobsters on the Mabuiag fishing grounds.
    e. Another Industry member reported that catches around Darnley island are slow (average of 10-20 kg of tails per fishing trip). In previous seasons there were more larger lobsters around.
    f. An Industry observer reported that TVH fishers appear to be concentrated around Buru (Turnagain). There seems to be good number of larger lobsters (over 1.5 kg) around Mabuiag island.
    g. Another Industry observer reported that catches around Tudu island have not been as good as they have in previous seasons, they have started slow and remained slow. Dungeness Reef is the same. The fleet is favouring the Western fishing grounds. Sizes are ok, about half are > 1 kg and half are < 1 kg.

h. Another Industry observer reported that there is food on the grounds around Thursday Island, but the lobsters are in low numbers.

i. An Industry member noted that it is unlikely that freshwater inflow would be affecting lobster numbers on the grounds. Around the outflow of the Fly River in PNG, lobsters have shown an ability to adapt their tolerance to freshwater. In past seasons, Deliverance Island had some very large lobsters and these may have migrated to the grounds around Mabuiag island. Something similar may be occurring this season.

j. An industry member noted that the catches from PNG are low but slightly higher than last season which was very poor. This is in the main due to a hookah closure being in place until 31 March 2018.

2.2 Government

14. The RAG noted an update provided by the AFMA member regarding management initiatives relevant to the TRL Fishery:

    a. Industry meeting - on 27 February 2018 AFMA held an industry meeting on Thursday Island. AFMA provided industry members information about the preliminary RBC and catch rates, explained the stock assessment process, explained the purpose of this RAG and the following Working Group meeting, to notify industry members that additional measures may be needed to regulate catch in the 2017/18 fishing season and to gather industry views.

    b. Draft TRL Management Plan - the TSRA has conducted further consultation with Traditional Inhabitant fishers about how quota allocations under a quota management system could be managed. Outcomes from this consultation as well as that on the draft TRL Management Plan and TRL Working Group advice will be tabled with the PZJA.

    c. Australia and PNG bilateral meeting - the Fisheries Committee met on 5 February 2018 and provided advice to the Joint Advisory Council (JAC). The JAC noted advice regarding the preliminary TRL RBC for the 2017/18 fishing season. The JAC also noted ongoing interest by the PNG prawn trawl industry to retain TRL and agreed that any departures from the current ban must be assessed in line with the Treaty. The JAC recognised the importance of the resource to Traditional Inhabitants noting that it is a shared stock and the potential for trawling to impact spawning migration pathways and biomass in the Torres Strait. PNG also agreed to provide data on catches. The AFMA CEO will be following up again with the NFA Managing Director on these matters.

    d. Australian National Audit Office (ANAO) - the ANAO has commenced a performance audit of Australian Government coordination arrangements in the Torres Strait. ANAO officers will be visiting the Torres Strait in April.

15. The RAG noted an update provided by the QDAF member regarding QDAF activities relevant to the management of the TRL Fishery:

    a. East Coast TRL Working Group – this group met for the first time since 2011 and will focus on developing a harvest strategy, to be implemented by 2020. The group will also review existing management arrangements.

    b. Catch to date – approximately 55 tonnes of the 195 tonnes TAC has been caught. Last season the TAC was reached by 1 July. Catch for the last month has slowed (3 tonnes in March) as the industry has decided to fish to higher market prices and catch per unit effort (CPUE) expected later in the season. The QDAF member advised that there is 5 tonnes allocated to the indigenous sector under indigenous fishing permits. The purpose of these permits is to provide the opportunity for indigenous fishers to trial commercial fishing. In order to access more quota, fishers would need to purchase it. QDAF are currently reviewing the policy detailing access arrangements to the 5 tonnes indigenous sector allocation.

16. An industry member noted that the East Coast TRL Fishery is able to fish to higher market prices due to the certainty provided by quota.
17. The RAG noted an update provided by the TSRA member regarding TSRA activities relevant to the management of the TRL Fishery:
    a. Fisheries Summit – planned for May 2018 to span 3 days. Further details to be provided closer to time but key fisheries projects and issues will be up for discussion as well as seeking nominations for Traditional Inhabitant positions on PZJA forums. These positions will be for a three-year term. AFMA will write to all licence holders with further details.
    b. Audit of infrastructure and services – a draft report has been considered by the TSRA Board and the report will be finalised shortly. The report will be made public on the TSRA website, and made available at the Fisheries Summit.
    c. Export and branding for Torres Strait seafood - a consultant has been engaged to assess the economic feasibility, regulatory requirements and infrastructure needs to export seafood directly from the Torres Strait and the potential value derived from creating a brand for Torres Strait seafood.
    d. Separate licence entity – broad consultation has been conducted on a project looking at the establishment of a corporate entity separate from the TSRA to hold in trust and manage commercial fishing licences on behalf of Torres Strait communities. There is general support for the entity and TSRA now need to complete further work on legal and governance structures.

2.2.1 Fish receiver update

18. In the interests of time, the RAG noted the update provided in the associated agenda paper as read.

2.2.2 TRL Fishery export approval

19. In the interests of time, the RAG noted the update provided in the associated agenda paper as read.

2.2.3 Legislative amendments update

20. In the interests of time, the RAG noted the update provided in the associated agenda paper as read.

2.3 PNG NFA

21. This item was not discussed as the PNG NFA invited participant was not in attendance.

2.4 Native Title

22. The RAG noted concerns raised by the representative for the Malu Lamar (Torres Strait Islanders) Corporation RNTBC. The Chairperson for Malu Lamar was an apology for the meeting. The Malu Lamar representative expressed concerns over the low RBC for the 2017/18 fishing season. The representative advised that the rights of Traditional Inhabitants to fish are protected under Article 10 of the Torres Strait Treaty and

prescribed in the objectives of the *Torres Strait Fisheries Act 1984*. The representative stated that what remains of the RBC needs to be allocated to Traditional Inhabitants.

3 2017/18 TRL catch and effort information

23. The RAG noted an update provided by the AFMA Executive Officer on catch and effort in the TRL Fishery for the 2017/18 fishing season to date:
    a. As reported through the new mandatory fish receiver system implemented on 1 December 2017, the total landed catch reported for the TRL Fishery from 1 December 2017 to 21 March 2018 is 81,688 kg (**Table 1**).
    b. There are outstanding catch disposal records (TDB02) for the period 1 to 21 March 2018. Therefore, the landed catch reported for the March period may be under-reported.
    c. AFMA is awaiting an update from the PNG National Fisheries Authority on catches to date for the PNG TRL Fishery.

Table 1: Landed catch (kilograms whole weight) of tropical rock lobster by sector for the Torres Strait TRL Fishery for the period 1 December 2017 to 21 March 2018. Source: catch records from the Torres Strait Catch Disposal Record (TDB02).

Dates	TIB (kg)	TVH (kg)	Combined catch (kg)	Number of records
01/12/2017 to 31/12/2017	8,516.8	31.3	8,548.1	414
01/01/2018 to 31/01/2018	9,802.4	0.0	9,802.4	493
01/02/2018 to 28/02/2018	21,574.2	27,307.8	48,882.0	755
1/03/2018 to 21/03/2018	5,749.8	8,706.0	14,455.9	255
Total	**45,643.2**	**36,045.2**	**81,688.4**	**1,917**

4 Finalising the stock assessment update and recommended biological catch

24. The RAG noted a presentation provided by Dr Mark Tonks, CSIRO Scientific observer, detailing the results of the November 2017 pre-season survey. With regards to survey design, the RAG noted:
    a. Dive surveys were conducted at 77 sites using 500 x 4 m belt transects. These sites have been repeated over the last two years. At each site the number of lobsters is counted and seabed habitat assessed. Some of the sites occur in currently fished areas.
    b. Survey conditions were fair with good visibility and were similar to previous surveys. Noting this, weather is not considered to have impacted on the survey results.
25. The results of the survey show:
    a. 1+ lobster abundance index – 1.78 lobsters observed per transect. This is the lowest recorded for a pre-season survey, just 25% of the highest index in 2015. The index is the same as the 1998 mid-season survey and higher than the 2001 and 2005 mid-year surveys. Compared to previous surveys, it is looking similar to previous poor seasons.

b. 1+ lobster abundance and distribution – low abundance around the Western survey sites (Thursday Island, Mabuiag, Buru (Turnagain)). The South East survey sites were up 250% from the 2016 survey. Distribution is similar to previous surveys but with an absence of 1+ lobsters around Buru.
c. 0+ lobster abundance index – lowest ever recorded, just 20% of the 2016 survey index.
d. 0+ lobster abundance and distribution – very low abundance around Mabuiag and Thursday Island and low across most other sites except the South East. The distribution is unusual compared to the 2016 survey.
e. Certainty - CSIRO are confident about the 1+ lobster results, with a little less certainty about the 0+ lobster results because 0+ lobsters are harder to see.
f. Size frequency – commercial size length frequency data provided by MG Kailis has been fairly consistent through time. However, the survey data is showing tail width size has decreased over the last 4 years.
g. Seabed habitat – the seabed habitat has remained relatively consistent through time (1994-2014), with a slight downwards trend in rubble and coral, and a slight increase in algae and seagrass. There was a coral bleaching event recorded in 2010. Sand cover has been relatively consistent with the Southern sites experiencing some sand incursions in 2015.

26. The RAG noted the number of survey sites has decreased through time (from 144 to 77 sites). The biggest decrease has been in the last 3 years. A drop in precision was seen with the removal of some Eastern sites, however the existing sites are considered representative of the TRL Fishery.
27. RAG members discussed the value in increasing the number of sites in subsequent years. It was noted that increasing the number of sites will reduce the standard error, however the trend of abundance will remain the same. The CSIRO Scientific observer advised that new sites would need to randomly stratified and scaled on the basis of TRL stock distribution and previous surveys. Industry members suggested additional sites are needed at Warrior Reef. The RAG noted that there were more survey sites around Warrior Reef previously, and that surveys in this area may be able to indicate of any change to migration patterns.
28. The CSIRO Scientific member noted that tagging and larval convection studies look at developing a better understanding the TRL life cycle and may assist in understanding if there have been any changes to migration patterns through time.
29. RAG members discussed the utility of a mid-season survey to provide better precision in survey results. The CSIRO Scientific member advised that:
    a. Pre-season surveys provide the best information about 1+ lobster abundance, but also provide abundance information on 0+ and 2+ lobsters.
    b. Mid-season surveys provide good information 2+ lobsters. In the absence of a mid-season survey, CPUE data is used as an indicator of 2+ lobster abundance. When conducted in the past, the mid-season surveys showed a strong correlation with the CPUE data.
    c. Pre-season surveys are more important for setting a TAC for the following fishing season. A mid-season survey would give independent information about the spawning stock. The Independent Scientific member noted however, as there is not a stable relationship between the spawning stock and recruitment, it is not possible to predict recruitment from this information. It is better to survey those lobsters that have already recruited into the fishery, that being the 0+ and 1+ lobsters.

d. Much remains uncertain as to where the sources of recruitment are for the TRL Fishery, the thinking is that there are many sources. Given this uncertainty, the TRL stock needs to be protected across its distribution.

30. In summary, the RAG noted that the November 2017 pre-season survey showed the lowest level of 1+ (high certainty) and 0+ (less certainty) lobsters in the TRL Fishery's history of pre-season surveys. This is the main factor causing the reduction of the RBC for the 2017/18 fishing season.

31. The RAG noted a presentation, titled *Draft Updated 2017 Integrated Stock Assessment to provide management advice on the Torres Strait rock lobster fishery*, provided by Dr Eva Plaganyi, CSIRO Scientific member, detailing the results of the updated integrated stock assessment and RBC calculations. The RAG noted the integrated stock assessment takes into account:

    a. Data from pre-season surveys – last 8 years, including that conducted in November 2017;
    b. Data from mid-year surveys – 1989-2014;
    c. Catch and effort information – TIB and TVH;
    d. Length frequency information – Australia and PNG;
    e. Historical information;
    f. Environmental information.

32. The RAG noted catch data for the period 1973-2017 and in particular 2017 catch against the RBC: Traditional Inhabitant Boat sector 106.4 tonnes; Transferable Vessel Holder sector 149 tonnes; PNG 113 tonnes. This accounted for 74% of the 495 tonnes RBC.

33. Industry observers requested further details on the TRL life cycle. The RAG discussed the TRL life cycle as presented by the CSIRO Scientific member (**Attachment E**). The life cycle that was presented is general in nature and it was noted that there will be exceptions. In the Western Torres Strait, females walk East to PNG in August-September and don't return. In the Eastern Torres Strait female lobsters walk out to deeper water and then return. The same is thought to occur in the East Coast TRL Fishery. Lobsters spawn and recruit within the Coral Sea gyre. The TRL larval phase lasts approximately 6 months.

34. The RAG discussed possible explanations for the low abundance of TRL around Thursday Island. The CSIRO Scientific member advised that the research shows TRL do not migrate far once settled in the Torres Strait, until they migrate to spawn. An Industry member noted that there have been some historical observations of 1+ lobsters moving from the Northern area of the East Coast TRL Fishery into the Torres Strait, but strong evidence for this is not available. Recruitment in the Torres Strait is primarily through the settlement of juvenile lobsters. As such it is unlikely that TRL settled in the East Coast TRL Fishery migrate to the Torres Strait.

35. The RAG noted a summary the survey cycle (**Attachment F**).

36. The RAG noted the model used is an age-structured production model (ASPM) which integrates all available data and fits that data to calculate an RBC. The outputs of the model show:

    a. Abundance of TRL in each age class (0+, 1+ and 2+) – all age classes are lower than previous years. Model does not fit 0+ lobsters as the variability of the data is high.
    b. CPUE – the trend is down for 2017. This trend was also seen in other poor years (2004, 2008, 2011). If there are not a lot of 1+ lobsters growing into fishable size, then should see a drop in CPUE around March-April 2018. TRL generally reach legal size at 22 months, they are generally 18 months old at the time of the pre-season survey each November.

c. Stock-recruitment residuals – recruitment in 2016 and 2017 is worse than average. There have been poor recruitment years in the past, but not for two consecutive years.

37. The RAG discussed the implications of the low abundance of 0+ and 1+ lobsters for the 2017/18 fishing season. 1+ lobsters surveyed during the November 2017 pre-season survey will grow out to fishable size around March/April 2018. 0+ lobsters will grow out to fishable size a year later in March/April 2019. If the abundance of 1+ lobsters is as low as the survey indicates, then fishing mortality for the 2017/18 fishing season needs to be decreased to allow for a sufficient spawning stock for subsequent seasons. A similar issue may arise for the 2018/19 fishing season, given the low abundance of 0+ lobsters during the pre-season survey, though there is less certainty around the estimates of abundance for this age class.

38. The CSIRO Scientific member advised that where there are low abundances of 1+ and 2+ lobsters, concentrations or 'hot spots' would be expected. There would not be high abundances spread across the fishery as has occurred in past years.

39. The RAG noted that the 2+ lobsters being caught now are likely larger males left over from the previous year. This is borne out by the length frequency data. It is expected that when the 2+ lobsters are mostly caught, which they generally are during a season, there will be a drop in CPUE as they are replaced by a low abundance of 1+ lobsters.

40. The Independent Scientific member advised that they have reviewed the results of the November 2017 pre-season survey and the outputs of the model and has confidence in the findings.

41. The RAG discussed the CPUE data in further detail (**Attachment G**):

   a. December 2017 and January 2018 CPUEs are higher than in recent years. February 2018 is looking to be on a par with the long-term average, maybe slightly lower. The effort for the TVH sector in 2018 is not particularly high compared to past years.

   b. The Chair noted that the effort information collected in catch disposal records may not always be accurate, for example in many cases dive hours are not recorded and fishing days where there has been zero catch or low catch may not be recorded. Given this, any trends extrapolated from this data may be impacted. There is also a need to update the CPUE standardisation with regards to fishing patterns and efficiency.

   c. An Industry member noted that if the survey is correct, and noting that in the past there has been a strong correlation between the survey results and CPUE data, then it should be expected that the CPUE will drop markedly and as such are less likely to reach the Australian catch share of the RBC.

   d. Another Industry member noted that in order to get the best outcome for the Fishery and the industry this season, the fishers themselves have a responsibility to come together to participate in and support the making of decisions.

42. In summary, the RAG noted that the CPUE data for the 2017/18 season to date has not contradicted the results of the November 2017 pre-season survey nor the outputs of the integrated stock assessment.

43. Taking into consideration all of the above, the RAG recommended a final RBC for the 2017/18 of 299 tonnes for Australia and PNG inclusive.

Recommendation 1

The RAG recommended a final RBC for the 2017/18 of 299 tonnes for Australia and PNG inclusive.

44. With reference to FMP1, the RAG discussed the attendance of the large number of observers at the meeting, noting some were wearing protest shirts and the majority were in attendance without seeking the prior agreement of the Chair. The RAG noted that while observers are generally welcome to attend RAG meetings to observe the proceedings, their presence in large numbers, particularly at this meeting, may have had the potential to inhibit or disrupt members from freely contributing to discussions and recommendations. The Chair also noted that Agenda Item 5 involved fine-scale examination of individual fisher's catch and effort data. It was not considered appropriate that observers had access to this information. On this basis, the Chair thanked observers for the time taken to attend the meeting and advised that the next session of the meeting would be closed to observers.

45. Following observers leaving the meeting the members discussed the implications of having such a large group of observers at a meeting and whether it impacted on members' comfort in providing advice to the RAG. Members considered it was generally (two-way) a positive role that observers played in the RAG and that although there were large numbers at this meeting, they did not disrupt the meeting or behave in a manner inconsistent with the standard of behaviour expected under FMP1. It was noted that many of the observers, however, had not sought permission from the Chair to attend and that this should be addressed in the future. Members agreed that, in general, they would be comfortable with observers continuing to attend the meetings.

5 Data rules for using catch data reported in the Torres Strait Buyers and Processors Docket Book

46. RAG members discussed data rules for the use of TRL catch data reported in the Torres Strait Buyers and Processors Docket Book (TDB01). The RAG noted:
    a. The TDB01 was used in the TRL Fishery principally to record the catch and effort for fishers operating in the TIB sector of the fishery. The TDB01 was replaced on 1 December 2017 by the mandatory Torres Strait Catch Disposal Record (TDB02);
    b. Catch from the TRL Fishery is also reported through the Torres Strait Tropical Rock Lobster Fishery Daily Fishing Log (TRL04). Catch sold between processors can also be recorded in the TBD01. This can create duplicate catch records making it difficult to accurately determining the true catch taken by the TIB sector of the fishery.
    c. A number of mechanisms have been introduced in an attempt to reduce duplicate catch records, however a number of uncertainties still remain, including:
        i. The TDB01 "related-logs" field identifies if the catch has been reported elsewhere (e.g. TRL04). If the fisher or processor does not complete this field, duplicate records may not be identified.
        ii. The TDB01 "seller-type" field identifies the fisher by name/entity. This can be used to identify between TIB and TVH fishers. Seller names are often not included, misspelt or a nickname is used reducing the utility of this field.
        iii. The TDB01 "vessel-type" field is used to indicate whether the vessel-symbol detailed in the TBD01 corresponds to a vessel listed in the TVH database.
    d. The recommended data rules are proposed to assign TDB01 records with unknown or missing information to either the TIB sector, TVH sector or as processor-to-processor trading.

47. The RAG agreed to adopt the data rules provided at **Attachment H**.

Recommendation 2
The RAG agreed to adopt the data rules provided at Attachment H.

6 TRL harvest strategy

48. The RAG noted an update provided by the AFMA member regarding the Harvest Strategy for the TRL Fishery:
    a. The TRLWG considered the draft TRL Harvest Strategy at its meeting on 25-26 July 2017.
    b. The WG recommended that further work be undertaken by the WG and RAG to examine possible options for including social and/or economic objective in the draft harvest strategy and applying a management trigger under the harvest strategy as the stock approaches the limit reference point to minimise the impacts on traditional inhabitant commercial fishers.
49. The RAG was asked to advise on the likely:
    a. Data and assessment requirements to support the proposed management trigger;
    b. Impediments, if relevant, to meeting the data and assessment requirements; and,
    c. Costs of any new data and assessment requirements.
50. The RAG agreed that a management trigger can be included that results in alternative management and catch sharing arrangements. However, the trigger level itself and proposed management response needs to be identified by the WG before the RAG can provide advice about how the Harvest Strategy should be modified to accommodate it. The RAG discussed that:
    a. Social and economic limits are often based on tonnage and not % biomass. Biomass based triggers are difficult to monitor and it is not practical for the TRL Fishery given the limitations of available data.
    b. Triggers that result in management changes part way through a season are complex to administer and require real time data and analysis which is expensive for the fishery. In the TRL Fishery in-season adjustments would be difficult under the current inputs.
    c. If a new trigger is incorporated, the Harvest Strategy would need to undergo management strategy evaluation (MSE) testing. This is a costly exercise.
51. The RAG endorsed the draft TRL Harvest Strategy and recommended the WG further discuss and provide the RAG with details on the trigger level and proposed management response.

Recommendation 3
The RAG endorsed the draft TRL Harvest Strategy and recommended the WG further discuss and provide the RAG with details on the trigger level and proposed management response.

7 Justification for a January season start date for the QLD East Coast TRL Fishery

52. The RAG noted a summary provided by the QDAF Member regarding the 1 January season start date for the East Coast TRL Fishery:

a. In 2014, QDAF changed the end date of the East Coast TRL Fishery's spawning closure from 31 January to 31 December. The start date of the spawning closure 1 October remained unchanged.
b. The amendment to the closure date did not remove the closure over the peak spawning months of October-December, but reduced the length of the closure to allow industry to take advantage of a period of high demand in January.
c. The limited data available indicates the peak spawning period for the East Coast TRL Fishery occurs in November and in deep water. The closure starts and finishes one month either side of the peak spawning period. Fishers are also restricted to shallower waters reducing their interactions with spawning lobsters in deep water. If spawning lobsters are encountered at any time whilst the fishery is open there is total protection on the take of berried and tar spot lobsters. A total allowable catch (TAC) also restricts the level of catch.
d. Advice from CSIRO TRL scientists at the time of the change was supportive in bringing forward the start date of the new season to 31 December considering the East Coast TRL Fishery is managed under a TAC and the peak spawning period is in November.
e. The Torres Strait TRL Fishery spawning closure is slightly different to the East Coast TRL Fishery with a closure from 1 October to 30 November and then a prohibition on the use of hookah gear from December-January.

53. The CSIRO Scientific member reinforced that there are no concerns about a season opening in January, as peak spawning occurs November in deeper water. This change is not considered to affect the Torres Strait TRL Fishery.
54. The RAG noted advice from some Industry members that there is little evidence that larger lobsters migrate from the East Coast to the Torres Strait. Therefore, it is considered to be minimal impact from this spawning closure on the Torres Strait. There is anecdotal evidence that 1+ lobsters migrate from the Northern area of the East Coast into the Torres Strait. But these lobsters would be undersize and only grow to a fishable size later in the fishing season.
55. The RAG noted that historically TIB fishers had access to areas of the East Coast TRL Fishery. It was advised that concerned fishers raise this matter with QDAF directly.
56. The QDAF member advised that they are seeking an indigenous member for their East Coast TRL Fishery and have sought nominations including from relevant native title bodies. No nominations have been received to date.

8 Setting of hookah closures

57. The RAG noted a proposal from the TSRA Portfolio Member for Fisheries regarding the setting of moon-tide hookah closures for the TRL Fishery. It was proposed that:
    a. A second hookah closure period be implemented each month in the TRL Fishery for the remainder of the 2017/18 fishing season, effective from 13 April 2018.
    b. Consideration be given prior to each fishing season as an additional effort control in years with a recommended biological catch set below historical catch averages.
58. The RAG noted that moon-tide hookah closures were originally introduced in 2005 as a temporary measure as a way to reduce fishing effort to levels recorded in 2002. This was at a time when the TRL Fishery was considered to be subject to overfishing. In 2013 the closures were removed following a buy-out of TVH licences. They were again reintroduced for the 2014/15 fishing season following agreement from both the TIB and TVH sectors.

59. It was highlighted that any changes in fishery management during 2018 to respond to the low TAC, could impact on or bias CPUE as an index of abundance for input into the next assessment or a harvest strategy.
60. The CSIRO Scientific member noted that a second hookah closure period would slow the rate of fishing which would prolong fishing and support the continuity of CPUE data for a longer period. This would be important particularly in a year where the fishery may close early as having continuous CPUE throughout a fishing season is important for informing calculations on spawning biomass.
61. The RAG recommended the proposal be put forward to the WG for further consideration.

Recommendation 4

The RAG recommended the proposal from the TSRA Portfolio Member for Fisheries regarding the setting of moon-tide hookah closures for the TRL Fishery be put forward to the WG for further consideration.

9 Other Business

62. There was no other business raised by members.

10 Date and venue for next meeting

63. The RAG noted that the next meeting is tentatively scheduled for December 2018, with a date to be decided out of session.
64. The meeting was closed in prayer at 12:00pm on 28 March 2018.

Declaration of interests
Dr Ian Knuckey – April 2018

Positions:

- Director – Fishwell Consulting Pty Ltd
- Director – Olrac Australia (Electronic logbooks)
- Chair / Director – Australian Seafood Co-products (seafood waste utilisation)
- Chair / Director – ASCo Fertilisers (seafood waste utilization)
- Chair – Northern Prawn Fishery Resource Assessment Group
- Chair – Tropical Rock Lobster Resource Assessment Group
- Chair – Victorian Rock Lobster and Giant Crab Assessment Group
- Scientific Member – Northern Prawn Management Advisory Committee
- Scientific Member – SESSF Shark Resource Assessment Group
- Scientific Member – Great Australian Bight Resource Assessment Group
- Invited scientific participant – SEMAC, SERAG

Current / Recent Projects and funding:

- Principal Investigator – FRDC Project 2017-069 Indigenous Capacity Building
- Principal Investigator – VFA Project 17-646976 – Ocean Scallop Biomass Survey – 2018
- Principal Investigator – FRDC Project 2017/122 - Review of fishery resource access and allocation arrangements across Australian jurisdictions
- Principal Investigator – FRDC Project 2016/116 - 5-year RD&E Plan for Northern Territory fisheries and aquaculture
- Principal Investigator – AFMA Project 2017/0803 - Analysis of Shark Fishery Electronic Monitoring data
- Principal Investigator – AFMA Project 2017/0807 - Resource Survey of the Great Australian Bight Trawl Sector – 2018
- Principal Investigator – AFMA Project 2016/0809 – Improved targeting of arrow squid
- Principal Investigator – AFMA Project 2018/08xx – Bass Strait and Central Zone Scallop Fishery – 2018 and 2019 Survey
- Principal Investigator – DPIPWE Project – Review of abalone dive rates
- Principal Investigator – FRDC Project 2015/204 – Realising economic returns of reducing waste through utilization of bycatch in the GAB Trawl Sector of the SESSF
- Principal Investigator – FRDC Project 2014/203 – Review of Monitoring and Assessment in the SESSF
- Principal Investigator – AFMA Project 2014/0809 – Fishery Independent Survey of shelf resources in the Great Australian Bight Trawl Fishery 2017
- Principal Investigator – Survey for Black teatfish in the Queensland Sea Cucumber Fishery.
- Principal Investigator – CRC Project 2013/748.40 – Improved understanding of economics in fisheries harvest strategies.
- Principal Investigator – FRDC Project 2014/207 – The social drivers and implications of conducting an ecological risk assessment of both recreational and commercial fishing - a case study from Port Phillip Bay
- Co-Investigator – Optimising processes and policy to minimise business and operational impacts of seismic surveys on the fishing industry and oil and gas industry.
- Co-Investigator – FRDC Project 2017/014 – SA Marine Scalefish Review
- Co-investigator – AFMA Project - SESSF 2018 Fishery Independent Survey

- Co-investigator – Bird mitigation in the SESSF trawl sector
- Researcher – Various fishing industry liaison projects for oil and gas industry
- Scientific Advisor – Atlantis, GABIA, Gulf St Vincent Prawn Fishery, Seafish JV, SETFIA, SSIA
- MSC Auditor – Falklands Is 2016 Surveillance Audit (Acoura), Macquarie Is Toothfish (SCS)
- Facilitator – WWF shark traceability workshop
- Facilitator – SPC Tuna Data Collection Committee
- Facilitator – Indonesian fishery training and development

Current / Recent Clients (>$5000):

- ABARES
- Acoura
- Atlantis Fisheries Consulting Group
- Australian Fisheries Management Authority (AFMA)
- CRC – Seafoods
- Department of Agriculture and Water Resources
- Department of Primary Industry - Victoria
- Dept. Primary Industry, Parks Water and Environment (DPIPWE) Tasmania
- Fisheries Research and Development Corporation (FRDC)
- Great Australian Bight Fishing Industry Association (GABIA)
- Gulf of St Vincent Prawn Boat Owners Association
- Monash University
- NT Fisheries
- Richey Fishing
- South Australian Rock Lobster Advisory Council (SARLAC)
- SARDI Aquatic Sciences
- SCS Global Services
- Seafood Industry Victoria
- Seafish JV
- SeaFresh
- Secretariat of the Pacific Community
- South East Trawl Fishing Industry Association (SETFIA)
- Southern Shark Industry Alliance (SSIA)
- Tasmanian Seafoods
- Victorian Fisheries Authority
- Western and Central Pacific Fisheries Commission
- World Wildlife Fund – Australia (WWF)

TORRES STRAIT TROPICAL ROCK LOBSTER

RESOURCE ASSESSMENT GROUP (TRLRAG) MEETING #22

TUESDAY 27 March 2018 1:00PM-5:30PM

WEDNESDAY 28 March 2018 8:30AM-12:00PM

THURSDAY ISLAND, TSRA CONFERENCE ROOM

AGENDA

1. Preliminaries
   1.1. Apologies
   1.2. Adoption of agenda
   1.3. Declaration of interests
   1.4. Action items from previous meetings

2. Updates from Members
   2.1. Industry and scientific
   2.2. Government
      2.2.1. Torres Strait Fisher Receiver System
      2.2.2. TRL Fishery Strategic Assessment
      2.2.3. Torres Strait legislative amendments
   2.3. PNG-NFA
   2.4. Native Title

3. 2017/18 TRL catch and effort information

4. Finalising the stock assessment update and recommended biological catch

5. Data rules for using catch data reported in the Torres Strait Buyers and Processors Docket Book

6. TRL harvest strategy

7. Justification for a January season start date for the QLD East Coast TRL Fishery

8. Setting of hookah closures

9. Other Business

10. Date and venue for next meeting

Summary of the statement made by Napau Pedro Stephen to the TRLRAG on 28 March 2018

Key points made by Napau Pedro Stephen:

- Noted the low recommended biological catch (RBC) of 299 tonnes for the Torres Strait TRL Fishery for the current season (2017/18 fishing season).
- Mr Stephen acknowledged that the TRL Resource Assessment Group (RAG) and Working Group are the appropriate bodies through which advice needs to be provided about the management of the TRL Fishery this season.
- The TSRA Board are of the view that in making decisions about the management of the TRL Fishery this season, noting aspirations for 100% ownership of Torres Strait fisheries, the benefits of any such decisions need to go to the Traditional Inhabitants of the Torres Strait.
- Mr Stephen has requested an urgent meeting with the Commonwealth and Queensland Ministers to discuss the outcomes of the meeting. Mr Stephen will represent the interests of Traditional Inhabitant fishers at this meeting.
- Mr Stephen's message to the meeting with Ministers will be that, in light of a low RBC, it should not be on Traditional Inhabitants to sacrifice this season. Traditional Inhabitant fishers from day dot have sacrificed to ensure the stock is sustainable. The TRL Fishery is critical in providing livelihoods for Traditional Inhabitants across the Torres Strait, and it is under threat this season. The only choice many Traditional Inhabitant fishers will have if the TRL Fishery is closed will be the Community Development Programme (CDP). This is no choice. Future decisions about the management of the TRL Fishery need to be made to the benefit of Traditional Inhabitants.
- Mr Stephen made himself available to any fishers that would like to meet with him.
- Mr Stephen noted that both the Management Plan and Harvest Strategy for the TRL Fishery had yet to be finalised. Regardless, action is needed now and this action needs to benefit Traditional Inhabitants.
- Traditional management of the TRL stock has been historically practised. These practices are in line with the science in ensuring that effort on the stock is controlled so the sustainability of the stock is not negatively impacted. The science does not tell us anything new regarding the management of the TRL stock.
- Mr Stephen noted that the TSRA Portfolio Member for Fisheries (and TSRA Deputy Chair), in attendance at the meeting, speaks for the TSRA Board. Mr Stephen requested AFMA consider the appointment of TSRA Portfolio Member for Fisheries as a member of the TRLRAG.
- There are already tensions between Traditional Inhabitant fishers and TVH fishers out on the fishing grounds and no one wants to see these tensions inflamed and ending up in front of the Court.

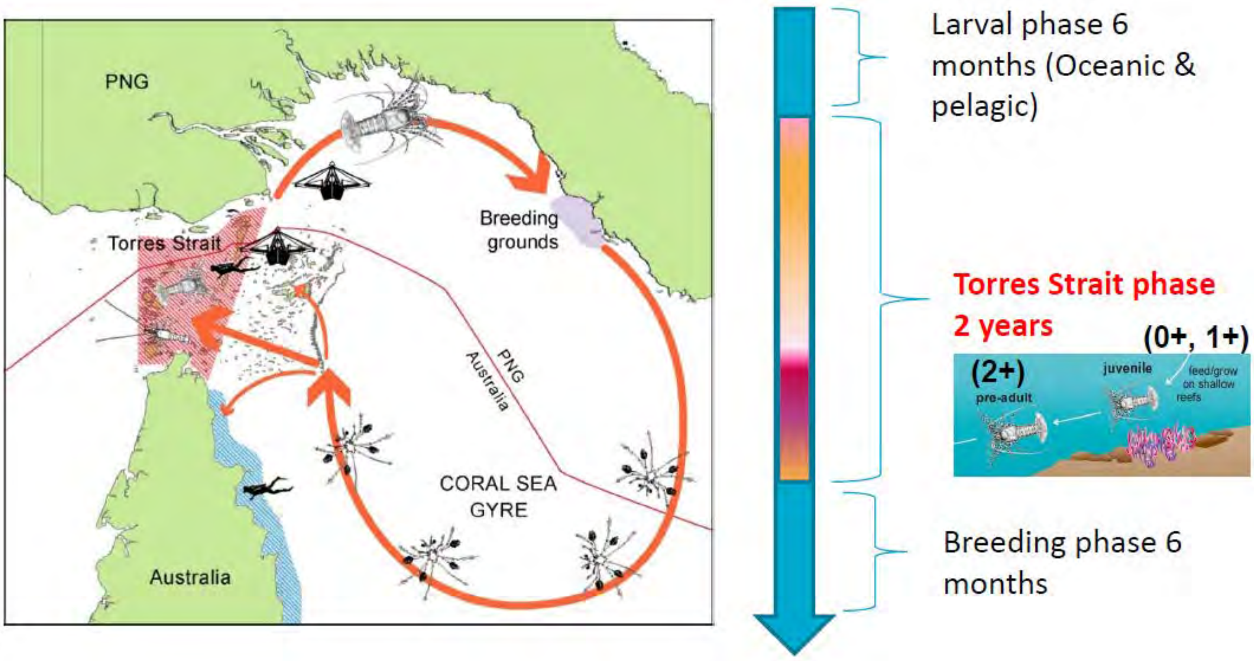
Action items from previous meetings

#	Action Item	Agenda	Agency	Due Date	Status
1.	AFMA to review the effectiveness of certain TIB licensing arrangements (in its 2016 licencing review) including: • TIB licenses should share a common expiry date • licences to last for longer than the current 12 month period.	TRLRAG14	AFMA	2017	**Ongoing** AFMA has begun undertaking a review of licensing of Torres Strait Fisheries, this issue will be considered as part of this review. At present however, AFMA resources are focused on progressing the proposed legislative amendments as a matter of priority.
2.	AFMA and CSIRO prepare a timeline of key events that have occurred in the Torres Strait Tropical Rock Lobster Fishery (e.g. licence buy backs, weather events and regulation changes) and provide a paper to TRLRAG.	TRLRAG14	AFMA CSIRO	TRLRAG17	**Ongoing** AFMA to complete further work. This has been difficult to action ahead of other priorities for the TRL Fishery.
3.	AFMA to prepare a summary of evidence that PNG trawl-caught TRL are a shared stock between Australia and PNG, including details such as the TRL biological characteristics, larvae dispersal, tag recapture data and catch and effort information. AFMA will circulate the paper to the RAG	TRLRAG19	AFMA		**Ongoing** AFMA sent a letter to PNG NFA outlining concerns of trawlers retaining TRL on 8 March 2017. AFMA presented the key findings of the CSIRO larval advection model at the Fisheries Bilateral meeting held in Port Moresby on 5 February 2018. The bilateral meeting noted that the findings show the Australian and PNG TRL fisheries are based on a single stock. AFMA and CSIRO (Dr Plaganyi) met with PNG NFA officials, including the NFA Managing Director, John Kasu on 7 February 2018 at the NFA offices in Port

	out-of-session for comment before sending to PNG NFA.				Moresby. Dr Plaganyi presented the updated stock assessment results and larval advection modelling. There was agreement that the updated larval modelling together with past research provides strong evidence that TRL is a shared stock between Australia and PNG. These meetings have been followed up with a phone call between the PNG NFA Managing Director and AFMA CEO which included discussions on the importance of controlling catches so they do not exceed each jurisdiction’s catch share of the recommended biological catch (RBC).
4.	Malu Lamar RNTBC to provide AFMA with the map of traditional boundaries and regional area and reef names for each of the Torres Strait Island nations and for CSIRO to examine possible revised naming conventions for survey sites	TRLRAG20	Malu Lamar		**Ongoing** AFMA is awaiting advice from Malu Lamar and will assist where possible. Email reminders sent 20/12/2017 and 08/03/2018. CSIRO advised that they have received some maps with information on traditional names but that this is not complete. They will work with Malu Lamar if further information is needed.
5.	AFMA to investigate the potential cause of the TVH sector misreporting of fishing hours.	TRLRAG21	AFMA	TRLRAG22	**Complete** The missing data was tracked to logbooks returns from two vessel operators. The licence holder was notified.
6.	Lamp fishing data should be used for future TIB CPUE analyses	TRLRAG21			**Complete** TIB sector CPUE analysis will be updated to include lamp fishing.
7.	Torres Strait Docket Book (TDB01) data rules to be presented at the next RAG meeting scheduled for March 2018	TRLRAG21	CSIRO AFMA	Deferred to TRLRAG22	**Complete** Data rules to be considered at TRLRAG 22.

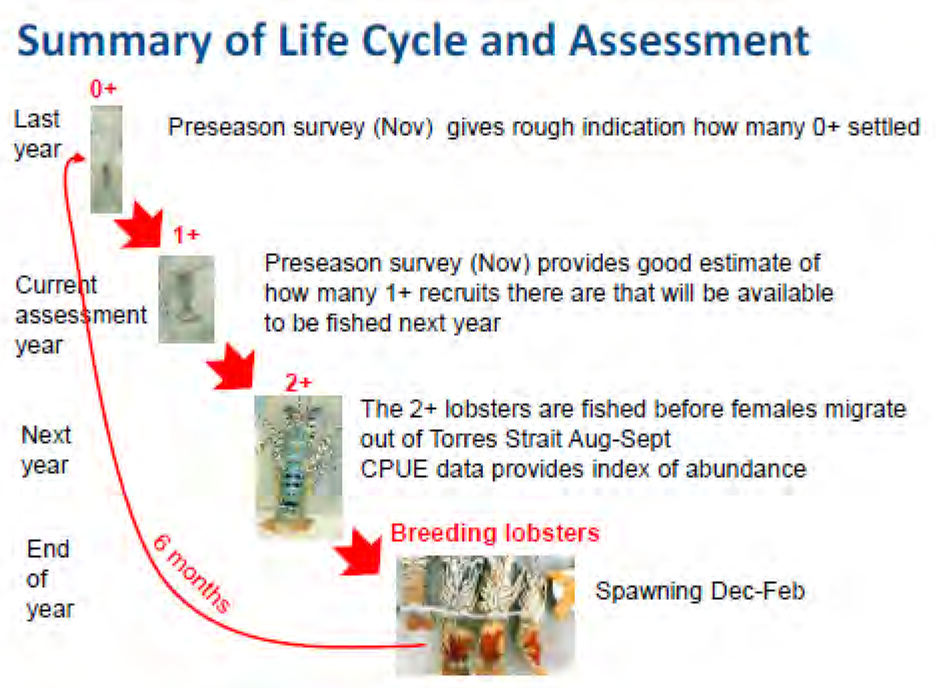
	The scientific observer recommended that RAG members and observers read the meeting paper prior to discussing this agenda item at the next meeting.				

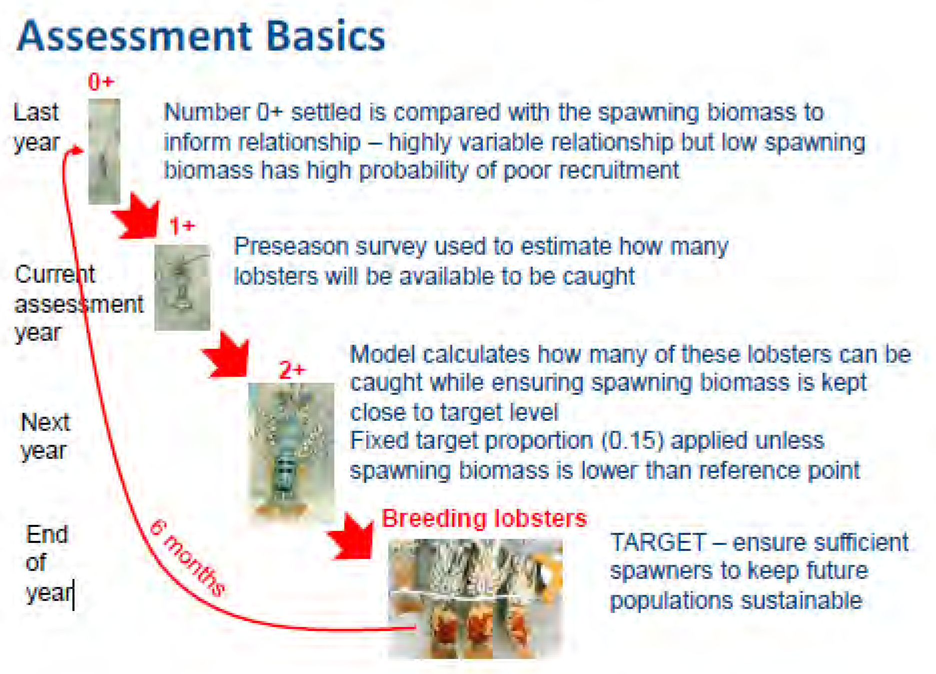
Panulirus ornatus Life Cycle



Source: : Éva Plagányi, Mark Tonks, Rob Campbell, Mick Haywood, Roy Deng (2018) Final 2017 Integrated Stock Assessment and RBC (2018) for the Torres Strait rock lobster fishery. Powerpoint presentation presented to the 22nd meeting of the Torres Strait Tropical Rock Lobster Resource Assessment Group held on 27-28 March 2018.

Summary of the Assessment Cycle for the Torres Strait Tropical Rock Lobster Fishery





Source: Éva Plagányi, Rob Campbell, Mark Tonks, Mick Haywood, Roy Deng, Nicole Murphy, Kinam Salee (2018) Torres Strait rock lobster (TRL) 2017 fishery surveys, CPUE and stock assessment: AFMA Project 2016/0822. March 2018 Draft Final Report.

Nominal CPUE for the Torres Strait Tropical Rock Lobster Fishery

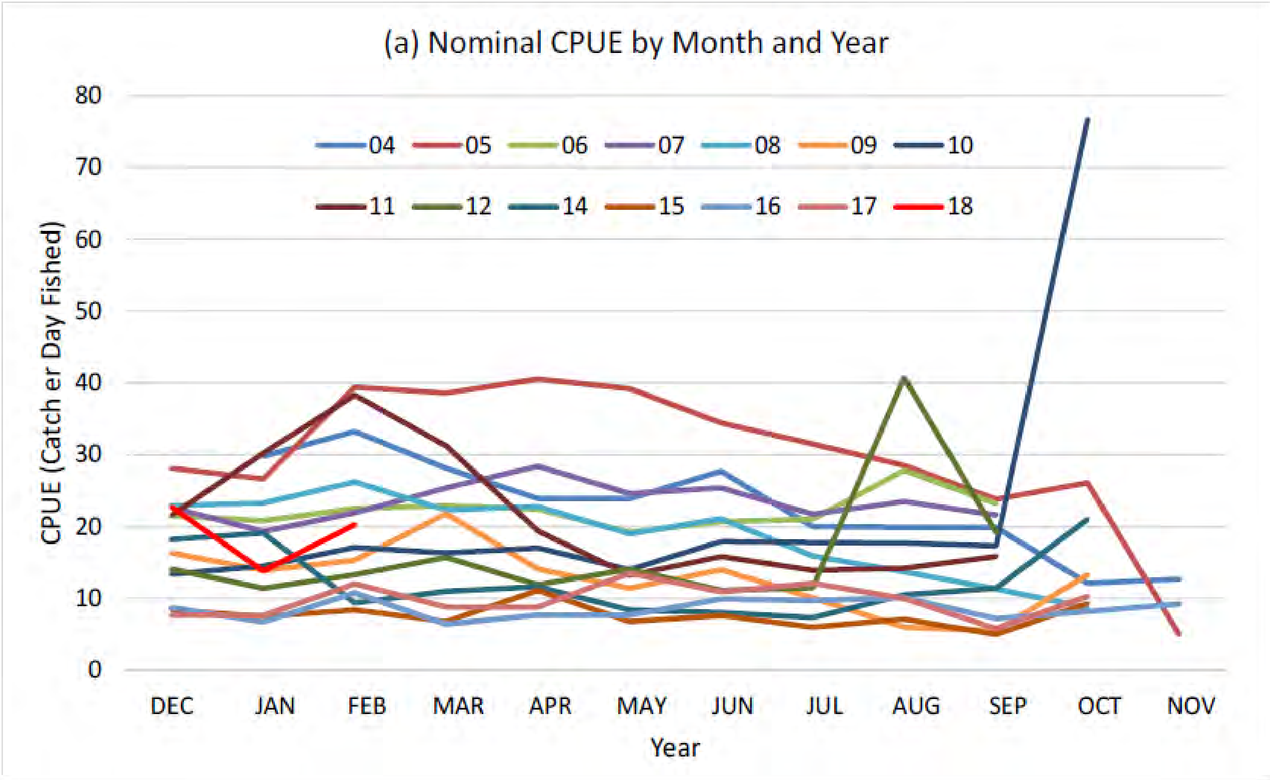


Figure1: Nominal CPUE for the Traditional Inhabitant Boat (TIB) sector per month and year.

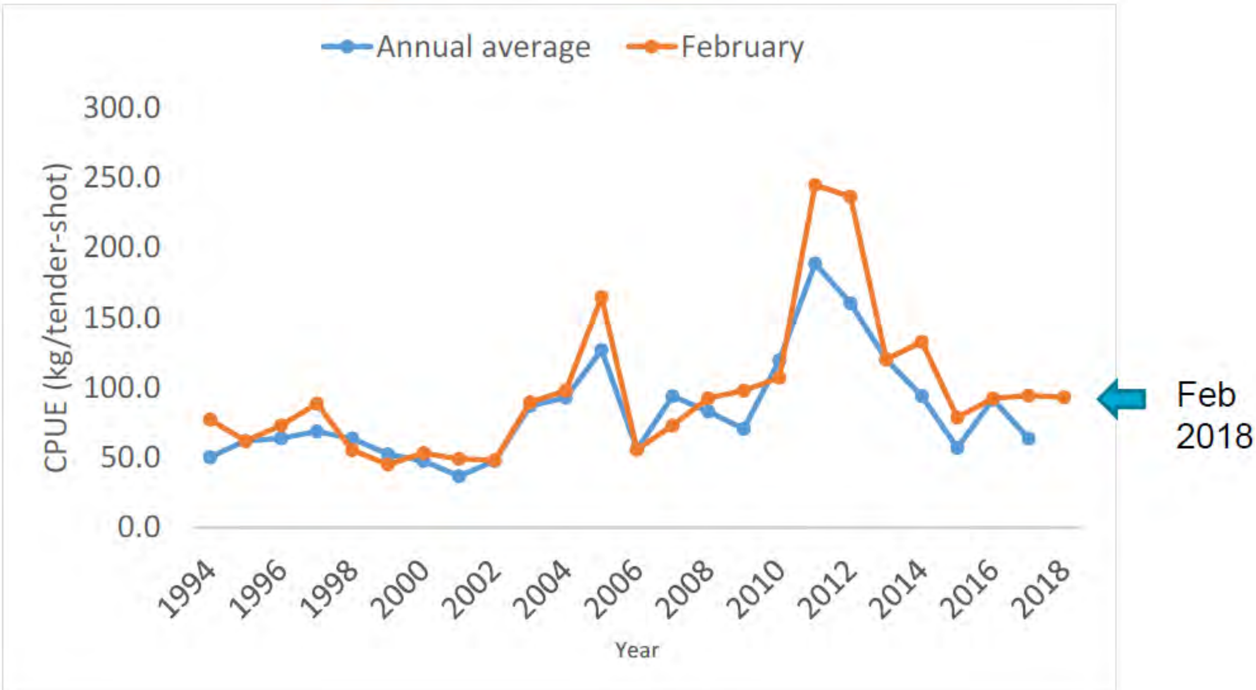


Figure 2: Nominal CPUE for the Transferable Vessel Holder (TVH) sector per year (annual average and February each year).

Source: : Éva Plagányi, Mark Tonks, Rob Campbell, Mick Haywood, Roy Deng (2018) Final 2017 Integrated Stock Assessment and RBC (2018) for the Torres Strait rock lobster fishery. Powerpoint presentation presented to the 22nd meeting of the Torres Strait Tropical Rock Lobster Resource Assessment Group held on 27-28 March 2018.

Data rules for using Tropical Rock Lobster catch data reported in the Torres Strait Buyers and Processors Docket Book (TDB01)

1. Where Seller-Type is identified as a processor then the corresponding catch record should be interpreted as a duplicate associated with a Processor-to-Processor trade and as such should not be included in the catch for the TIB sector. The DATA_TYPE associated with these records is therefore set to 'PROCESSOR'.
    a. An exception is made for the records associated with Joseph Dai where DATA_TYPE='TIB'.
2. Where Seller-Type is identified as processor but the Seller-Name is a business name then the corresponding catch record should be identified with the fishery sector (TIB or TVH). The DATA-TYPE is listed as 'TVH-TradeName' or 'TIBTradeName' respectively.
3. Where Vessel-Type is identified as a TVH-vessel then the corresponding catch record should be interpreted as a duplicate associated with the TVH sector and as such should not be included in the catch for the TIB sector. The DATA-TYPE is listed as TVH.
    a. Note, whether or not the corresponding catch is contained in the TVH database needs to be checked.
4. Where Vessel-Type identifies the distinguishing symbol as an 'F-symbol' then the corresponding catch record should be included in the catch for the TIB sector and the DATA-TYPE is listed as 'TIB'.
    a. An exception is made for the two vessels with the symbol FXYC or FWED which are TVH vessels and for these records the DATA-TYPE is listed as 'TVH'.
5. Where Related-Log is blank then the corresponding catch record should be identified as a catch for the TIB sector and the DATA-TYPE is listed as 'TIB'.
6. All other records should be attributed to the TIB sector and the DATA-TYPE listed as 'TIB'.
    a. After fitting the five rules above, only 1055 records (of the 77,358 in total) remained un-assigned. Note: all but 3 of the 1055 (22 of the 25 vessels-symbols) occur in the Docket-Book database where the DATA-TYPE has already been assigned to the TIB sector.

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Australian Fisheries Management Authority

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Meeting participants

Members

Name	Position	Declaration of interest
Dr Ian Knuckey	Chair	Chair/Director of Fishwell Consulting Pty Ltd and Olrac Australia (electronic logbooks). Chair/member of other RAGs and MACs. Conducts various AFMA and FRDC funded research projects including FRDC Indigenous Capacity Building project. Nil interests in TRL Fishery and no research projects in the Torres Strait. Full declaration of interests provided at **Attachment A**.
Natalie Couchman	AFMA Executive Officer	Nil
Selina Stoute	AFMA member	Nil
Allison Runck	TSRA member	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them
John Dexter	Queensland Department of Agriculture and Fisheries (QDAF) member	Nil
Dr Andrew Penney	Scientific member	Research consultant (Pisces Australis), member of other RAGs. Nil pecuniary or research interests in the Torres Strait
Dr Eva Plaganyi	Scientific member	Project staff for PZJA funded TRL research projects
Aaron Tom	Industry member	Nil. Traditional Inhabitant Gudumalulgal and TIB licence holder
Terrence Whap*	Industry member	Nil. Traditional Inhabitant Maluialgal and Traditional Owner. Does not hold a TIB licence

Name	Position	Declaration of interest
Les Pitt	Industry member	Nil. Traditional Inhabitant Kemer Meriam and TIB licence holder
Phillip Ketchell**	Industry member	Nil. Traditional Inhabitant Kaiwalagal and Traditional Owner
Daniel Takai	Industry member	Pearl Island Seafoods, Tanala Seafoods, TIB licence holder and lessee of TSRA TVH licence
Dr Ray Moore	Industry member	Industry representative, Torres Strait Master Fisherman licence holder and East Coast TRL Fishery licence holder
Brett Arlidge*	Industry member	General Manager MG Kailis Pty Ltd. MG Kailis Pty Ltd is a holder of TVH licences

Observers

Name	Position	Declaration of interest
Dr Robert Campbell	CSIRO scientific observer	Nil pecuniary interests. Project staff for PZJA funded TRL research projects
Jerry Stephen	TSRA Deputy Chair, TSRA Member for Ugar and TSRA Portfolio Member for Fisheries	TIB licence holder and Native Title holder
Trent Butcher*	Industry observer	TVH licence holder
Kenny Bedford*	Observer	Finfish RAG industry member and TIB licence holder
Suzannah Salam	Industry observer	TIB licence holder and lessee of TSRA TVH licence

Notes:

* Arrived at 8:30 am, partway through agenda item 1.2.

** Arrived at 9:15 am, partway through agenda item 2.1 and departed at 3:15 pm partway through agenda item 5.

1 Preliminaries

1.1 Apologies

1. Mr Jerry Stephen opened the meeting in prayer at 8:15 am on 15 May 2018.
2. The Chair welcomed attendees to the 23rd meeting of the Torres Strait Tropical Rock Lobster Resource Assessment Group (TRLRAG 23). The Chair acknowledged the Traditional Owners of the land on which the meeting was held and paid respect to Elders past and present.
3. Attendees at the RAG are detailed in the meeting participant tables at the start of this meeting record.
4. Apologies were received from Charlie Kaddy (TSRA Member) and Tom Roberts (QDAF member). Mark David (Industry Member), Ian Liviko (PNG National Fisheries Authority (NFA)) and Benjamin (Maluwap) Nona (Chair, Malu Lamar (Torres Strait Islander) Corporation RNTBC) were invited but did not confirm attendance.
5. The Chair noted that the RAG's role is to provide advice for the TRL Fishery based on the best available science. In this regard, the Chair thanked CSIRO, the independent scientific member, industry and other agencies for pulling together the required data and analyses to enable the meeting to be held at such short notice.

1.2 Adoption of agenda

6. The draft agenda was adopted without change (**Attachment B**).
7. The RAG noted that the draft record of the 22nd meeting of TRLRAG held from 27-28 March 2018 had been circulated to members for out-of-session comment on 14 May 2018. Comments on the draft record are due by 25 May 2018, after which time the record would be finalised.

1.3 Declaration of interests

8. The Chair stated that as outlined in PZJA Fisheries Management Paper No. 1 (FMP1), all members of the RAG must declare all real or potential conflicts of interest in Torres Strait TRL Fishery at the commencement of the meeting. Declarations of interests were provided by each meeting participant. These are detailed in the meeting participant tables at the start of this meeting record.

1.4 Action items from previous meetings

9. The RAG noted the report provided by the Executive Officer advising of the status of actions arising from previous TRLRAG meetings (**Attachment C**).
10. The RAG discussed the following action items further:
    a. Action item 3 - an industry member queried whether more information was available from PNG on the location and quantum of PNG TRL trawl catches. The AFMA member advised that at recent meetings with the PNG NFA, including the Fisheries Bilateral meeting held on 5 February 2018, the updated stock assessment results and key findings of the larval advection model were presented. PNG acknowledged that the larval advection modelling together with past research provides strong evidence that TRL is a shared stock between Australia and PNG. AFMA has requested more detailed catch and effort data from PNG, in particular from their trawl fleet as well as length frequency, sex and spatial data where available. PNG showed an interest in participating in future

stock surveys and AFMA will work with CSIRO and PNG to identify opportunities to do so.

b. Action item 4 – Mr Les Pitt advised that he has a compilation of traditional names for the areas around Erub and can provide this if it will assist. The CSIRO scientific member noted that they are using the traditional names provided for a number of purposes and are working through Malu Lamar to obtain names that have been broadly agreed. AFMA agreed to follow up with Mr Pitt and Malu Lamar on this matter.

Action 1
AFMA to liaise with Mr Pitt and Malu Lamar to provide agreed traditional names for the area around Erub.

2 Updates from members

2.1 Industry and scientific

11. The RAG noted updates provided by industry and scientific members and observers on the recent performance and key issues affecting the TRL Fishery:

    a. An industry member advised that there have been major impacts from the hookah closure implemented on 30 April 2018 for both fishers and buyers. The member further advised that one buyer has already shut down their operations in the Torres Strait and other buyers are feeling the pinch. MG Kailis has diversified sources of TRL supply, including the East Coast and PNG TRL fisheries and have been able to adapt but not without losses. Catches have dropped to 1-2 tonnes per week. The member advised that they estimate the lost earnings from the closure to be $11 million for all licence holders ($4 million for TIB licence holders). He emphasised that this is money that is not flowing back into Torres Strait communities.

    b. The member also stated that he has written two letters to AFMA detailing MG Kailis' and other operators' concerns as to the reliability of pre-season surveys to accurately estimate stock abundance. Based on catch and effort data for the season to date, the member estimated that stock abundance has been underestimated by 50% and there remain uncertainties around the actual abundance of residual 2+ lobsters. On this basis, the member advised that they believe the prohibition on the use of hookah gear to be unjustified. The member noted they have contributed detailed length frequency data to CSIRO to assist in the development of analyses and to support the RAG in providing advice.

    c. Another industry member advised that he stopped diving a while back in the Eastern region of the Fishery as the catch rate had dropped too low. The member fishes a large area out past Mer, towards Cumberland Passage and back towards Erub. The member is aware of ten or more divers operating in the Eastern region. He has heard reports that divers around Masig are experiencing good catches.

    d. Another industry member confirmed that the central islands are getting decent catches. Masig is catching better than this time last year and is doing better than Warraber and Poruma. More recently there have been some adverse weather conditions and community issues which has slowed effort. Fishers have reported areas of abundance which were not surveyed in the pre-season survey. Divers from Iama free dive and are fishing around Warrior Reef. Catches out of Badu and Mabuiag are good. The member suspects there are some catches that remain unreported. The component of his business that relies on the TRL Fishery is struggling at the moment and he is having to absorb staff and costs into other parts of his business but does not know how sustainable this is over the longer term.

e. Another industry member noted that catches around Thursday Island and the inner group of islands are very low. The only significant catches are around Mabuiag.
f. Another industry member advised that effort is low around Boigu. The lobsters are there but can't be fished due to dirty water. PNG is reportedly using set nets and catching good amounts. There are lots of lobsters to be found and moulted shells are washing up on the shore around Mari Village (adjacent to Deliverance Island). The member noted that some historical fishing grounds down the East Coast are no longer accessible by Torres Strait fishers. The RAG noted that this area is now managed by QDAF.

12. The Chair acknowledged members concerns with regards to the impacts the advice the RAG provides to the PZJA can have on the livelihoods of the industry and their communities. He pointed out that the RAG does not take this responsibility lightly and upmost care is taken to fully understand not just the biological but also the economic and social impacts of RAG advice when it is being provided.
13. An industry observer sought clarification on the survey regime for the TRL Fishery. The CSIRO scientific member advised that the last mid-season survey was conducted in 2014. The move to a single pre-season survey has been subject to close scrutiny by the RAG prior to the change being implemented. This included consideration of trade-offs and costs of such a change. It was noted that analysis considered by the RAG showed a good correlation between pre-season surveys and actual catches.
14. An industry member suggested that the design of the pre-season survey needs to be reviewed, particularly around the number and spatial structuring of survey sites and the timing of surveys. The member expressed concerns that some areas were not surveyed adequately this season, particularly to the North of Mabuiag, and this may have affected estimates of abundance. The CSIRO scientific member noted that there can be variations from year to year. The survey is timed to align with the average over the available time series. The RAG noted that the natural variability of the stock and limits on funding create challenges for the science.

2.2 Government

15. The RAG noted an update provided by the AFMA member regarding management initiatives relevant to the TRL Fishery:
    a. Catches in the TRL Fishery to date - as at 10 May 2018, the total reported catch for the TRL Fishery was 156 tonnes. There have been delays in receiving catch disposal records, and given this, this amount is likely to be under-reported.
    b. Management changes since TRLRAG22 - there have been two major management changes since the last meeting. Additional moon-tide hookah closures commenced on 13 April 2018 followed by a prohibition on the use of hookah for the remainder of the season commencing 30 April 2018. The intent of these management changes was to give effect to the TRL Working Group recommendations that catches should not exceed the RBC and to prolong the opportunity for TIB fishers to fish for the duration of the season. While the additional moon-tide hookah closures did slow fishing, projections following these meetings indicated the Australian share of the RBC would be reached by the end of May 2018. The decision to prohibit the use of hookah was taken to

slow fishing further. The impacts of these changes on the data is one reason for this meeting.

c. Finalisation of catch sharing arrangements with PNG – AFMA continues to pursue a meeting with PNG in order to finalise catch sharing arrangements for the 2017/18 fishing season, noting that Australia cannot make a unilateral decision about catch shares. Under the terms of the Torres Strait Treaty, the Australian share is 190.65 tonnes in Australian waters and 11.2 tonnes in PNG waters. Cross-endorsement arrangements to enable Australian boats to access the 11.2 tonnes in PNG waters have yet to be agreed with PNG, and AFMA is looking at alternatives under the Treaty to enable Australian boats to access Australia's full share. In a situation in which the TAC is so low, AFMA does not want to see catch go uncaught. Should Australia cross-endorse PNG boats to fish in Australian waters, they would be subject to the same management requirements as Australian boats, including licence conditions.

16. An industry member noted that PNG had caught approximately 30 tonnes to date, noting hookah fishing was not permitted until 30 April 2018. The member expects that PNG will catch their full share regardless of whether catch sharing arrangements have been agreed.

17. The RAG noted an update provided by the QDAF member regarding QDAF activities relevant to the management of the TRL Fishery:

    a. Catches in the East Coast TRL Fishery to date - as at 14 May 2018, the total reported catch for the TRL Fishery was 80 tonnes or 41% of the TAC for the Fishery (195 tonnes). Fishing slowed in March 2018 but is picking up again.

    b. East Coast TRL Working Group – the next meeting will take place in late July 2018 and will look at finalising the management objectives as well as have discussions on the biomass proxies for the Fishery to enable an adjustable TAC. The Department will also be putting out a reform discussion paper for public comment at the end of May 2018, which includes a review of management and licensing arrangements with a view to improve the efficiency and effectiveness of the arrangements and provide greater consistency with other jurisdictions.

18. An industry observer questioned the impacts of the change to the East Coast TRL Fishery season start date on the TRL stock. The Chair advised that this matter was considered at the last RAG meeting in March 2018, and there was no evidence to suggest that this change has had an impact on the Torres Strait TRL Fishery.

19. The RAG noted an update provided by the TSRA member regarding TSRA activities relevant to the management of the TRL Fishery:

    a. Fisheries Summit – the summit planned for May 2018 has been postponed. This will affect nominations for Traditional Inhabitant representatives on PZJA fora. The existing terms for members will be extended until new representatives can be appointed. TSRA will advise once new dates for the Summit are confirmed.

2.3 PNG NFA

20. An update from PNG NFA was not available as a representative was not in attendance.

2.4 Native Title

21. An update from Malu Lamar (Torres Strait Islander) Corporation RNTBC (Malu Lamar) was not available as a representative was not in attendance.

3 2017/18 TRL CPUE and length frequency trends

22. The RAG considered a presentation provided by Dr Robert Campbell, CSIRO scientific observer, detailing analyses of catch and effort data pertaining to the TRL Fishery for the 2017/18 season:
    a. The Chair explained that this is the third in-season CPUE analyses conducted for the TRL Fishery. It is not normal for such analyses to be conducted in-season, but that the unusual circumstances experienced in the 2017/18 season has meant processes have had to be adapted. This and other analyses to be provided at this meeting, will ensure the RAG has the best available science upon which to provide advice. The Chair thanked CSIRO for pulling together the required data and analyses at such short notice. The Chair also thanked MG Kailis for voluntarily providing the detailed length frequency data for the RAG's consideration.
    b. Data informing the analysis was received on 8 May 2018. In considering the analyses, the March and April 2018 data is not complete (~80% for March and ~60% for April). There are three sources data drawn on for the analysis:
        i. the TRL04 logbook - mandatory for TVH licence holders only;
        ii. TDB01 docket book - voluntary for all licence holders, no longer in use; and
        iii. TDB02 catch disposal record - mandatory for all licence holders, replaced the TDB01 docket book from 1 December 2018.
    c. With regards to the TVH sector's catch and effort data, AFMA are investigating some discrepancies between the TRL04 and TDB02 returns. With regards to the TIB sector's catch and effort data, the monthly catches for the 2013-2016 fishing seasons is an estimate as the catch month is not known for a substantive portion (33-55%) of the total catch in these seasons.~~average across months as the data source this was derived from was aggregated across each season~~. With regards to catch per unit effort (CPUE), the data presented was nominal, not standardised.
    d. A comparison of TIB sector's catch and effort data shows:
        i. Catch by month – December 2017 and January 2018 are ~~slightly~~ considerably higher than those in the previous year, while February and March 2018 are ~~lower~~similar. The trend seen in March 2018 may be attributable to incomplete data.
        ii. Catch by method – the hookah fishing method as a percent of total catch was highest in 2017 and has declined in 2018. There is a clear correlation between methods reported as hookah fishing and unknown, so the unknown is likely to be hookah fishing.
        iii. Catch by processed form – there is a clear correlation between hookah fishing and the catch composition skewing to whole (generally live) lobsters. The data also indicates there has been a move to whole lobsters over the years with the highest catch of whole lobsters as a per cent of overall catch occurring in 2017.
        iv. Catch by area fished – catches around Thursday Island as a percent of total catch were high (>50%) in 2017, but the data indicates this is not the case this season. Catches in the 2018 season are mainly coming from the Mabuiag, Badu, Thursday Island and Warrior Reef areas. There was some discussion on the accuracy of the area information being recorded on TDB01 docket book and TDB02 CDR forms, with some industry members suggesting that this recorded area often reflects where the lobsters are sold and not where the catch was caught.
        v. Catch by effort (days fished) – during 2018 there has been an increase in proportion of trips of >1 day in length in recent years, noting however that

Commented [CN1]: Change suggested by Robert Campbell – accepted.

Commented [CN2]: Change suggested by Robert Campbell – accepted.

'days fished' is a crude measure of effort. Total effort (days fished) during December-April this season is estimated to be around 30% higher than during the same period in the previous season.

vi. Nominal CPUE – CPUE by month was found to be similar to recent years. CPUE for hookah fishing is variable but there is no clear trend. CPUE for lamp fishing is the lowest since 2004. Overall the CPUE for 2018 is looking average, again noting 'days fished' is a crude unit of measure.

vii. CPUE by area – catch rates in 2018 are highest in Mabuiag, Northern and Mt Adolphus areas. Mean catch rates over all areas lowest since 2015.

e. A comparison of TVH sector's catch and effort data shows:

i. Catch by month – catches in February and March 2018 are slightly higher than those in the previous year.

ii. Catch by method and processed form – hookah fishing is the predominant method used and whole lobsters comprise the majority of catch.

iii. Catch and effort by area fished – in 2018, ~55% of effort and catch from the TVH sector was in the Northern area, followed by Mabuiag, Warrior and Warraber areas.

iv. Catch by effort ('hours fished') – there was a higher proportion of catch taken in periods of >6 hours in 2018, compared with previous years. Dr Campbell questioned how accurately 'hours fished' is reported. Industry members and observers noted that they take 'hours fished' to mean different things (e.g. hours the tender spends away from the boat, hours divers are in the water) and that AFMA needs to clarify how this needs to be reported. The RAG noted that there was a significant proportion of 'unknown' catch by 'hours fished' data for the TVH sector in 2017. The AFMA member advised that this has been looked into as noted at the previous RAG meeting.

v. CPUE – generally, while catches may have been high, effort was also high and the CPUE reflects this. Catch rates decrease after February and remain similar in March and April. In 2018, mean catch rate in March and April is 28.4% lower than in February (average decrease over past 6 years is 20.5%). Mean catch rates in 2018 of 12.6 kg/hour are lower than mean catch rates over past 6 years of 14.8 kg/hour, though slightly higher than 2017.

vi. 'Hours fished' per tender set - greater proportion of tender-sets with >5 hours of effort.

vii. Total effort - data for 2018 is incomplete but indicates an increase over 2017. Dr Campbell advised that looking at individual boat data (which could not be presented due to data confidentiality rules), it may be the case that one or two boats may have fished harder thus accounting for a greater proportion of catch and effort, in effect skewing the data across the whole sector.

23. Dr Campbell advised that following the RAG meeting he would recirculate his paper with corrections, as raised and discussed with members throughout the presentation.

Action 2
Dr Campbell's corrected paper to be circulated to the RAG following the meeting.

24. The RAG considered a presentation provided by Dr Eva Plaganyi, CSIRO scientific member, detailing further analyses of available data pertaining to the TRL Fishery for the 2017/18 season:
    a. The stock assessment is reliant on accurate information from all 4 indicators. The empirical harvest control rule detailed in the draft harvest strategy will also rely on these indicators with the following weighting: CPUE data for the TIB sector (10% weighting); CPUE data for the TVH sector (10% weighting); pre-season survey 0+ lobster index of abundance (10% weighting); and, pre-season survey 1+ lobster index of abundance (70% weighting).
    b. Available data for the Fishery to date (e.g. catch, effort, length composition) does not indicate a better than average season, although it could be argued that it is a low-average season rather than a low season. Combined Fishery catch over the period December to March 2018 is 87% of the average catch in the preceding period 2005-2017, and 37% of the maximum catch over this period.
    c. Although there is evidence of localised hotspots, CPUE estimates for 2017/18 fishing season are low to average relative to historical levels, noting the CPUE data presented were nominal and would likely be scaled down if standardised. There is some evidence that fishing effort (days/hours fished) may have increased.
    d. Length composition data indicates that catch is shifting as expected from larger males to a more even sex ratio. The data are also showing an increase in the proportion of recruiting 1+ lobsters being caught alongside a decrease in the proportion of residual 2+ lobsters.
    e. PNG TRL Fishery length composition data is different to that provided for the Australian TRL Fishery. The PNG data indicates there may be stronger recruitment in PNG waters, however further information is needed on the spatial distribution of catches to further inform analyses.
    f. MG Kailis data detailing the proportion (of total catch) of different size grades for catch received from both the Australian and PNG TRL Fishery does not show a marked deviation from average. Additional data were provided to members by Mr Brett Arlidge during discussion on this item. Noting that the data presented encompasses more than 50% of total catches for the Fishery, Mr Arlidge suggested that the data does not align with what would be expected under a low RBC.
25. An industry member queried whether there may have also been environmental factors that have affected the stock this season, for example high turbidity from South Fly River outflows impacting on migration. The AFMA member advised that studies on this matter can be tabled at the next TRL and Finfish RAG meetings for consideration.

Action 3
South Fly River studies to be provided for consideration at the next TRL and Finfish RAG meetings.

26. The RAG agreed that catch and effort data (and the indicators derived from these data e.g. CPUE) are fundamental to understanding the dynamics of the TRL stock and performance of the TRL Fishery and discussed improvements that could be made to its collection and analysis:
    a. The RAG noted that any analysis of data will only be as good as the data itself.
    b. Spatial structure - industry members advised that catches attributed to the Badu and Thursday Island areas are likely to be overstated, as fishers are reluctant to

disclose the areas in which they have fished and may instead nominate the area the lobsters are being landed - catches are more likely coming from the Mabuiag and Northern areas. Dr Campbell agreed that this is a credible conclusion given anecdotal reports do not appear to align spatially with the catch and effort data. With regards to the TVH sector, the TRL04 logbook limits the reporting of catch and effort to a single location. Given this, the location the primary boat is anchored is generally recorded, not the location where tenders are actually fishing (which can range as far as 20 nm from the primary boat).

c. Measure of effort – the RAG agreed that the 'days fished' measure used in the TDB02 catch disposal record is a crude measure of effort and may not include travel or searching time nor indicate what portion of the day was spent actively fishing. Industry members advised it is common practice for fishers to round-up to whole days. Further, the 'hours fished' measure used in the TRL04 logbook is being reported inconsistently across fishers (e.g. hours the tender spends away from the boat, hours divers are in the water).
d. CPUE – noting the CPUE data presented was nominal, the RAG agreed that there is a need to standardise the CPUE data. Standardisation of CPUE data involves making adjustments to the data to take into account factors other than stock abundance that may influence catch rates. An important one of these factors is changes in fishing behaviour and fishing power over time. These changes can otherwise confound results by overestimating CPUE and by inference stock abundance. This "effort creep" includes changes to the size of engines, use of GPS, gear, areas fished, time fished and experience of divers. Current CPUE data may also be confounded by a hyperstability effect, seen when fishers remain on fishing "hotspots" or move from one hotspot to another – thereby maintaining high catch rates that don't represent the population size of the entire stock. Industry members and observers acknowledged the best way to understand effort creep is to talk to the fishers themselves.
e. Voluntary fields - Given constraints under the *Torres Strait Fisheries Act 1984* (the Act), some data fields on the TDB02 catch disposal record are voluntary and as such often left uncompleted. This creates problems in providing a complete analysis of the data for the TIB sector and it is recommended that all fields be made mandatory. The AFMA member advised that amendments to the Act are being progressed to provide the capacity to require all licence holders to complete logbooks, but that this process is lengthy one and these amendments are a number of years off.
f. Length frequency – the RAG noted that length frequency data is currently provided by Kailis. The RAG agreed this data is of high value and has been particularly useful this season in informing analyses on the performance of the Fishery. However, there is a longer term need to collect representative length frequency data from across the Fishery.

27. The RAG agreed that if the catch and effort data for the TRL Fishery is not accurate, this undermines:
    a. general confidence in the science and the ability of the RAG to understand the dynamics of the stock and performance of the Fishery;
    b. the effectiveness of the standardisation of the CPUE data series used in the stock assessment as well as survey design both of which are informed by data on the spatial structure of catch and effort;
    c. the accuracy of the stock assessment itself as catch and effort data from both the TIB and TVH sectors is expressly considered in the assessment (10% weighting per sector).

Recommendation 1

For these reasons, the RAG recommended that the accuracy of catch and effort data for the TRL Fishery be improved as a matter of priority, with a particular focus on:

- improving the accuracy of the spatial information on catch and effort data (e.g. point of capture as opposed to point of anchoring or landing) and providing further guidance to fishers on how this data should be recorded;
- developing a finer scale measure of effort for the TDB02 catch disposal record (e.g. 'hours fished' as opposed to 'days fished') and providing further guidance to all fishers on how effort should be recorded in both the TDB02 catch disposal record and TRL04 logbook (e.g. to include time spent travelling, searching and actively fishing);
- developing a better understanding on changes in fishing behaviour and power over time (e.g. changes to the size of engines, use of GPS, gear, areas fished, time fished, experience of divers), to inform the standardisation of CPUE data. This should be done through close consultation with industry;
- in the longer term, consider the inclusion of travelling time, searching time and fishing time as separate effort fields in the logbooks.

4 2017/18 trends in 2+ lobster abundance

28. The RAG considered a presentation provided by Dr Eva Plaganyi, CSIRO scientific member, detailing the current stock assessment methods and analyses pertaining to residual 2+ lobsters in the TRL Fishery:
    a. RBCs - Reflecting the variable nature of the TRL stock, the RBCs for the Fishery between seasons have also varied. However, catches have generally corresponded with the RBCs as set. For the 2017/18 fishing season, taking into account considerable uncertainty across a range of different inputs, the assessment suggested an RBC of 299 tonnes with a 90% confidence interval of 196-401 tonnes.
    b. Draft harvest strategy - the target and limit reference points for the TRL Fishery, as detailed in the draft harvest strategy, have been deliberately set at conservative levels (and 0.65 B_0 and 0.40 B_0 respectively) to take account of the fact that the resource is shared and important for the traditional way of life and livelihood of traditional inhabitants. The target reference point is currently set at a level that gives higher average stock biomass consistently across years. Increasing catch levels above the RBC will result in the Fishery fluctuating around a lower average stock biomass level. Whilst this can be done under a harvest strategy, there will be trade-offs (e.g. higher risks, lower highs) and it did not align with previous recommendations of all RAG members to have a conservative harvest strategy.
    c. Implications of exceeding catch limits - The conservative settings in place for the TRL Fishery mean there is a fairly low risk that exceeding the RBC one season will significantly deplete the stock. However, scientific analyses of fisheries from around the world have demonstrated that when a~~n~~ scientifically determined catch limit is regularly exceeded, it results in a decline in the stock biomass and leads to overfished stocks that are no longer able to produce the same large yields as in the past. The CSIRO scientific member explained that this is one of the reasons that it can be beneficial to not deviate from the best available science (which could include advice that conditions are anomalous) and is also part of the motivation for the development of harvest strategies which include pre-agreed rules for decision making.

d. The stock assessment model - the model used in the TRL Fishery is an age-structured model (includes different selectivities for 1+ and 2+ lobsters) and is similarly conservative to that of the draft harvest strategy. The complexity of the model matches the management needs for the Fishery as well as the availability and reliability of data. There are other models that could be used in the Fishery (e.g. a spatially-disaggregated model or a length-based and age-disaggregated model), however these options are more data "hungry" and would cost more as a result. The existing model is considered to perform reasonably given management needs and budget constraints.
e. Uncertainties in the stock assessment – the TRL stock exhibits considerable natural inter-annual variability with regards to spawning, settlement and growth. Further, environmental influences (e.g. climate change) also affect these relationships. It is generally understood that when less data is available for a fishery, a more conservative approach needs to be taken. More data can help address some of these uncertainties and allow for a more precise (less conservative) RBC to be set. However, the more complex an assessment, the more costly it is to maintain.
f. TRL biology - catches over December to February are mostly made up of large male lobsters (referred to as residual 2+ lobsters). The incoming (recruiting) 1+ lobsters are usually only accessible to fishers from around March, when they have grown to legal size as 2+ lobsters. There is significant variability in the length composition data caused by the relative abundance of the two age groups (cohorts), inter-annual variations in size and ~~sampling design~~spatial distribution. It is therefore difficult to quantify the biomass of the residual 2+ lobsters each season.
g. Residual 2+ lobsters - because there is insufficient data to quantify the biomass of the residual 2+ lobsters each season, the stock assessment model assumes there to be an average size each year which is scaled up or down based on the inter-annual variability of the 1+ lobsters as determined through survey data. The assessment focuses on what can be quantified from the available data, that being the 1+ lobsters that grow to legal size to be fished that season.
h. Survey data – the pre-season survey samples recruiting 0+, 1+ and residual 2+ lobsters. Mid-season surveys sample 1+ and 2+ lobsters. Pre-season survey data for 2+ lobsters is highly variable due to the small sample size and so is unreliable as an index of abundance (e.g. 2+ lobster index coefficient of variation (CV) of 0.19-0.89 vs. 1+ lobster index CV of 0.12-0.19). In addition, the pre-season survey 2+ lobster index does not show a strong correlation with catch the following season. Further, the stock assessment model does not show a clear relationship between the relative number of 3+ lobsters in the pre-season survey and the catch taken the following year.
i. Observed variability - given small inter-annual variability in the December-March proportion of total catch (average 0.37, range 0.26-0.44) and December-February proportion of total catch (average 0.21, range 0.15-0.29), residual biomass could be estimated and used to adjust the RBC. However the quantum of these adjustments (up or down) would only be in the range of 30-60 tonnes per year. The lower the RBC, the smaller the adjustment. The model predicted December 2017-March 2018 proportion of total catch is higher than past observations since 2005 and may indicate a slight anomaly.
j. Data needs to support a RBC adjustment – any adjustment to the RBC based on observed variability would need to occur in-season. As neither the survey data nor stock assessment model provide a means to accurately estimate the biomass of residual 2+ lobsters, a mid-season survey and representative length

Commented [CN3]: Change suggested by Eva Plaganyi – accepted.

composition data would be needed. Given historical variability has not been that great, any adjustment from this process would only be small, and may not be justified by the additional monitoring, analysis and review costs.

29. The RAG considered a presentation provided by Dr Andrew Penney, independent scientific member, detailing analyses pertaining to residual 2+ lobsters in the TRL Fishery:
    a. Did the pre-season survey underestimate abundance? – if the November 2017 pre-season survey 1+ lobster index of abundance was underestimated, this could mean early season catches of 2+ lobsters were higher than predicted. However, data presented to the RAG to date does not indicate an alternative to the below average abundance of recruiting 1+ lobsters.
    b. Did industry fish harder at the start of the season? – if industry fished harder at the start of the season in response to the lower RBC, this could result in higher than expected early season catches. Data presented to the RAG to date indicates that CPUE for the start of the 2017/18 season was average or slightly higher compared to the previous season. However, data for the current season is incomplete and further work is needed to better understand those factors affecting CPUE before it can be reliably interpreted.
    c. Is there a greater abundance of residual 2+ lobsters than expected? – if there was a higher than expected abundance of residual 2+ lobsters at the start of the season, this could explain the good catches experienced despite a low abundance of recruiting 1+ lobsters. Length composition data (from January 2008, 2015, 2016, 2018) indicates residual 2+ lobsters make up a significant proportion of early season catches across these years. Compared to the average contribution of residual 2+ lobsters to early season catches across years, the catches from January 2018 appear to be above average. However, the variation from this average varies between years but is small in scale (3-4%, or if scaled to weight <1 tonne).
    d. Relationship between 1+ and 2+ lobster catches – the data showed a clear correlation that when there is a high abundance of recruiting 1+ lobsters then there is an increased contribution of 1+ and corresponding reduced contribution of 2+ lobsters in early season catches. This suggests fishers catch what is there, not how much is there (e.g. spatial vs. volume). Again further work is needed to better understand those factors affecting CPUE before this relationship can be reliably interpreted.
    e. Relative contribution – estimation of the relative contribution of residual 2+ lobsters to January catches could provide the basis for an index of abundance against which a RBC adjustment could be considered. Given the scale of variation, any adjustment would only be small (e.g. approximately 10 tonnes).
    f. Data needs to support a RBC adjustment – as with CSIRO's analysis, any adjustment to the RBC based on relative contribution would need to occur in-season. Representative length composition data would be needed. Any adjustment from this process would only be small, and given this may not be justified by the additional monitoring, analysis and review costs.
    g. Alternative strategy – a better strategy to respond to inter-annual variability is to implement a harvest control rule which smooths variation to the RBC across years, resulting in less highs but also less lows.

30. In summary, the RAG noted:
    a. The scale of any adjustment would be small (e.g. 30-60 tonnes or 10 tonnes depending on the methods presented). The lower the RBC, the smaller the

adjustment. Adjustments would need to apply equally (i.e. increasing and decreasing the RBC).

b. Additional real-time data would be needed to support any adjustment (e.g. mid-season survey, representative length composition data).

c. Given the data needed to inform any adjustment, the adjustment itself would need to happen in-season.

d. The additional monitoring, analysis and review costs may not be justified given the considerations detailed above.

5 Evaluation of additional survey options to support future stock assessments

31. The RAG noted a summary provided by the Chair regarding developments in the TRL Fishery in the 2017/18 season to date:
    a. At meetings in December 2017 and March 2018, the RAG considered the results of the November 2017 pre-season survey and stock assessment. Driven primarily by a low index of abundance for recruiting 1+ lobsters obtained from the survey, the stock assessment suggested an RBC of 299 tonnes.
    b. Some industry members have expressed concerns that the catches experienced in-season to date do not align with what would be expected from a low RBC. For this reason they believe the assessment may be misaligned with actual abundance this season.
    c. However, available data and analyses does not indicate a better than average season, although it could be argued that it is a low-average season rather than a low season. Nor does the data or analyses support an alternative to the survey prediction of a below average abundance of recruiting 1+ lobsters when averaged across the whole Fishery. Early season catches have comprised largely of residual 2+ lobsters. The data has not shown an input of recruiting1+ lobsters into the Fishery that is higher than expected.
    d. The spatial distribution of catches is notably different from previous seasons, and are concentrated in the North West of the Fishery.
    e. Changes to the management arrangements and fishing effort this season has impacted on the reliability of CPUE data, used as an indicator of abundance for the Fishery. The CPUE can be standardised to take account of these changes however some uncertainties will remain. In addition, should the Fishery be closed early this season, the CPUE data would be incomplete and less usable in the stock assessment. The assessment will still function, but there will be greater uncertainty around the results.
    f. The low RBC and changes to management arrangements are having social and economic impacts on communities across the region.
32. Noting these developments, the RAG was asked to provide advice on survey options to support future stock assessments and management of the TRL Fishery. The RAG discussed three survey options as presented by Dr Eva Plaganyi, CSIRO scientific member:
    a. Mid-season survey – this option would cost $174,000 (CSIRO contribution $69,000, external contribution $104,000). Given the indications from available data for the Fishery to date, it would be unlikely that the survey results would result in a change to the current RBC. However, the survey would provide a better understanding of current stock status to validate previous surveys and inform on the standardisation of CPUE for future stock assessments. It would also provide

forewarning of low indexes of abundance for recruiting age classes and as such potential for another low RBC for the 2018/19 season. Should the Fishery close early this season, the survey would also provide information on the stock that would otherwise be unavailable. The bias caused by sampling sites that may not have been fished for a number of months should the Fishery close early would also need to be accounted for in any analyses.

b. Extension to pre-season survey – this option would cost $55,000 (CSIRO contribution $22,000, external contribution $33,000). This would involve adding approximately 5 days to the November 2018 pre-season survey. Sites would be chosen to provide increased precision in predictions, particularly for a couple of key areas where there may have been changes in stock distribution. Given the timing, this survey would not provide a basis to change the current RBC. Nor would it provide information on current stock status to validate previous surveys or provide information on the stock that would otherwise be unavailable should the Fishery close early. However it would improve the precision (less uncertainty) of the pre-season survey indexes of abundance for the 2018/19 season.

c. Benchmark survey – this option would cost $486,000 (CSIRO contribution $194,000, external contribution $291,000). This would build on previous benchmark surveys conducted in 1989 and 2002. Timing would be similar to the current November pre-season survey. Given the timing, this survey has similar limitations as the extension to the pre-season survey. However it would improve the precision of the pre-season survey indexes of abundance for the 2018/19 season and future seasons. It would also provide additional data to inform on habitat changes across the Fishery that may need to be taken into account in the stock assessment.

33. The TSRA member suggested, that if the timing of the mid-season survey does not provide for a review of the RBC, then an extension of the pre-season survey may be the better option. The TSRA advised that they are unable to commit funding for additional survey work this season due to competing projects.

34. The RAG discussed the selection of survey sites noting concerns expressed by industry members earlier in the meeting that some areas were not adequately surveyed in the November 2017 pre-season survey, particularly to the North of Mabuiag. The CSIRO scientific member advised that sites are randomly stratified and in the case of a mid-season survey, would be selected to expressly provide for comparison with previous mid-season surveys. It is possible to include additional sites to cover off on areas which may not have been covered in the November 2017 pre-season survey. CSIRO agreed to work with industry to ensure areas fished in the current season are adequately represented in any survey conducted.

35. The CSIRO scientific member advised that there are a number of constraints around when a mid-season survey can be conducted. These constraints include scientific permit requirements and processes, funding availability, contract negotiations with funding and charter providers, and availability and mobilisation of resources to actually do the survey. Given these constraints, a mid-season survey is most likely to occur in July 2018, with results available around August 2018. This timing is within the window of when previous mid-season surveys have been conducted. The RAG agreed that industry and PZJA agencies should contribute to and facilitate the mid-season survey wherever possible.

36. The AFMA member advised that industry could contribute to a mid-season survey and the broader science underpinning the management of the Fishery in a number of ways. This could be through a commitment of funding, an in-kind contribution of vessels to support the conduct of surveys or the voluntary provision of additional data on catch and effort to support analyses on the dynamics of the stock and performance of the Fishery. One industry member noted that an industry contribution is justified and they would be

willing to work with AFMA and CSIRO on possible options to provide an in-kind vessel for future surveys.

37. The RAG agreed that a broader discussion is needed at the next meeting on available data as well as data and analyses needs, and how this may be facilitated by industry.

Recommendation 2

The RAG recommended that a mid-season survey be conducted as soon as practically possible, to be facilitated by industry and PZJA agencies, for the purposes of:

- providing further data on the abundance and spatial distribution of all age classes in the current season to input to the 2018/19 stock assessment, noting that CPUE data for the current season is now biased by management changes and may be unusable should the Fishery close early this season;
- providing further data to validate the 0+ and 1+ indexes of abundance from the November 2017 pre-season survey, noting the 0+ index may not have been reliably estimated from the November 2017 pre-season survey and the model was unable to satisfactorily fit this index;
- providing an 2+ index of abundance to more accurately inform on stock status and for comparison with CPUE data;
- provide a preliminary prediction of the expected 1+ lobster recruitment for the 2018/19 season (0+ lobsters in November 2017 pre-season survey) to provide forewarning on the likelihood of another low RBC for the 2018/19 season.

The survey will consist of 77 pre-determined sites expressly selected to provide for comparison with previous mid-season surveys.

The RAG further recommended that CSIRO work with industry to ensure areas fished in the current season are adequately represented in the sites sampled in the mid-season and future pre-season surveys.

38. The RAG discussed at what point the mid-season survey may trigger a review of the RBC for the TRL Fishery. The AFMA member advised that there would need to be a significant variation between the results of the November 2017 pre-season survey and the 2018 mid-season survey to trigger a review. Such an “anomalous” result is considered unlikely at this point given indications from available data for the Fishery to date. The CSIRO scientific member supported this view and suggested an anomalous result be defined as a 2018 mid-season survey 2+ survey index that falls outside the 95% confidence interval associated with the model forward prediction based on the November 2017 pre-season survey 1+ index. This is given uncertainties in available data and the fact that a mid-season survey has not been conducted since 2014. The RAG noted that a 95% confidence interval sets a high bar, but agreed that this would be appropriate.

39. The CSIRO scientific member noted that should a review of the RBC be triggered, a revised RBC would be calculated based on an updated stock assessment fitted to the mid-season survey data. The November 2017 pre-season survey results will remain an input into the stock assessment but may be weighted differently depending on the reliability of the 2 surveys.

Recommendation 4

The RAG recommended a review of the RBC be undertaken if the results of the 2018 mid-season survey 2+ survey index falls outside the 95% confidence interval associated with the model forward prediction based on the November 2017 pre-season survey 1+ index, in relation to directly comparable sites (e.g. sites sampled in both surveys only).

6 Other business

40. The TSRA member sought an update on progress to finalise the harvest strategy for the TRL Fishery. The AFMA member advised that the draft harvest strategy has been referred back to the TRL Working Group for further consideration at their next meeting.
41. An industry member sought clarification on the area of waters to which the RBC applies. The RAG noted that the RBC encompasses the Torres Strait Protected Zone (TSPZ) as well as the outside but near areas and PNG waters. The TRL stock moves from the TSPZ through PNG waters as part of its spawning migration.

7 Date and venue for next meeting

42. The RAG noted that the next meeting is tentatively scheduled for August 2018 for the purpose of discussing the results of the mid-season survey.
43. The meeting was closed in prayer at 3:45 pm on 15 May 2018.

Declaration of interests
Dr Ian Knuckey – April 2018

Positions:

- Director – Fishwell Consulting Pty Ltd
- Director – Olrac Australia (Electronic logbooks)
- Chair / Director – Australian Seafood Co-products (seafood waste utilisation)
- Chair / Director – ASCo Fertilisers (seafood waste utilization)
- Chair – Northern Prawn Fishery Resource Assessment Group
- Chair – Tropical Rock Lobster Resource Assessment Group
- Chair – Victorian Rock Lobster and Giant Crab Assessment Group
- Scientific Member – Northern Prawn Management Advisory Committee
- Scientific Member – SESSF Shark Resource Assessment Group
- Scientific Member – Great Australian Bight Resource Assessment Group
- Invited scientific participant – SEMAC, SERAG

Current / Recent Projects and funding:

- Principal Investigator – FRDC Project 2017-069 Indigenous Capacity Building
- Principal Investigator – VFA Project 17-646976 – Ocean Scallop Biomass Survey – 2018
- Principal Investigator – FRDC Project 2017/122 - Review of fishery resource access and allocation arrangements across Australian jurisdictions
- Principal Investigator – FRDC Project 2016/116 - 5-year RD&E Plan for Northern Territory fisheries and aquaculture
- Principal Investigator – AFMA Project 2017/0803 - Analysis of Shark Fishery Electronic Monitoring data
- Principal Investigator – AFMA Project 2017/0807 - Resource Survey of the Great Australian Bight Trawl Sector – 2018
- Principal Investigator – AFMA Project 2016/0809 – Improved targeting of arrow squid
- Principal Investigator – AFMA Project 2018/08xx – Bass Strait and Central Zone Scallop Fishery – 2018 and 2019 Survey
- Principal Investigator – DPIPWE Project – Review of abalone dive rates
- Principal Investigator – FRDC Project 2015/204 – Realising economic returns of reducing waste through utilization of bycatch in the GAB Trawl Sector of the SESSF
- Principal Investigator – FRDC Project 2014/203 – Review of Monitoring and Assessment in the SESSF
- Principal Investigator – AFMA Project 2014/0809 – Fishery Independent Survey of shelf resources in the Great Australian Bight Trawl Fishery 2017
- Principal Investigator – Survey for Black teatfish in the Queensland Sea Cucumber Fishery.
- Principal Investigator – CRC Project 2013/748.40 – Improved understanding of economics in fisheries harvest strategies.
- Principal Investigator – FRDC Project 2014/207 – The social drivers and implications of conducting an ecological risk assessment of both recreational and commercial fishing - a case study from Port Phillip Bay
- Co-Investigator – Optimising processes and policy to minimise business and operational impacts of seismic surveys on the fishing industry and oil and gas industry.
- Co-Investigator – FRDC Project 2017/014 – SA Marine Scalefish Review
- Co-investigator – AFMA Project - SESSF 2018 Fishery Independent Survey

- Co-investigator – Bird mitigation in the SESSF trawl sector
- Researcher – Various fishing industry liaison projects for oil and gas industry
- Scientific Advisor – Atlantis, GABIA, Gulf St Vincent Prawn Fishery, Seafish JV, SETFIA, SSIA
- MSC Auditor – Falklands Is 2016 Surveillance Audit (Acoura), Macquarie Is Toothfish (SCS)
- Facilitator – WWF shark traceability workshop
- Facilitator – SPC Tuna Data Collection Committee
- Facilitator – Indonesian fishery training and development

Current / Recent Clients (>$5000):

- ABARES
- Acoura
- Atlantis Fisheries Consulting Group
- Australian Fisheries Management Authority (AFMA)
- CRC – Seafoods
- Department of Agriculture and Water Resources
- Department of Primary Industry - Victoria
- Dept. Primary Industry, Parks Water and Environment (DPIPWE) Tasmania
- Fisheries Research and Development Corporation (FRDC)
- Great Australian Bight Fishing Industry Association (GABIA)
- Gulf of St Vincent Prawn Boat Owners Association
- Monash University
- NT Fisheries
- Richey Fishing
- South Australian Rock Lobster Advisory Council (SARLAC)
- SARDI Aquatic Sciences
- SCS Global Services
- Seafood Industry Victoria
- Seafish JV
- SeaFresh
- Secretariat of the Pacific Community
- South East Trawl Fishing Industry Association (SETFIA)
- Southern Shark Industry Alliance (SSIA)
- Tasmanian Seafoods
- Victorian Fisheries Authority
- Western and Central Pacific Fisheries Commission
- World Wildlife Fund – Australia (WWF)

23rd MEETING OF THE PZJA TORRES STRAIT TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG 23)

Tuesday 15 May 2018 - 8:00 AM - 4:00 PM

Cairns - Northern Fisheries Centre, 38-40 Tingira Street, Portsmith

DRAFT AGENDA

1. Preliminaries
   1.1. Welcome and apologies
   1.2. Adoption of agenda
   1.3. Declaration of interests
   1.4. Action items from previous meetings

2. Updates from members
   2.1. Industry and scientific members
   2.2. Government agencies
   2.3. PNG National Fisheries Authority
   2.4. Native Title

3. 2017/18 TRL CPUE and length frequency trends

4. 2017/18 trends in 2+ lobster abundance

5. Evaluation of additional survey options to support future stock assessments

6. Other business

7. Date and venue for next meeting

Action items from previous TRLRAG meetings

#	Action Item	Agenda	Agency	Due Date	Status
1.	AFMA to review the effectiveness of certain TIB licensing arrangements (in its 2016 licencing review) including: • TIB licenses should share a common expiry date • licences to last for longer than the current 12 month period.	TRLRAG14	AFMA	2017	**Ongoing** AFMA has begun undertaking a review of licensing of Torres Strait Fisheries, this issue will be considered as part of this review. At present however, AFMA resources are focused on progressing the proposed legislative amendments as a matter of priority.
2.	AFMA and CSIRO prepare a timeline of key events that have occurred in the Torres Strait Tropical Rock Lobster Fishery (e.g. licence buy backs, weather events and regulation changes) and provide a paper to TRLRAG.	TRLRAG14	AFMA CSIRO	TRLRAG17	**Ongoing** AFMA to complete further work. This has been difficult to action ahead of other priorities for the TRL Fishery.
3.	AFMA to prepare a summary of evidence that PNG trawl-caught TRL are a shared stock between Australia and PNG, including details such as the TRL biological characteristics, larvae dispersal, tag recapture data and catch and effort information. AFMA will circulate the paper to the RAG	TRLRAG19	AFMA		**Ongoing** AFMA sent a letter to PNG NFA outlining concerns of trawlers retaining TRL on 8 March 2017. The key findings of the CSIRO larval advection model was presented at the Fisheries Bilateral meeting held in Port Moresby on 5 February 2018. The bilateral meeting noted that the findings show the Australian and PNG TRL fisheries are based on a single stock. AFMA and CSIRO (Dr Plaganyi) met with PNG NFA officials, including the NFA Managing Director, John Kasu on 7 February 2018 at the NFA offices in Port

	out-of-session for comment before sending to PNG NFA.				Moresby. Dr Plaganyi presented the updated stock assessment results and larval advection modelling. There was agreement that the updated larval modelling together with past research provides strong evidence that TRL is a shared stock between Australia and PNG. These meetings have been followed up with teleconference between the PNG NFA Managing Director and AFMA CEO which included discussions on the importance of controlling catches so they do not exceed each jurisdiction's catch share of the recommended biological catch (RBC).
4.	Malu Lamar RNTBC to provide AFMA with the map of traditional boundaries and regional area and reef names for each of the Torres Strait Island nations and for CSIRO to examine possible revised naming conventions for survey sites	TRLRAG20	Malu Lamar		**Ongoing** AFMA is awaiting advice from Malu Lamar and will assist where possible. CSIRO advised that they have received some maps with information on traditional names but that this is not complete. They will work with Malu Lamar if further information is needed.

Relevant action items from previous TRLWG meetings*

#	Action Item	Agenda	Agency	Due Date	Status
1.	TRLRAG to provide advice on any findings relating to the impacts of changing the season start date to provide industry with a longer TAC notice period.	TRLWG #5 held on 5-6 April 2016	AFMA to draft RAG paper	TRLRAG22	**Ongoing** AFMA are working with CSIRO to progress this action, noting competing priorities relating to the TRL Fishery have caused delays.

*TRLWG actions not relevant to TRLRAG have not been included in the above.

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Meeting participants

Members

Name	Position	Declaration of interest
Dr Ian Knuckey	Chair	Chair/Director of Fishwell Consulting Pty Ltd and Olrac Australia (electronic logbooks). Chair/member of other RAGs and MACs. Conducts various AFMA and FRDC funded research projects including FRDC Indigenous Capacity Building project. Nil interests in TRL Fishery and no research projects in the Torres Strait. Full declaration of interests provided at **Attachment A**.
Natalie Couchman	AFMA Executive Officer	Nil
Selina Stoute	AFMA member	Nil
Allison Runck	TSRA member	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them
John Dexter	Queensland Department of Agriculture and Fisheries (QDAF) member	Nil
Dr Andrew Penney	Scientific member	Research consultant (Pisces Australis), member of other RAGs. Nil pecuniary or research interests in the Torres Strait
Dr Eva Plaganyi	Scientific member	Project staff for PZJA funded TRL research projects
Aaron Tom	Industry member	Nil. Traditional Inhabitant Gudumalulgal and TIB licence holder
Terrence Whap*	Industry member	Nil. Traditional Inhabitant Maluialgal and Traditional Owner. Does not hold a TIB licence

Name	Position	Declaration of interest
Les Pitt	Industry member	Nil. Traditional Inhabitant Kemer Meriam and TIB licence holder
Phillip Ketchell**	Industry member	Nil. Traditional Inhabitant Kaiwalagal and Traditional Owner
Daniel Takai	Industry member	Pearl Island Seafoods, Tanala Seafoods, TIB licence holder and lessee of TSRA TVH licence
Dr Ray Moore	Industry member	Industry representative, Torres Strait Master Fisherman licence holder and East Coast TRL Fishery licence holder
Brett Arlidge*	Industry member	General Manager MG Kailis Pty Ltd. MG Kailis Pty Ltd is a holder of TVH licences

Observers

Name	Position	Declaration of interest
Dr Robert Campbell	CSIRO scientific observer	Nil pecuniary interests. Project staff for PZJA funded TRL research projects
Jerry Stephen	TSRA Deputy Chair, TSRA Member for Ugar and TSRA Portfolio Member for Fisheries	TIB licence holder and Native Title holder
Trent Butcher*	Industry observer	TVH licence holder
Kenny Bedford*	Observer	Finfish RAG industry member and TIB licence holder
Suzannah Salam	Industry observer	TIB licence holder and lessee of TSRA TVH licence

Notes:

* Arrived at 8:30 am, partway through agenda item 1.2.

** Arrived at 9:15 am, partway through agenda item 2.1 and departed at 3:15 pm partway through agenda item 5.

1 Preliminaries

1.1 Apologies

1. Mr Jerry Stephen opened the meeting in prayer at 8:15 am on 15 May 2018.
2. The Chair welcomed attendees to the 23rd meeting of the Torres Strait Tropical Rock Lobster Resource Assessment Group (TRLRAG 23). The Chair acknowledged the Traditional Owners of the land on which the meeting was held and paid respect to Elders past and present.
3. Attendees at the RAG are detailed in the meeting participant tables at the start of this meeting record.
4. Apologies were received from Charlie Kaddy (TSRA Member) and Tom Roberts (QDAF member). Mark David (Industry Member), Ian Liviko (PNG National Fisheries Authority (NFA)) and Benjamin (Maluwap) Nona (Chair, Malu Lamar (Torres Strait Islander) Corporation RNTBC) were invited but did not confirm attendance.
5. The Chair noted that the RAG's role is to provide advice for the TRL Fishery based on the best available science. In this regard, the Chair thanked CSIRO, the independent scientific member, industry and other agencies for pulling together the required data and analyses to enable the meeting to be held at such short notice.

1.2 Adoption of agenda

6. The draft agenda was adopted without change (**Attachment B**).
7. The RAG noted that the draft record of the 22nd meeting of TRLRAG held from 27-28 March 2018 had been circulated to members for out-of-session comment on 14 May 2018. Comments on the draft record are due by 25 May 2018, after which time the record would be finalised.

1.3 Declaration of interests

8. The Chair stated that as outlined in PZJA Fisheries Management Paper No. 1 (FMP1), all members of the RAG must declare all real or potential conflicts of interest in Torres Strait TRL Fishery at the commencement of the meeting. Declarations of interests were provided by each meeting participant. These are detailed in the meeting participant tables at the start of this meeting record.

1.4 Action items from previous meetings

9. The RAG noted the report provided by the Executive Officer advising of the status of actions arising from previous TRLRAG meetings (**Attachment C**).
10. The RAG discussed the following action items further:
    a. Action item 3 - an industry member queried whether more information was available from PNG on the location and quantum of PNG TRL trawl catches. The AFMA member advised that at recent meetings with the PNG NFA, including the Fisheries Bilateral meeting held on 5 February 2018, the updated stock assessment results and key findings of the larval advection model were presented. PNG acknowledged that the larval advection modelling together with past research provides strong evidence that TRL is a shared stock between Australia and PNG. AFMA has requested more detailed catch and effort data from PNG, in particular from their trawl fleet as well as length frequency, sex and spatial data where available. PNG showed an interest in participating in future

stock surveys and AFMA will work with CSIRO and PNG to identify opportunities to do so.

b. Action item 4 – Mr Les Pitt advised that he has a compilation of traditional names for the areas around Erub and can provide this if it will assist. The CSIRO scientific member noted that they are using the traditional names provided for a number of purposes and are working through Malu Lamar to obtain names that have been broadly agreed. AFMA agreed to follow up with Mr Pitt and Malu Lamar on this matter.

Action 1
AFMA to liaise with Mr Pitt and Malu Lamar to provide agreed traditional names for the area around Erub.

2 Updates from members

2.1 Industry and scientific

11. The RAG noted updates provided by industry and scientific members and observers on the recent performance and key issues affecting the TRL Fishery:

    a. An industry member advised that there have been major impacts from the hookah closure implemented on 30 April 2018 for both fishers and buyers. The member further advised that one buyer has already shut down their operations in the Torres Strait and other buyers are feeling the pinch. MG Kailis has diversified sources of TRL supply, including the East Coast and PNG TRL fisheries and have been able to adapt but not without losses. Catches have dropped to 1-2 tonnes per week. The member advised that they estimate the lost earnings from the closure to be $11 million for all licence holders ($4 million for TIB licence holders). He emphasised that this is money that is not flowing back into Torres Strait communities.

    b. The member also stated that he has written two letters to AFMA detailing MG Kailis' and other operators' concerns as to the reliability of pre-season surveys to accurately estimate stock abundance. Based on catch and effort data for the season to date, the member estimated that stock abundance has been underestimated by 50% and there remain uncertainties around the actual abundance of residual 2+ lobsters. On this basis, the member advised that they believe the prohibition on the use of hookah gear to be unjustified. The member noted they have contributed detailed length frequency data to CSIRO to assist in the development of analyses and to support the RAG in providing advice.

    c. Another industry member advised that he stopped diving a while back in the Eastern region of the Fishery as the catch rate had dropped too low. The member fishes a large area out past Mer, towards Cumberland Passage and back towards Erub. The member is aware of ten or more divers operating in the Eastern region. He has heard reports that divers around Masig are experiencing good catches.

    d. Another industry member confirmed that the central islands are getting decent catches. Masig is catching better than this time last year and is doing better than Warraber and Poruma. More recently there have been some adverse weather conditions and community issues which has slowed effort. Fishers have reported areas of abundance which were not surveyed in the pre-season survey. Divers from Iama free dive and are fishing around Warrior Reef. Catches out of Badu and Mabuiag are good. The member suspects there are some catches that remain unreported. The component of his business that relies on the TRL Fishery is struggling at the moment and he is having to absorb staff and costs into other parts of his business but does not know how sustainable this is over the longer term.

e. Another industry member noted that catches around Thursday Island and the inner group of islands are very low. The only significant catches are around Mabuiag.

f. Another industry member advised that effort is low around Boigu. The lobsters are there but can't be fished due to dirty water. PNG is reportedly using set nets and catching good amounts. There are lots of lobsters to be found and moulted shells are washing up on the shore around Mari Village (adjacent to Deliverance Island). The member noted that some historical fishing grounds down the East Coast are no longer accessible by Torres Strait fishers. The RAG noted that this area is now managed by QDAF.

12. The Chair acknowledged members concerns with regards to the impacts the advice the RAG provides to the PZJA can have on the livelihoods of the industry and their communities. He pointed out that the RAG does not take this responsibility lightly and upmost care is taken to fully understand not just the biological but also the economic and social impacts of RAG advice when it is being provided.

13. An industry observer sought clarification on the survey regime for the TRL Fishery. The CSIRO scientific member advised that the last mid-season survey was conducted in 2014. The move to a single pre-season survey has been subject to close scrutiny by the RAG prior to the change being implemented. This included consideration of trade-offs and costs of such a change. It was noted that analysis considered by the RAG showed a good correlation between pre-season surveys and actual catches.

14. An industry member suggested that the design of the pre-season survey needs to be reviewed, particularly around the number and spatial structuring of survey sites and the timing of surveys. The member expressed concerns that some areas were not surveyed adequately this season, particularly to the North of Mabuiag, and this may have affected estimates of abundance. The CSIRO scientific member noted that there can be variations from year to year. The survey is timed to align with the average over the available time series. The RAG noted that the natural variability of the stock and limits on funding create challenges for the science.

2.2 Government

15. The RAG noted an update provided by the AFMA member regarding management initiatives relevant to the TRL Fishery:

a. Catches in the TRL Fishery to date - as at 10 May 2018, the total reported catch for the TRL Fishery was 156 tonnes. There have been delays in receiving catch disposal records, and given this, this amount is likely to be under-reported.

b. Management changes since TRLRAG22 - there have been two major management changes since the last meeting. Additional moon-tide hookah closures commenced on 13 April 2018 followed by a prohibition on the use of hookah for the remainder of the season commencing 30 April 2018. The intent of these management changes was to give effect to the TRL Working Group recommendations that catches should not exceed the RBC and to prolong the opportunity for TIB fishers to fish for the duration of the season. While the additional moon-tide hookah closures did slow fishing, projections following these meetings indicated the Australian share of the RBC would be reached by the end of May 2018. The decision to prohibit the use of hookah was taken to slow fishing further. The impacts of these changes on the data is one reason for this meeting.

c. Finalisation of catch sharing arrangements with PNG – AFMA continues to pursue a meeting with PNG in order to finalise catch sharing arrangements for the 2017/18 fishing season, noting that Australia cannot make a unilateral decision about catch shares. Under the terms of the Torres Strait Treaty, the Australian share is 190.65 tonnes in Australian waters and 11.2 tonnes in PNG waters. Cross-endorsement arrangements to enable Australian boats to access the 11.2 tonnes in PNG waters have yet to be agreed with PNG, and AFMA is looking at alternatives under the Treaty to enable Australian boats to access Australia's full share. In a situation in which the TAC is so low, AFMA does not want to see catch go uncaught. Should Australia cross-endorse PNG boats to fish in Australian waters, they would be subject to the same management requirements as Australian boats, including licence conditions.

16. An industry member noted that PNG had caught approximately 30 tonnes to date, noting hookah fishing was not permitted until 30 April 2018. The member expects that PNG will catch their full share regardless of whether catch sharing arrangements have been agreed.

17. The RAG noted an update provided by the QDAF member regarding QDAF activities relevant to the management of the TRL Fishery:

    a. Catches in the East Coast TRL Fishery to date - as at 14 May 2018, the total reported catch for the TRL Fishery was 80 tonnes or 41% of the TAC for the Fishery (195 tonnes). Fishing slowed in March 2018 but is picking up again.

    b. East Coast TRL Working Group – the next meeting will take place in late July 2018 and will look at finalising the management objectives as well as have discussions on the biomass proxies for the Fishery to enable an adjustable TAC. The Department will also be putting out a reform discussion paper for public comment at the end of May 2018, which includes a review of management and licensing arrangements with a view to improve the efficiency and effectiveness of the arrangements and provide greater consistency with other jurisdictions.

18. An industry observer questioned the impacts of the change to the East Coast TRL Fishery season start date on the TRL stock. The Chair advised that this matter was considered at the last RAG meeting in March 2018, and there was no evidence to suggest that this change has had an impact on the Torres Strait TRL Fishery.

19. The RAG noted an update provided by the TSRA member regarding TSRA activities relevant to the management of the TRL Fishery:

    a. Fisheries Summit – the summit planned for May 2018 has been postponed. This will affect nominations for Traditional Inhabitant representatives on PZJA fora. The existing terms for members will be extended until new representatives can be appointed. TSRA will advise once new dates for the Summit are confirmed.

2.3 PNG NFA

20. An update from PNG NFA was not available as a representative was not in attendance.

2.4 Native Title

21. An update from Malu Lamar (Torres Strait Islander) Corporation RNTBC (Malu Lamar) was not available as a representative was not in attendance.

3 2017/18 TRL CPUE and length frequency trends

22. The RAG considered a presentation provided by Dr Robert Campbell, CSIRO scientific observer, detailing analyses of catch and effort data pertaining to the TRL Fishery for the 2017/18 season:
    a. The Chair explained that this is the third in-season CPUE analyses conducted for the TRL Fishery. It is not normal for such analyses to be conducted in-season, but that the unusual circumstances experienced in the 2017/18 season has meant processes have had to be adapted. This and other analyses to be provided at this meeting, will ensure the RAG has the best available science upon which to provide advice. The Chair thanked CSIRO for pulling together the required data and analyses at such short notice. The Chair also thanked MG Kailis for voluntarily providing the detailed length frequency data for the RAG's consideration.
    b. Data informing the analysis was received on 8 May 2018. In considering the analyses, the March and April 2018 data is not complete (~80% for March and ~60% for April). There are three sources data drawn on for the analysis:
        i. the TRL04 logbook - mandatory for TVH licence holders only;
        ii. TDB01 docket book - voluntary for all licence holders, no longer in use; and
        iii. TDB02 catch disposal record - mandatory for all licence holders, replaced the TDB01 docket book from 1 December 2018.
    c. With regards to the TVH sector's catch and effort data, AFMA are investigating some discrepancies between the TRL04 and TDB02 returns. With regards to the TIB sector's catch and effort data, the monthly catches for the 2013-2016 fishing seasons is an estimate as the catch month is not known for a substantive portion (33-55%) of the total catch in these seasons.. With regards to catch per unit effort (CPUE), the data presented was nominal, not standardised.
    d. A comparison of TIB sector's catch and effort data shows:
        i. Catch by month – December 2017 and January 2018 are considerably higher than those in the previous year, while February and March 2018 are similar. The trend seen in March 2018 may be attributable to incomplete data.
        ii. Catch by method – the hookah fishing method as a percent of total catch was highest in 2017 and has declined in 2018. There is a clear correlation between methods reported as hookah fishing and unknown, so the unknown is likely to be hookah fishing.
        iii. Catch by processed form – there is a clear correlation between hookah fishing and the catch composition skewing to whole (generally live) lobsters. The data also indicates there has been a move to whole lobsters over the years with the highest catch of whole lobsters as a per cent of overall catch occurring in 2017.
        iv. Catch by area fished – catches around Thursday Island as a percent of total catch were high (>50%) in 2017, but the data indicates this is not the case this season. Catches in the 2018 season are mainly coming from the Mabuiag, Badu, Thursday Island and Warrior Reef areas. There was some discussion on the accuracy of the area information being recorded on TDB01 docket book and TDB02 CDR forms, with some industry members suggesting that this recorded area often reflects where the lobsters are sold and not where the catch was caught.
        v. Catch by effort (days fished) – during 2018 there has been an increase in proportion of trips of >1 day in length in recent years, noting however that 'days fished' is a crude measure of effort. Total effort (days fished) during

December-April this season is estimated to be around 30% higher than during the same period in the previous season.

vi. Nominal CPUE – CPUE by month was found to be similar to recent years. CPUE for hookah fishing is variable but there is no clear trend. CPUE for lamp fishing is the lowest since 2004. Overall the CPUE for 2018 is looking average, again noting 'days fished' is a crude unit of measure.

vii. CPUE by area – catch rates in 2018 are highest in Mabuiag, Northern and Mt Adolphus areas. Mean catch rates over all areas lowest since 2015.

e. A comparison of TVH sector's catch and effort data shows:

i. Catch by month – catches in February and March 2018 are slightly higher than those in the previous year.

ii. Catch by method and processed form – hookah fishing is the predominant method used and whole lobsters comprise the majority of catch.

iii. Catch and effort by area fished – in 2018, ~55% of effort and catch from the TVH sector was in the Northern area, followed by Mabuiag, Warrior and Warraber areas.

iv. Catch by effort ('hours fished') – there was a higher proportion of catch taken in periods of >6 hours in 2018, compared with previous years. Dr Campbell questioned how accurately 'hours fished' is reported. Industry members and observers noted that they take 'hours fished' to mean different things (e.g. hours the tender spends away from the boat, hours divers are in the water) and that AFMA needs to clarify how this needs to be reported. The RAG noted that there was a significant proportion of 'unknown' catch by 'hours fished' data for the TVH sector in 2017. The AFMA member advised that this has been looked into as noted at the previous RAG meeting.

v. CPUE – generally, while catches may have been high, effort was also high and the CPUE reflects this. Catch rates decrease after February and remain similar in March and April. In 2018, mean catch rate in March and April is 28.4% lower than in February (average decrease over past 6 years is 20.5%). Mean catch rates in 2018 of 12.6 kg/hour are lower than mean catch rates over past 6 years of 14.8 kg/hour, though slightly higher than 2017.

vi. 'Hours fished' per tender set - greater proportion of tender-sets with >5 hours of effort.

vii. Total effort - data for 2018 is incomplete but indicates an increase over 2017. Dr Campbell advised that looking at individual boat data (which could not be presented due to data confidentiality rules), it may be the case that one or two boats may have fished harder thus accounting for a greater proportion of catch and effort, in effect skewing the data across the whole sector.

23. Dr Campbell advised that following the RAG meeting he would recirculate his paper with corrections, as raised and discussed with members throughout the presentation.

Action 2
Dr Campbell's corrected paper to be circulated to the RAG following the meeting.

24. The RAG considered a presentation provided by Dr Eva Plaganyi, CSIRO scientific member, detailing further analyses of available data pertaining to the TRL Fishery for the 2017/18 season:

    a. The stock assessment is reliant on accurate information from all 4 indicators. The empirical harvest control rule detailed in the draft harvest strategy will also rely on these indicators with the following weighting: CPUE data for the TIB sector (10% weighting); CPUE data for the TVH sector (10% weighting); pre-season survey 0+ lobster index of abundance (10% weighting); and, pre-season survey 1+ lobster index of abundance (70% weighting).
    b. Available data for the Fishery to date (e.g. catch, effort, length composition) does not indicate a better than average season, although it could be argued that it is a low-average season rather than a low season. Combined Fishery catch over the period December to March 2018 is 87% of the average catch in the preceding period 2005-2017, and 37% of the maximum catch over this period.
    c. Although there is evidence of localised hotspots, CPUE estimates for 2017/18 fishing season are low to average relative to historical levels, noting the CPUE data presented were nominal and would likely be scaled down if standardised. There is some evidence that fishing effort (days/hours fished) may have increased.
    d. Length composition data indicates that catch is shifting as expected from larger males to a more even sex ratio. The data are also showing an increase in the proportion of recruiting 1+ lobsters being caught alongside a decrease in the proportion of residual 2+ lobsters.
    e. PNG TRL Fishery length composition data is different to that provided for the Australian TRL Fishery. The PNG data indicates there may be stronger recruitment in PNG waters, however further information is needed on the spatial distribution of catches to further inform analyses.
    f. MG Kailis data detailing the proportion (of total catch) of different size grades for catch received from both the Australian and PNG TRL Fishery does not show a marked deviation from average. Additional data were provided to members by Mr Brett Arlidge during discussion on this item. Noting that the data presented encompasses more than 50% of total catches for the Fishery, Mr Arlidge suggested that the data does not align with what would be expected under a low RBC.

25. An industry member queried whether there may have also been environmental factors that have affected the stock this season, for example high turbidity from South Fly River outflows impacting on migration. The AFMA member advised that studies on this matter can be tabled at the next TRL and Finfish RAG meetings for consideration.

Action 3
South Fly River studies to be provided for consideration at the next TRL and Finfish RAG meetings.

26. The RAG agreed that catch and effort data (and the indicators derived from these data e.g. CPUE) are fundamental to understanding the dynamics of the TRL stock and performance of the TRL Fishery and discussed improvements that could be made to its collection and analysis:

    a. The RAG noted that any analysis of data will only be as good as the data itself.
    b. Spatial structure - industry members advised that catches attributed to the Badu and Thursday Island areas are likely to be overstated, as fishers are reluctant to

disclose the areas in which they have fished and may instead nominate the area the lobsters are being landed - catches are more likely coming from the Mabuiag and Northern areas. Dr Campbell agreed that this is a credible conclusion given anecdotal reports do not appear to align spatially with the catch and effort data. With regards to the TVH sector, the TRL04 logbook limits the reporting of catch and effort to a single location. Given this, the location the primary boat is anchored is generally recorded, not the location where tenders are actually fishing (which can range as far as 20 nm from the primary boat).

c. Measure of effort – the RAG agreed that the 'days fished' measure used in the TDB02 catch disposal record is a crude measure of effort and may not include travel or searching time nor indicate what portion of the day was spent actively fishing. Industry members advised it is common practice for fishers to round-up to whole days. Further, the 'hours fished' measure used in the TRL04 logbook is being reported inconsistently across fishers (e.g. hours the tender spends away from the boat, hours divers are in the water).

d. CPUE – noting the CPUE data presented was nominal, the RAG agreed that there is a need to standardise the CPUE data. Standardisation of CPUE data involves making adjustments to the data to take into account factors other than stock abundance that may influence catch rates. An important one of these factors is changes in fishing behaviour and fishing power over time. These changes can otherwise confound results by overestimating CPUE and by inference stock abundance. This "effort creep" includes changes to the size of engines, use of GPS, gear, areas fished, time fished and experience of divers. Current CPUE data may also be confounded by a hyperstability effect, seen when fishers remain on fishing "hotspots" or move from one hotspot to another – thereby maintaining high catch rates that don't represent the population size of the entire stock. Industry members and observers acknowledged the best way to understand effort creep is to talk to the fishers themselves.

e. Voluntary fields - Given constraints under the *Torres Strait Fisheries Act 1984* (the Act), some data fields on the TDB02 catch disposal record are voluntary and as such often left uncompleted. This creates problems in providing a complete analysis of the data for the TIB sector and it is recommended that all fields be made mandatory. The AFMA member advised that amendments to the Act are being progressed to provide the capacity to require all licence holders to complete logbooks, but that this process is lengthy one and these amendments are a number of years off.

f. Length frequency – the RAG noted that length frequency data is currently provided by Kailis. The RAG agreed this data is of high value and has been particularly useful this season in informing analyses on the performance of the Fishery. However, there is a longer term need to collect representative length frequency data from across the Fishery.

27. The RAG agreed that if the catch and effort data for the TRL Fishery is not accurate, this undermines:

a. general confidence in the science and the ability of the RAG to understand the dynamics of the stock and performance of the Fishery;

b. the effectiveness of the standardisation of the CPUE data series used in the stock assessment as well as survey design both of which are informed by data on the spatial structure of catch and effort;

c. the accuracy of the stock assessment itself as catch and effort data from both the TIB and TVH sectors is expressly considered in the assessment (10% weighting per sector).

Recommendation 1

For these reasons, the RAG recommended that the accuracy of catch and effort data for the TRL Fishery be improved as a matter of priority, with a particular focus on:

- improving the accuracy of the spatial information on catch and effort data (e.g. point of capture as opposed to point of anchoring or landing) and providing further guidance to fishers on how this data should be recorded;
- developing a finer scale measure of effort for the TDB02 catch disposal record (e.g. 'hours fished' as opposed to 'days fished') and providing further guidance to all fishers on how effort should be recorded in both the TDB02 catch disposal record and TRL04 logbook (e.g. to include time spent travelling, searching and actively fishing);
- developing a better understanding on changes in fishing behaviour and power over time (e.g. changes to the size of engines, use of GPS, gear, areas fished, time fished, experience of divers), to inform the standardisation of CPUE data. This should be done through close consultation with industry;
- in the longer term, consider the inclusion of travelling time, searching time and fishing time as separate effort fields in the logbooks.

4 2017/18 trends in 2+ lobster abundance

28. The RAG considered a presentation provided by Dr Eva Plaganyi, CSIRO scientific member, detailing the current stock assessment methods and analyses pertaining to residual 2+ lobsters in the TRL Fishery:

    a. RBCs - Reflecting the variable nature of the TRL stock, the RBCs for the Fishery between seasons have also varied. However, catches have generally corresponded with the RBCs as set. For the 2017/18 fishing season, taking into account considerable uncertainty across a range of different inputs, the assessment suggested an RBC of 299 tonnes with a 90% confidence interval of 196-401 tonnes.

    b. Draft harvest strategy - the target and limit reference points for the TRL Fishery, as detailed in the draft harvest strategy, have been deliberately set at conservative levels (and 0.65 B_0 and 0.40 B_0 respectively) to take account of the fact that the resource is shared and important for the traditional way of life and livelihood of traditional inhabitants. The target reference point is currently set at a level that gives higher average stock biomass consistently across years. Increasing catch levels above the RBC will result in the Fishery fluctuating around a lower average stock biomass level. Whilst this can be done under a harvest strategy, there will be trade-offs (e.g. higher risks, lower highs) and it did not align with previous recommendations of all RAG members to have a conservative harvest strategy.

    c. Implications of exceeding catch limits - The conservative settings in place for the TRL Fishery mean there is a fairly low risk that exceeding the RBC one season will significantly deplete the stock. However, scientific analyses of fisheries from around the world have demonstrated that when a scientifically determined catch limit is regularly exceeded, it results in a decline in the stock biomass and leads to overfished stocks that are no longer able to produce the same large yields as in the past. The CSIRO scientific member explained that this is one of the reasons that it can be beneficial to not deviate from the best available science (which could include advice that conditions are anomalous) and is also part of the motivation for the development of harvest strategies which include pre-agreed rules for decision making.

d. The stock assessment model - the model used in the TRL Fishery is an age-structured model (includes different selectivities for 1+ and 2+ lobsters) and is similarly conservative to that of the draft harvest strategy. The complexity of the model matches the management needs for the Fishery as well as the availability and reliability of data. There are other models that could be used in the Fishery (e.g. a spatially-disaggregated model or a length-based and age-disaggregated model), however these options are more data "hungry" and would cost more as a result. The existing model is considered to perform reasonably given management needs and budget constraints.
e. Uncertainties in the stock assessment – the TRL stock exhibits considerable natural inter-annual variability with regards to spawning, settlement and growth. Further, environmental influences (e.g. climate change) also affect these relationships. It is generally understood that when less data is available for a fishery, a more conservative approach needs to be taken. More data can help address some of these uncertainties and allow for a more precise (less conservative) RBC to be set. However, the more complex an assessment, the more costly it is to maintain.
f. TRL biology - catches over December to February are mostly made up of large male lobsters (referred to as residual 2+ lobsters). The incoming (recruiting) 1+ lobsters are usually only accessible to fishers from around March, when they have grown to legal size as 2+ lobsters. There is significant variability in the length composition data caused by the relative abundance of the two age groups (cohorts), inter-annual variations in size and spatial distribution. It is therefore difficult to quantify the biomass of the residual 2+ lobsters each season.
g. Residual 2+ lobsters - because there is insufficient data to quantify the biomass of the residual 2+ lobsters each season, the stock assessment model assumes there to be an average size each year which is scaled up or down based on the inter-annual variability of the 1+ lobsters as determined through survey data. The assessment focuses on what can be quantified from the available data, that being the 1+ lobsters that grow to legal size to be fished that season.
h. Survey data – the pre-season survey samples recruiting 0+, 1+ and residual 2+ lobsters. Mid-season surveys sample 1+ and 2+ lobsters. Pre-season survey data for 2+ lobsters is highly variable due to the small sample size and so is unreliable as an index of abundance (e.g. 2+ lobster index coefficient of variation (CV) of 0.19-0.89 vs. 1+ lobster index CV of 0.12-0.19). In addition, the pre-season survey 2+ lobster index does not show a strong correlation with catch the following season. Further, the stock assessment model does not show a clear relationship between the relative number of 3+ lobsters in the pre-season survey and the catch taken the following year.
i. Observed variability - given small inter-annual variability in the December-March proportion of total catch (average 0.37, range 0.26-0.44) and December-February proportion of total catch (average 0.21, range 0.15-0.29), residual biomass could be estimated and used to adjust the RBC. However the quantum of these adjustments (up or down) would only be in the range of 30-60 tonnes per year. The lower the RBC, the smaller the adjustment. The model predicted December 2017-March 2018 proportion of total catch is higher than past observations since 2005 and may indicate a slight anomaly.
j. Data needs to support a RBC adjustment – any adjustment to the RBC based on observed variability would need to occur in-season. As neither the survey data nor stock assessment model provide a means to accurately estimate the biomass of residual 2+ lobsters, a mid-season survey and representative length composition data would be needed. Given historical variability has not been that

great, any adjustment from this process would only be small, and may not be justified by the additional monitoring, analysis and review costs.

29. The RAG considered a presentation provided by Dr Andrew Penney, independent scientific member, detailing analyses pertaining to residual 2+ lobsters in the TRL Fishery:
    a. Did the pre-season survey underestimate abundance? – if the November 2017 pre-season survey 1+ lobster index of abundance was underestimated, this could mean early season catches of 2+ lobsters were higher than predicted. However, data presented to the RAG to date does not indicate an alternative to the below average abundance of recruiting 1+ lobsters.
    b. Did industry fish harder at the start of the season? – if industry fished harder at the start of the season in response to the lower RBC, this could result in higher than expected early season catches. Data presented to the RAG to date indicates that CPUE for the start of the 2017/18 season was average or slightly higher compared to the previous season. However, data for the current season is incomplete and further work is needed to better understand those factors affecting CPUE before it can be reliably interpreted.
    c. Is there a greater abundance of residual 2+ lobsters than expected? – if there was a higher than expected abundance of residual 2+ lobsters at the start of the season, this could explain the good catches experienced despite a low abundance of recruiting 1+ lobsters. Length composition data (from January 2008, 2015, 2016, 2018) indicates residual 2+ lobsters make up a significant proportion of early season catches across these years. Compared to the average contribution of residual 2+ lobsters to early season catches across years, the catches from January 2018 appear to be above average. However, the variation from this average varies between years but is small in scale (3-4%, or if scaled to weight <1 tonne).
    d. Relationship between 1+ and 2+ lobster catches – the data showed a clear correlation that when there is a high abundance of recruiting 1+ lobsters then there is an increased contribution of 1+ and corresponding reduced contribution of 2+ lobsters in early season catches. This suggests fishers catch what is there, not how much is there (e.g. spatial vs. volume). Again further work is needed to better understand those factors affecting CPUE before this relationship can be reliably interpreted.
    e. Relative contribution – estimation of the relative contribution of residual 2+ lobsters to January catches could provide the basis for an index of abundance against which a RBC adjustment could be considered. Given the scale of variation, any adjustment would only be small (e.g. approximately 10 tonnes).
    f. Data needs to support a RBC adjustment – as with CSIRO's analysis, any adjustment to the RBC based on relative contribution would need to occur in-season. Representative length composition data would be needed. Any adjustment from this process would only be small, and given this may not be justified by the additional monitoring, analysis and review costs.
    g. Alternative strategy – a better strategy to respond to inter-annual variability is to implement a harvest control rule which smooths variation to the RBC across years, resulting in less highs but also less lows.

30. In summary, the RAG noted:
    a. The scale of any adjustment would be small (e.g. 30-60 tonnes or 10 tonnes depending on the methods presented). The lower the RBC, the smaller the adjustment. Adjustments would need to apply equally (i.e. increasing and decreasing the RBC).

b. Additional real-time data would be needed to support any adjustment (e.g. mid-season survey, representative length composition data).
c. Given the data needed to inform any adjustment, the adjustment itself would need to happen in-season.
d. The additional monitoring, analysis and review costs may not be justified given the considerations detailed above.

5 Evaluation of additional survey options to support future stock assessments

31. The RAG noted a summary provided by the Chair regarding developments in the TRL Fishery in the 2017/18 season to date:
    a. At meetings in December 2017 and March 2018, the RAG considered the results of the November 2017 pre-season survey and stock assessment. Driven primarily by a low index of abundance for recruiting 1+ lobsters obtained from the survey, the stock assessment suggested an RBC of 299 tonnes.
    b. Some industry members have expressed concerns that the catches experienced in-season to date do not align with what would be expected from a low RBC. For this reason they believe the assessment may be misaligned with actual abundance this season.
    c. However, available data and analyses does not indicate a better than average season, although it could be argued that it is a low-average season rather than a low season. Nor does the data or analyses support an alternative to the survey prediction of a below average abundance of recruiting 1+ lobsters when averaged across the whole Fishery. Early season catches have comprised largely of residual 2+ lobsters. The data has not shown an input of recruiting1+ lobsters into the Fishery that is higher than expected.
    d. The spatial distribution of catches is notably different from previous seasons, and are concentrated in the North West of the Fishery.
    e. Changes to the management arrangements and fishing effort this season has impacted on the reliability of CPUE data, used as an indicator of abundance for the Fishery. The CPUE can be standardised to take account of these changes however some uncertainties will remain. In addition, should the Fishery be closed early this season, the CPUE data would be incomplete and less usable in the stock assessment. The assessment will still function, but there will be greater uncertainty around the results.
    f. The low RBC and changes to management arrangements are having social and economic impacts on communities across the region.
32. Noting these developments, the RAG was asked to provide advice on survey options to support future stock assessments and management of the TRL Fishery. The RAG discussed three survey options as presented by Dr Eva Plaganyi, CSIRO scientific member:
    a. Mid-season survey – this option would cost $174,000 (CSIRO contribution $69,000, external contribution $104,000). Given the indications from available data for the Fishery to date, it would be unlikely that the survey results would result in a change to the current RBC. However, the survey would provide a better understanding of current stock status to validate previous surveys and inform on the standardisation of CPUE for future stock assessments. It would also provide forewarning of low indexes of abundance for recruiting age classes and as such potential for another low RBC for the 2018/19 season. Should the Fishery close

early this season, the survey would also provide information on the stock that would otherwise be unavailable. The bias caused by sampling sites that may not have been fished for a number of months should the Fishery close early would also need to be accounted for in any analyses.

b. Extension to pre-season survey – this option would cost $55,000 (CSIRO contribution $22,000, external contribution $33,000). This would involve adding approximately 5 days to the November 2018 pre-season survey. Sites would be chosen to provide increased precision in predictions, particularly for a couple of key areas where there may have been changes in stock distribution. Given the timing, this survey would not provide a basis to change the current RBC. Nor would it provide information on current stock status to validate previous surveys or provide information on the stock that would otherwise be unavailable should the Fishery close early. However it would improve the precision (less uncertainty) of the pre-season survey indexes of abundance for the 2018/19 season.

c. Benchmark survey – this option would cost $486,000 (CSIRO contribution $194,000, external contribution $291,000). This would build on previous benchmark surveys conducted in 1989 and 2002. Timing would be similar to the current November pre-season survey. Given the timing, this survey has similar limitations as the extension to the pre-season survey. However it would improve the precision of the pre-season survey indexes of abundance for the 2018/19 season and future seasons. It would also provide additional data to inform on habitat changes across the Fishery that may need to be taken into account in the stock assessment.

33. The TSRA member suggested, that if the timing of the mid-season survey does not provide for a review of the RBC, then an extension of the pre-season survey may be the better option. The TSRA advised that they are unable to commit funding for additional survey work this season due to competing projects.

34. The RAG discussed the selection of survey sites noting concerns expressed by industry members earlier in the meeting that some areas were not adequately surveyed in the November 2017 pre-season survey, particularly to the North of Mabuiag. The CSIRO scientific member advised that sites are randomly stratified and in the case of a mid-season survey, would be selected to expressly provide for comparison with previous mid-season surveys. It is possible to include additional sites to cover off on areas which may not have been covered in the November 2017 pre-season survey. CSIRO agreed to work with industry to ensure areas fished in the current season are adequately represented in any survey conducted.

35. The CSIRO scientific member advised that there are a number of constraints around when a mid-season survey can be conducted. These constraints include scientific permit requirements and processes, funding availability, contract negotiations with funding and charter providers, and availability and mobilisation of resources to actually do the survey. Given these constraints, a mid-season survey is most likely to occur in July 2018, with results available around August 2018. This timing is within the window of when previous mid-season surveys have been conducted. The RAG agreed that industry and PZJA agencies should contribute to and facilitate the mid-season survey wherever possible.

36. The AFMA member advised that industry could contribute to a mid-season survey and the broader science underpinning the management of the Fishery in a number of ways. This could be through a commitment of funding, an in-kind contribution of vessels to support the conduct of surveys or the voluntary provision of additional data on catch and effort to support analyses on the dynamics of the stock and performance of the Fishery. One industry member noted that an industry contribution is justified and they would be willing to work with AFMA and CSIRO on possible options to provide an in-kind vessel for future surveys.

37. The RAG agreed that a broader discussion is needed at the next meeting on available data as well as data and analyses needs, and how this may be facilitated by industry.

Recommendation 2

The RAG recommended that a mid-season survey be conducted as soon as practically possible, to be facilitated by industry and PZJA agencies, for the purposes of:

- providing further data on the abundance and spatial distribution of all age classes in the current season to input to the 2018/19 stock assessment, noting that CPUE data for the current season is now biased by management changes and may be unusable should the Fishery close early this season;
- providing further data to validate the 0+ and 1+ indexes of abundance from the November 2017 pre-season survey, noting the 0+ index may not have been reliably estimated from the November 2017 pre-season survey and the model was unable to satisfactorily fit this index;
- providing an 2+ index of abundance to more accurately inform on stock status and for comparison with CPUE data;
- provide a preliminary prediction of the expected 1+ lobster recruitment for the 2018/19 season (0+ lobsters in November 2017 pre-season survey) to provide forewarning on the likelihood of another low RBC for the 2018/19 season.

The survey will consist of 77 pre-determined sites expressly selected to provide for comparison with previous mid-season surveys.

The RAG further recommended that CSIRO work with industry to ensure areas fished in the current season are adequately represented in the sites sampled in the mid-season and future pre-season surveys.

38. The RAG discussed at what point the mid-season survey may trigger a review of the RBC for the TRL Fishery. The AFMA member advised that there would need to be a significant variation between the results of the November 2017 pre-season survey and the 2018 mid-season survey to trigger a review. Such an “anomalous” result is considered unlikely at this point given indications from available data for the Fishery to date. The CSIRO scientific member supported this view and suggested an anomalous result be defined as a 2018 mid-season survey 2+ survey index that falls outside the 95% confidence interval associated with the model forward prediction based on the November 2017 pre-season survey 1+ index. This is given uncertainties in available data and the fact that a mid-season survey has not been conducted since 2014. The RAG noted that a 95% confidence interval sets a high bar, but agreed that this would be appropriate.
39. The CSIRO scientific member noted that should a review of the RBC be triggered, a revised RBC would be calculated based on an updated stock assessment fitted to the mid-season survey data. The November 2017 pre-season survey results will remain an input into the stock assessment but may be weighted differently depending on the reliability of the 2 surveys.

Recommendation 4

The RAG recommended a review of the RBC be undertaken if the results of the 2018 mid-season survey 2+ survey index falls outside the 95% confidence interval associated with the model forward prediction based on the November 2017 pre-season survey 1+ index, in relation to directly comparable sites (e.g. sites sampled in both surveys only).

6 Other business

40. The TSRA member sought an update on progress to finalise the harvest strategy for the TRL Fishery. The AFMA member advised that the draft harvest strategy has been referred back to the TRL Working Group for further consideration at their next meeting.
41. An industry member sought clarification on the area of waters to which the RBC applies. The RAG noted that the RBC encompasses the Torres Strait Protected Zone (TSPZ) as well as the outside but near areas and PNG waters. The TRL stock moves from the TSPZ through PNG waters as part of its spawning migration.

7 Date and venue for next meeting

42. The RAG noted that the next meeting is tentatively scheduled for August 2018 for the purpose of discussing the results of the mid-season survey.
43. The meeting was closed in prayer at 3:45 pm on 15 May 2018.

Declaration of interests
Dr Ian Knuckey – April 2018

Positions:

- Director – Fishwell Consulting Pty Ltd
- Director – Olrac Australia (Electronic logbooks)
- Chair / Director – Australian Seafood Co-products (seafood waste utilisation)
- Chair / Director – ASCo Fertilisers (seafood waste utilization)
- Chair – Northern Prawn Fishery Resource Assessment Group
- Chair – Tropical Rock Lobster Resource Assessment Group
- Chair – Victorian Rock Lobster and Giant Crab Assessment Group
- Scientific Member – Northern Prawn Management Advisory Committee
- Scientific Member – SESSF Shark Resource Assessment Group
- Scientific Member – Great Australian Bight Resource Assessment Group
- Invited scientific participant – SEMAC, SERAG

Current / Recent Projects and funding:

- Principal Investigator – FRDC Project 2017-069 Indigenous Capacity Building
- Principal Investigator – VFA Project 17-646976 – Ocean Scallop Biomass Survey – 2018
- Principal Investigator – FRDC Project 2017/122 - Review of fishery resource access and allocation arrangements across Australian jurisdictions
- Principal Investigator – FRDC Project 2016/116 - 5-year RD&E Plan for Northern Territory fisheries and aquaculture
- Principal Investigator – AFMA Project 2017/0803 - Analysis of Shark Fishery Electronic Monitoring data
- Principal Investigator – AFMA Project 2017/0807 - Resource Survey of the Great Australian Bight Trawl Sector – 2018
- Principal Investigator – AFMA Project 2016/0809 – Improved targeting of arrow squid
- Principal Investigator – AFMA Project 2018/08xx – Bass Strait and Central Zone Scallop Fishery – 2018 and 2019 Survey
- Principal Investigator – DPIPWE Project – Review of abalone dive rates
- Principal Investigator – FRDC Project 2015/204 – Realising economic returns of reducing waste through utilization of bycatch in the GAB Trawl Sector of the SESSF
- Principal Investigator – FRDC Project 2014/203 – Review of Monitoring and Assessment in the SESSF
- Principal Investigator – AFMA Project 2014/0809 – Fishery Independent Survey of shelf resources in the Great Australian Bight Trawl Fishery 2017
- Principal Investigator – Survey for Black teatfish in the Queensland Sea Cucumber Fishery.
- Principal Investigator – CRC Project 2013/748.40 – Improved understanding of economics in fisheries harvest strategies.
- Principal Investigator – FRDC Project 2014/207 – The social drivers and implications of conducting an ecological risk assessment of both recreational and commercial fishing - a case study from Port Phillip Bay
- Co-Investigator – Optimising processes and policy to minimise business and operational impacts of seismic surveys on the fishing industry and oil and gas industry.
- Co-Investigator – FRDC Project 2017/014 – SA Marine Scalefish Review
- Co-investigator – AFMA Project - SESSF 2018 Fishery Independent Survey

- Co-investigator – Bird mitigation in the SESSF trawl sector
- Researcher – Various fishing industry liaison projects for oil and gas industry
- Scientific Advisor – Atlantis, GABIA, Gulf St Vincent Prawn Fishery, Seafish JV, SETFIA, SSIA
- MSC Auditor – Falklands Is 2016 Surveillance Audit (Acoura), Macquarie Is Toothfish (SCS)
- Facilitator – WWF shark traceability workshop
- Facilitator – SPC Tuna Data Collection Committee
- Facilitator – Indonesian fishery training and development

Current / Recent Clients (>$5000):

- ABARES
- Acoura
- Atlantis Fisheries Consulting Group
- Australian Fisheries Management Authority (AFMA)
- CRC – Seafoods
- Department of Agriculture and Water Resources
- Department of Primary Industry - Victoria
- Dept. Primary Industry, Parks Water and Environment (DPIPWE) Tasmania
- Fisheries Research and Development Corporation (FRDC)
- Great Australian Bight Fishing Industry Association (GABIA)
- Gulf of St Vincent Prawn Boat Owners Association
- Monash University
- NT Fisheries
- Richey Fishing
- South Australian Rock Lobster Advisory Council (SARLAC)
- SARDI Aquatic Sciences
- SCS Global Services
- Seafood Industry Victoria
- Seafish JV
- SeaFresh
- Secretariat of the Pacific Community
- South East Trawl Fishing Industry Association (SETFIA)
- Southern Shark Industry Alliance (SSIA)
- Tasmanian Seafoods
- Victorian Fisheries Authority
- Western and Central Pacific Fisheries Commission
- World Wildlife Fund – Australia (WWF)

23rd MEETING OF THE PZJA TORRES STRAIT TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG 23)

Tuesday 15 May 2018 - 8:00 AM - 4:00 PM

Cairns - Northern Fisheries Centre, 38-40 Tingira Street, Portsmith

DRAFT AGENDA

1. Preliminaries
   1.1. Welcome and apologies
   1.2. Adoption of agenda
   1.3. Declaration of interests
   1.4. Action items from previous meetings

2. Updates from members
   2.1. Industry and scientific members
   2.2. Government agencies
   2.3. PNG National Fisheries Authority
   2.4. Native Title

3. 2017/18 TRL CPUE and length frequency trends

4. 2017/18 trends in 2+ lobster abundance

5. Evaluation of additional survey options to support future stock assessments

6. Other business

7. Date and venue for next meeting

Action items from previous TRLRAG meetings

#	Action Item	Agenda	Agency	Due Date	Status
1.	AFMA to review the effectiveness of certain TIB licensing arrangements (in its 2016 licencing review) including: • TIB licenses should share a common expiry date • licences to last for longer than the current 12 month period.	TRLRAG14	AFMA	2017	**Ongoing** AFMA has begun undertaking a review of licensing of Torres Strait Fisheries, this issue will be considered as part of this review. At present however, AFMA resources are focused on progressing the proposed legislative amendments as a matter of priority.
2.	AFMA and CSIRO prepare a timeline of key events that have occurred in the Torres Strait Tropical Rock Lobster Fishery (e.g. licence buy backs, weather events and regulation changes) and provide a paper to TRLRAG.	TRLRAG14	AFMA CSIRO	TRLRAG17	**Ongoing** AFMA to complete further work. This has been difficult to action ahead of other priorities for the TRL Fishery.
3.	AFMA to prepare a summary of evidence that PNG trawl-caught TRL are a shared stock between Australia and PNG, including details such as the TRL biological characteristics, larvae dispersal, tag recapture data and catch and effort information. AFMA will circulate the paper to the RAG	TRLRAG19	AFMA		**Ongoing** AFMA sent a letter to PNG NFA outlining concerns of trawlers retaining TRL on 8 March 2017. The key findings of the CSIRO larval advection model was presented at the Fisheries Bilateral meeting held in Port Moresby on 5 February 2018. The bilateral meeting noted that the findings show the Australian and PNG TRL fisheries are based on a single stock. AFMA and CSIRO (Dr Plaganyi) met with PNG NFA officials, including the NFA Managing Director, John Kasu on 7 February 2018 at the NFA offices in Port

	out-of-session for comment before sending to PNG NFA.				Moresby. Dr Plaganyi presented the updated stock assessment results and larval advection modelling. There was agreement that the updated larval modelling together with past research provides strong evidence that TRL is a shared stock between Australia and PNG. These meetings have been followed up with teleconference between the PNG NFA Managing Director and AFMA CEO which included discussions on the importance of controlling catches so they do not exceed each jurisdiction's catch share of the recommended biological catch (RBC).
4.	Malu Lamar RNTBC to provide AFMA with the map of traditional boundaries and regional area and reef names for each of the Torres Strait Island nations and for CSIRO to examine possible revised naming conventions for survey sites	TRLRAG20	Malu Lamar		**Ongoing** AFMA is awaiting advice from Malu Lamar and will assist where possible. CSIRO advised that they have received some maps with information on traditional names but that this is not complete. They will work with Malu Lamar if further information is needed.

Relevant action items from previous TRLWG meetings*

#	Action Item	Agenda	Agency	Due Date	Status
1.	TRLRAG to provide advice on any findings relating to the impacts of changing the season start date to provide industry with a longer TAC notice period.	TRLWG #5 held on 5-6 April 2016	AFMA to draft RAG paper	TRLRAG22	**Ongoing** AFMA are working with CSIRO to progress this action, noting competing priorities relating to the TRL Fishery have caused delays.

*TRLWG actions not relevant to TRLRAG have not been included in the above.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	MEETING 24 18-19 October 2018
PRELIMINARIES **Out-of-session correspondence**	**Agenda Item 1.5** **For Information**

RECOMMENDATIONS

1. That the RAG **NOTE** the correspondence sent out-of-session since the last TRLRAG meeting held on 15 May 2018.

BACKGROUND

2. The following correspondence was circulated out-of-session since the last TRLRAG meeting held on 15 May 2018 (TRLRAG23). Copies of this correspondence can be requested at any time from the TRLRAG Executive Officer.

Date	Item
16 May 2018	Dr Robert Campbell circulated an updated paper '*Torres Strait Rock Lobster Fishery – Summary of the Catch and Effort Data pertaining to the 2018 Fishing Season (Dec-17 to Apr-18)*', to Members for information
5 July 2018	AFMA circulated the final meeting record for the TRLRAG meeting held on 27-28 March 2018, to Members for information
17 July 2018	AFMA circulated the draft meeting record for the TRLRAG meeting held on 15 May 2018, to Members for comment
20 July 2018	AFMA sent offers to extend current terms of appointment for Traditional Inhabitant members on TRLRAG until 31 December 2018, or until the appointment of new members is finalised
20 July 2018	AFMA circulated the preliminary results from the Torres Strait TRL mid-year survey conducted between 28 June and 9 July 2018, to Members for information
18 August 2018	AFMA circulated the final meeting record for the TRLRAG meeting held on 15 May 2018, to Members for information
20 August 2018	Dr Ian Knuckey responded to concerns raised by Mr Brett Arlidge on 27 July and 17 August 2018 regarding the survey and stock assessment processes for the TRL Fishery. Ms Selina Stoute confirmed support for the proposed approach
22 August 2018	AFMA circulated a media release from the Senator the Hon. Anne Ruston concerning the implementation of a Tropical Rock Lobster (TRL) Fishery Management Plan by 1 December 2018
7 September 2018	AFMA sought availability of members for proposed dates for a further two meetings of the TRLRAG prior to the end of 2018

12 September 2018	AFMA circulated the draft agenda for the TRLRAG meeting to be held on 18-19 October 2018. Also attached was a letter to Traditional Inhabitant members concerning new arrangements regarding meeting travel, remuneration as well as additional support to engage in and communicate the outcomes of meetings
17 September 2018	Dr Ian Knuckey responded to concerns raised by Mr Trent Butcher on 17 September 2018 regarding the survey and stock assessment processes for the TRL Fishery
17 September 2018	Ms Selina Stoute responded to concerns raised by Mr Trent Butcher and Mr Jerry Stephen on 17 September 2018 regarding the survey and stock assessment processes for the TRL Fishery

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
UPDATES FROM MEMBERS **Industry and scientific members**	**Agenda Item 2.1** **For Information**

RECOMMENDATIONS

1. That the RAG **NOTE** updates provided by industry and scientific members.

BACKGROUND

2. Verbal reports are sought from industry and scientific members under this item.
3. It is important that the RAG develops a common understanding of any strategic issues, including economic, fishing and research trends relevant to the management the TRL Fishery. This includes within adjacent jurisdictions. This ensures that where relevant, the RAG is able to have regard for these strategic issues and trends.
4. RAG members are asked to provide any updates on trends and opportunities in markets, processing and value adding. Industry is also asked to contribute advice on economic and market trends where possible. Scientific members are asked to contribute advice on any broader strategic research projects or issues that may be of interest to the Torres Strait in future.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	MEETING 24 18-19 October 2018
UPDATES FROM MEMBERS Government agencies	Agenda Item 2.2 For Information

RECOMMENDATIONS

1. That the RAG:
   a. **NOTE** the update provided by AFMA below;
   b. **NOTE** a verbal update will be provided by the QDAF and TSRA.

AFMA UPDATE

Summary of management arrangements for the 2017/18 fishing season

2. The Torres Strait Tropical Rock Lobster (TRL) Fishery 2017/18 fishing season was managed in line with a historically low recommended biological catch (RBC). Historically, existing management arrangements for the TRL Fishery have been largely sufficient to keep catch levels below the Australian catch share of the RBC without the need for additional management controls. However, during the 2017/18 fishing season, catches were tracking to reach the Australian catch share of the RBC prior to the end of the season on 30 September 2018. In response, changes were made to management arrangements within the fishing season for the purpose of prolonging the opportunity for the TIB sector to fish for the duration of the season and ensure the Australian catch share of the RBC was not exceeded.
3. These changes were largely in the form of input controls (e.g. restrictions on the use of hookah gear) which had impacts on both fishers and the fishery dependant data available to support future stock assessments. A summary of actions taken concerning the management of the TRL Fishery for the 2017/18 fishing season is provided for members' reference at **Attachment 2.2a**.

Outcomes of the Federal Court case

4. On 27 June 2018, his Honour Justice Rares of the Federal Court of Australia handed down an *ex tempore* decision in the matter of Malu Lamar (Torres Strait Islander) Corporation RNTBC (Malu Lamar) v James Findlay (VID577/2018). His Honour quashed the decision of the CEO of AFMA, as delegate of the PZJA, to implement a prohibition on the use of hookah for the remainder of the 2017/18 fishing season. This judgement took effect from 1600 AEST 29 June 2018.
5. His Honour found that the delegate was obliged to afford procedural fairness to Malu Lamar prior to making the decision to amend licence conditions, but had failed to do so on the basis that Malu Lamar's response to native title notification had not been considered by the delegate prior to making the decision.
6. The full judgement can be accessed on the Federal Court of Australia website at: http://www.judgments.fedcourt.gov.au/judgments/Judgments/fca/single/2018/2018fca1150
7. Malu Lamar's successful challenge meant that the decision to vary licence conditions was quashed, with the effect that both TIB and TVH licence holders were again permitted to use hookah gear to take TRL, except during moon-tide hookah closure periods previously implemented on 10 April 2018.

New Assistant Minister

8. On 28 August 2018, Senator the Hon. Richard Colbeck was sworn in as the Assistant Minister for Agriculture and Water Resources. In his position, Senator Colbeck will serve as the Chair of the Protected Zone Joint Authority. The previous Assistant Minister, Senator the Hon. Anne Ruston is now the Assistant Minister for International Development and the Pacific.

Australian National Audit Office (ANAO) performance audit

9. The ANAO is currently undertaking a performance audit of the coordination arrangements of Australian Government agencies operating in the Torres Strait. The audit will examine whether Australian Government agencies operating in the Torres Strait have appropriate governance arrangements to support the coordination of their activities; and the coordination arrangements are effective in supporting Australian Government activities in the Torres Strait.

10. The audit was open for contribution until 30 September 2018 with a report due to be tabled in January 2019. Australian Government agencies subject to the audit include AFMA, the Department of Agriculture and Water Resources, the Department of Foreign Affairs and Trade, the Department of Home Affairs and the TSRA.

11. Further information on the audit can be accessed on the ANAO website at: https://www.anao.gov.au/work/performance-audit/coordination-arrangements-australian-government-entities-operating-torres-strait

Summary of actions taken concerning the management of the Australian Torres Strait Tropical Rock Lobster (TRL) Fishery for the 2017/18 fishing season.

Date	Description of management action
1-12 Nov 17	**Pre-season survey** CSIRO conducted the annual pre-season survey.
12-13 Dec 17	**TRL Resource Assessment Group (RAG) meeting** The RAG considered the preliminary results of the November 2017 pre-season survey and integrated stock assessment. The RAG recommended a preliminary recommended biological catch (RBC) of 299,000 kg for the 2017/18 fishing season (Australia and PNG inclusive).
1 Feb 18	**Letter to licence holders – moon-tide hookah closures** AFMA (as PZJA licencing delegate) implemented moon-tide hookah closures in the TRL Fishery for the 2017/18 fishing season.
5 Feb 18	**Australia-PNG Fisheries Bilateral meeting** Australia and PNG agree to a preliminary RBC of 299,000 kg for the 2017/18 fishing season. Until final catch shares of the RBC were agreed between Australia and PNG, the TRL Fishery was managed to an Australian catch share of 190,650 kg. This amount reflects the ordinary operation of the apportionment process under the Torres Strait Treaty, pending agreement with PNG.
22 Feb 18	**Letter to licence holders – preliminary RBC** AFMA advised of the preliminary RBC for the 2017/18 fishing season, and that additional management measures may be needed to regulate catches in line with the RBC.
27 Feb 18	**Public meeting** AFMA held a public meeting with licence holders, industry representatives and other stakeholders to provide information of the preliminary RBC for the 2017/18 fishing season, and advise that additional management measures may be needed to regulate catches in line with the RBC.
27-28 Mar 18	**TRLRAG meeting** The RAG considered the final results of the November 2017 pre-season survey and integrated stock assessment. The RAG recommended a final RBC of 299,000 kg for the 2017/18 fishing season (Australia and PNG inclusive).
28-29 Mar 18	**TRL Working Group (WG) meeting** The WG considered management measures necessary to ensure catches do not exceed the Australian catch share of the RBC for the 2017/18 fishing season. The WG recommended: a. catches should not exceed the RBC noting over catching will increase the risk of the TRL Fishery not reaching its interim harvest strategy target. Which is to maintain the stock at (on average), or return to, a target biomass point B_{TARG} (B_{TARG} = 0.65 B_0) that takes account of the fact that the resource is shared and important for the traditional

	way of life and livelihood of traditional inhabitants and is biologically and economically acceptable; and b. measures be adopted to prolong the opportunity for the TIB sector to fish for the duration of the season. It was also noted that prolonging fishing would allow the collection of catch per unit effort data over a longer period which will inform the next stock assessment for the TRL Fishery.
10 Apr 18	**Letter to licence holders – additional moon-tide hookah closures** AFMA (as PZJA licencing delegate) implemented additional moon-tide hookah closures in the TRL Fishery covering all new and full moon periods for the remainder of the 2017/18 fishing season. The implementation of these closures was undertaken to give immediate effect to the WG recommendations. The closures reduced effort in the TRL Fishery but updated projections following the RAG and WG meetings estimated the Australian catch share of the RBC would be reached by late May 2018.
26 Apr 18	**Meeting of TRLWG members** A meeting of TRLWG members considered whether any additional management measures should be applied to further prolong fishing within the season, noting the PZJA will take steps to close the TRL Fishery to ensure the Australian catch share of the RBC is not exceeded. As a majority of TIB industry members were absent from the meeting, a quorum was not present and so did not constitute a formal meeting of the Working Group. The meeting proceeded to enable an opportunity for those members that were present to provide advice. Having regard for the objectives of the *Torres Strait Fisheries Act 1984* (the Act) and administrative feasibility options discussed by members of the TRLWG included: a. no additional measures and close the TRL Fishery when the Australian share of the RBC is reached; b. further hookah closures for May-June or for the remainder of the fishing season; c. TRL Fishery closure for May-June or fortnight each month; d. increase the minimum size limits.
27 Apr 18	**Letter to licence holders – hookah prohibition** AFMA (as PZJA licencing delegate) implemented a prohibition on the carriage and use of hookah gear in the TRL Fishery for the remainder of the 2017/18 fishing season. The implementation of this closure was undertaken to give immediate effect to the WG recommendations.
23 May 18	**TRLRAG meeting** The RAG considered analyses of CPUE and length frequency data and evaluated the merits of additional survey options to support future stock assessments. The RAG recommended that a mid-year survey be conducted for the purposes of providing further data: on the abundance and spatial distribution of TRL to input to the 2018/19 stock assessment; to validate the results of the November 2017 pre-season survey; and, to provide forewarning on the likelihood of another low RBC for the 2018/19 season.

8 Jun 18	**Letter to licence holders – Australia-PNG agreement on catch shares** AFMA advised of the agreement between Australia and PNG on final catch shares of the RBC for the 2017/18 fishing season, on the basis that there will be no cross-endorsement, whereby boats from Australia and PNG can be licensed to fish in the other country's waters. As a result, the final catch shares were: 254,150 kg to be taken by Australian boats in Australian waters; and 44,850 kg in to be taken by PNG boats in PNG waters.
28 Jun 18	**Letter to licence holders – Federal Court of Australia judgement** AFMA advised that Malu Lamar's application to reverse AFMA's decision, to prohibit the carriage and use of hookah gear in the TRL Fishery for the remainder of the 2017/18 fishing season, was granted by the Federal Court of Australia effective 1600 AEST 29 June 2018. Malu Lamar's successful challenge meant that both TIB and TVH licence holders were again permitted to use hookah gear, except during moon-tide hookah closure periods previously implemented on 10 April 2018.
28 Jun-9 Jul 18	**Mid-year survey** CSIRO conducted a mid-year survey.
20 Jul 18	**Management Instrument** *The Torres Strait Fisheries (Tropical Rock Lobster) Management Instrument 2018* (the Instrument) came into effect on 20 July 2018. The Instrument provides for: a. the closure of the TRL Fishery by the CEO of AFMA in circumstances where the commercial catch of TRL is likely to exceed the Australian catch share of the RBC (the total allowable catch (TAC)) before the end of a fishing season; and b. flexibility in the regulation of the carriage and use of hookah gear in the TRL Fishery. Future regulation of the carriage and use of hookah gear will occur under the Instrument, replacing conditions on licences under section 22 of the Act.
20 Jul 18	**TRLRAG correspondence** AFMA circulated the preliminary results from the mid-year survey to RAG members.
24 Jul 18	**Letter to licence holders – TRL Fishery closure** AFMA notified licence holders that commercial fishing in the TRL Fishery will close for the remainder of the 2017/18 fishing season, effective 31 July 2018 to 30 November 2018.
22 Aug 18	**TRL Fishery Management Plan** Media release from the Senator the Hon. Anne Ruston stating that after listening to the concerns of the Torres Strait community and commercial fishers, the PZJA will consider implementing a TRL Fishery Management Plan by 1 December 2018.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	MEETING 24 18-19 October 2018
UPDATES FROM MEMBERS **PNG National Fisheries Authority**	**Agenda Item 2.3** **For Information**

RECOMMENDATIONS

1. That the RAG **NOTE** the update to be provided by the PNG National Fisheries Authority (NFA).

BACKGROUND

2. A verbal report will be provided under this item subject to the availability of NFA officers.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
UPDATES FROM MEMBERS **Native Title**	**Agenda Item 2.4** **For Information**

RECOMMENDATIONS

1. That the RAG **NOTE** any updates on Native Title matters from members, including representatives of Malu Lamar (Torres Strait Islanders) Corporation RNTBC (Malu Lamar).

BACKGROUND

2. On 7 August 2013 the High Court of Australia confirmed coexisting Native Title rights, including commercial fishing, in the claimed area (covering most of the Torres Strait Protected Zone). This decision gives judicial authority for Traditional Owners to access and take the resources of the sea for all purposes. Native Title rights in relation to commercial fishing must be exercisable in accordance with the *Torres Strait Fisheries Act 1984*.
3. Traditional Owners and Native Title representative bodies have an important role in managing Torres Strait fisheries. It is important therefore that the RAG keep informed on any relevant Native Title issues arising.
4. AFMA has extended an invitation to Malu Lamar to attend this meeting as an observer and is investigating longer term arrangements for representation in consultation with PZJA agencies.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
CATCH SUMMARY FOR THE 2017/18 FISHING SEASON	**Agenda Item 3** **For Information**

RECOMMENDATIONS

1. That the RAG:

   a. **NOTE** the reported landed catch for the Australian Torres Strait TRL Fishery for the 2017-18 fishing season is 261,067 kg (**Attachment 3a**);

   b. **NOTE** the reported catch for the PNG TRL Fishery taken from inside and outside the Torres Strait Protected Zone for the period 1 January 2018 to 21 September 2018 is 66,361 kg and 2,302 kg respectively (**Attachment 3a**).

KEY ISSUES

Australian TRL catch

2. As reported through the mandatory fish receiver system, implemented on 1 December 2017, the reported landed catch for the Australian Torres Strait TRL Fishery for the 2017-18 fishing season is 261,067 kg (**Table 1**).
3. This equates to 102.72 per cent of the 254,150 kg Australian catch share of the recommended biological catch (RBC). This catch data is sourced from the Torres Strait Fisheries Catch Disposal Record (TDB02) and covers the Traditional Inhabitant Boat (TIB) and Transferable Vessel Holder (TVH) sectors only.
4. Further details are provided at **Attachment 3a**.

PNG TRL catch

5. The reported catch for the PNG TRL Fishery taken from the Torres Strait Protected Zone for the period 1 January 2018 to 21 September 2018 is 66,361 kg (**Table 2**). The reported catch for the PNG TRL Fishery taken from outside of the Torres Strait Protected Zone for the period 1 January 2018 to 21 September 2018 is 2,302 kg (**Table 3**).
6. The PNG catch share of the RBC for the 2017-18 fishing season was 44,850 kg.
7. Further details are provided at **Attachment 3a**.

Table 1. Reported landed catch (kg whole weight) of Tropical Rock Lobster (TRL) for the Australian Torres Strait TRL Fishery for the 2017-18 fishing season. Source: Torres Strait Fisheries Catch Disposal Record (TDB02) as at 03 October 2018.

Month	Reported catch (kg) for Traditional Inhabitant Boat (TIB) licence holders*	Reported catch (kg) for Transferable Vessel Holder (TVH) licence holders*^	Total reported catch (kg)*
Dec-17	15,077.98	33.72	**15,111.70**
Jan-18	13,059.72	0.00	**13,059.72**
Feb-18	20,936.83	42,415.36	**63,352.19**
Mar-18	19,095.97	28,605.83	**47,701.79**
Apr-18	17,063.75	23,381.14	**40,444.88**
May-18	10,130.47	3,110.28	**13,240.75**
Jun-18	10,832.57	2,966.17	**13,798.75**
Jul-18	20,800.78	33,557.31	**54,358.09**
Total reported catch (kg)*	**126,998.06**	**134,069.81**	**261,067.87**
Reported catch as a per cent (%) of the TAC~	**49.97**	**52.75**	**102.72**
Reported catch as a per cent (%) of total reported catch	**48.65**	**51.35**	**100.00**

Notes:

* The reported catch figures are sourced from catch disposal records (TDB02). There may be some outstanding records. The reported catch figures do not include any unreported catch.

^ The reported catch figures for Transferable Vessel Holder (TVH) licence holders includes catch taken under licences held by the Torres Strait Regional Authority (TSRA).

~ The total allowable catch (TAC) for the Australian Torres Strait TRL Fishery for the 2017-18 fishing season was 254,150kg. The 2017-18 fishing season ran from 1 December 2017 to 30 July 2018.

Table 2. Reported catch of Tropical Rock Lobster (TRL) for the PNG TRL Fishery taken from the Torres Strait Protected Zone for the period 1 January 2018 to 21 September 2018. Source: PNG National Fisheries Authority.

Month	Reported catch (kg) of frozen tails (converted to whole weight)*^	Reported catch (kg) of live TRL (whole weight)*	Total reported catch (kg)*
Jan-18	4,858.58	1,320.00	**6,178.58**
Feb-18	10,067.87	1,980.00	**12,047.87**
Mar-18	2,125.87	0.00	**2,125.87**
Apr-18	9,538.15	2,640.00	**12,178.15**
May-18	5,841.37	1,980.00	**7,821.37**
Jun-18	5,528.00	1,320.00	**6,848.00**
Jul-18	7,621.43	2,640.00	**10,261.43**
Aug-18	5,705.62	3,195.00	**8,900.62**
Total reported catch (kg)*	**51,286.89**	**15,075.00**	**66,361.89**

Notes:

* Reported catch is from the area of the Torres Strait Protected Zone only.

^ A conversion factor of 2.667 has been applied to convert tail to whole weight.

Table 3. Reported catch of Tropical Rock Lobster (TRL) for the PNG TRL Fishery taken from outside of the Torres Strait Protected Zone for the period 1 January 2018 to 21 September 2018. Source: PNG National Fisheries Authority.

Month	Reported catch (kg) of tails*^~
Jan-18	129.62
Feb-18	33.60
Mar-18	69.61
Apr-18	270.70
May-18	1,354.04
Jun-18	429.39
Jul-18	0.00
Aug-18	16.00
Total reported catch (kg)*~	**2,302.95**

Notes:

* Reported catch is from outside of the area of the Torres Strait Protected Zone only.

^ A conversion factor of 2.667 has been applied to convert tail to whole weight.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
CATCH AND CPUE ANALYSES FOR THE 2017/18 FISHING SEASON	**Agenda Item 4** **For Discussion and Advice**

RECOMMENDATIONS

1. That the RAG **DISCUSS** and **PROVIDE ADVICE** on the updated catch and catch per unit effort (CPUE) data analyses for the TRL Fishery for the 2017/18 fishing season (**Attachments 4a, 4b and 4c**) (Attachment 4c pending).

KEY ISSUES

2. At the TRLRAG meeting held on 27-28 March 2018 (TRLRAG22) some industry members expressed concerns that observations whilst fishing and the catch rates and sizes experienced by fishers did not align with what would be expected from the results of the November 2017 pre-season survey, 2017/18 integrated stock assessment and a low RBC. AFMA continued to receive similar feedback from some in industry as the season progressed. Based on these observations, some in industry believed the survey and assessment may be misaligned with actual abundance in the 2017/18 fishing season.
3. At the TRLRAG meeting held on 15 May 2018 (TRLRAG23), members considered catch, effort, length frequency and survey data analyses conducted by CSIRO. The RAG noted:
    a. The available data and presented analyses does not indicate a better than average season, although it could be argued that it is a low average season rather than a low season. Nor does the data or analyses support an alternative to the survey prediction of a below average abundance of recruiting 1+ lobsters when averaged across the whole Fishery. Early season catches have comprised largely of residual 2+ lobsters. The data has not shown an input of recruiting1+ lobsters into the Fishery that is higher than expected.
    b. The spatial distribution of catches is notably different from previous seasons, and are concentrated in the North West of the Fishery.
    c. Changes to the management arrangements and fishing effort this season has impacted on the reliability of CPUE data, used as an indicator of abundance for the Fishery. The CPUE can be standardised to take account of these changes however some uncertainties will remain. In addition, should the Fishery be closed early this season, the CPUE data would be incomplete and less usable in the stock assessment. The assessment will still function, but there will be greater uncertainty around the results.
4. CSIRO have continued to analyse all available data. CSIRO's latest analysis of the available catch and effort data is attached for RAG discussion and advice:
    a. *Torres Strait Rock Lobster Fishery – Summary of the Catch and Effort Data pertaining to the 2018 Fishing Season (Dec-17 to Jul-18)* (**Attachment 4a**);
    b. *Use of TVH Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2018 Update* (**Attachment 4b**);
    c. Pending (**Attachment 4c**).
5. These analyses will be presented further at the meeting. Further analyses of available length frequency and survey data will be provided under Agenda Item 5.

Torres Strait Rock Lobster Fishery – Summary of the Catch and Effort Data pertaining to the 2018 Fishing Season (Dec-17 to Jul-18)

Robert Campbell, Eva Plaganyi, Roy Deng, Mark Tonks, Mick Haywood

CSIRO Oceans and Atmosphere

October 2018

1. Introduction

This paper provides a summary of the catch and effort data pertaining to the Torres Strait Rock Lobster (TSRL) fishery during the 2018 fishing season. (Note, a fishing season begins on 1-December in a given year and extends through to 30-September the following year). In particular, as the 2018 ended early at the end of July, the paper provides a comparison of the annual trends in catch, effort and catch-rates in the eight months of December through to July so that the relative performance of the fishery during the 2018 season can be assessed relative to comparative periods of previous seasons. Note, this paper updates the previous paper presented to the Torres Strait Rock Lobster RAG in May 2018 (Campbell et al 2018).

2. Data

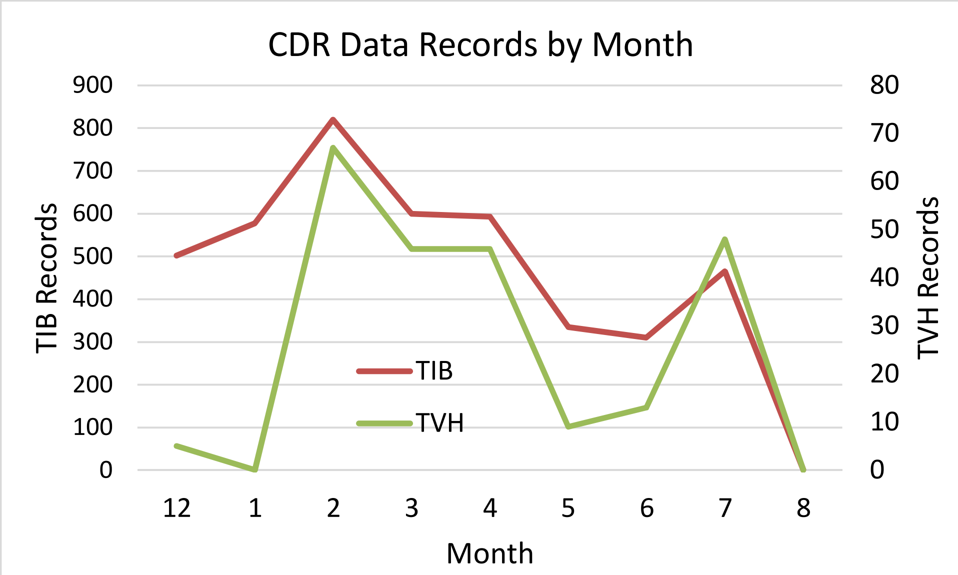
TIB-Sector

A new logbook, known as the Torres Strait Catch Disposal Record (TDB02), was introduced in the TSRL fishery on 1-December 2017. This logbook, which is mandatory to complete, records the catch weight of lobsters landed at the completion of all fishing trips. As well as information related to the fish receiver, the logbook also records information related to the fisher (name, boat symbol, etc), the sector of the fishery that the fisher operated (e.g. TIB or TVH) and the process state of the catch (e.g. whole, live or tailed). Additional information related to fishing effort (e.g. days fished, number of fishers) together with the area fished and methods used is currently only optional.

The TDB02 logbook replaces the Torres Strait Seafood Buyers and Processors Docket Book (TDB01) which had been used in the TIB sector to record the catch sold by fishers at the end of a fishing trip. Completion of this docket-book had only been voluntary and in several fishing seasons (2013-2016) the catch data for the TIB sector was supplemented with aggregate catch data obtained directly from several processors. The introduction of the compulsory TDB02 should rectify this past issue. Hopefully, the TDB02 logbook will also rectify previous issues which were associated with the use of the TDB01 docket-book such as the double recording of catches (see Campbell and Pease 2017). Whether or not the introduction of the compulsory TDB02 logbook will lead to an increase in the reporting levels of the TIB catch will also need to be assessed.

Data related to the TDB02 CDR logbook was last obtained from AFMA on 26 September 2018 while the last batch of data related to the TDB01 docket-book was obtained from AFMA in late October 2017. For the data summaries presented in this paper for the TIB sector, all data before December 2017 is based from this latter data while all data since December 2017 is taken from the TDB02 CDR logbook. The TDB01 docket-book data may be incomplete to some extent for the last few months up until November 2017; however the TDB02 data for

Figure 1. Number of data records per month for each sector of the TSRL fishery present in the TDB02 CDR data sent by AFMA on 25-Sep-18. Note, the month of each record is based on the trip-end date. The date of the last trip/shot date recorded for the TIB and TVH sectors is 30-Jul-18 and 24-Jul-18 respectively.



the 2018 season is considered to be complete (c.f. Figure 1). A more detailed summary of the TIB data for the period up to October 2017 is provided in Campbell et al (2017a).

TVH-Sector

Together with the catch landed by the TIB-sector of the TSRL fishery, the new Torres Strait Catch Disposal Record (TDB02), introduced in the TSRL fishery at the start of November 2017, also records the catch landed by the TVH-sector. However, unlike for the TIB-sector, catch and effort data related to the TVH sector also continues to be recorded in the Torres Strait Tropical Rock Lobster Fishery Daily Fishing Log (TRL04).

Data related to the TRL04 logbook for the 2018 season was obtained from AFMA on 25 September 2018. For the data summaries presented in this paper for the TVH sector all data is based on information recorded in the TRL04 logbook. As with the TSDB01 logbook, the TRL04 logbook data may also be incomplete to some extent up until November 2017, while the TRL04 data (as with the TDB02 logbook) for the 2018 season is considered to be complete (c.f. Figure 1). A more detailed summary of the TVH data for the period up to October 2017 is provided in Campbell et al (2017b).

3. Catch by Season

A comparison of the estimated total catch by sector for the seasons 2004 to 2018 is shown in Figure 2. As the TVH catch is recorded in both the TRL04 logbook and the TDB02 logbook, two estimates for the 2018 season are provided for this sector. The small difference noted in the estimated TVH catch from these two logbooks is likely due to the fact that TRL04 weights are often estimated compared to more accurate weighing on land and a discrepancy of between 5-10% can usually be expected. Some differences in these catch estimates may also be due to differences in the times that AFMA receive and enter data from the two logbook during the season.

Figure 2. Time-series of total catch by fishing season (December-November) and sector since 2004. TIB data is based on TDB01 docket-book and TDB02 CDR data, while TVH data is based on TRL04 logbook data. Data for 2018 only covers the period December-July as the fishery was closed at the end of July-2018.

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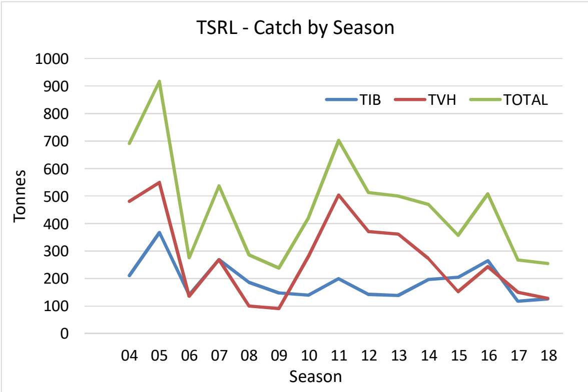
SEASON	TIB	TVH	TOTAL
2004	210.4	481.1	691.5
2005	367.6	549.9	917.6
2006	140.5	135.5	275.9
2007	268.7	268.6	537.3
2008	185.7	100.4	286.1
2009	147.8	91.1	238.9
2010	140.0	282.6	422.7
2011	199.1	503.5	702.6
2012	142.4	370.5	512.9
2013	138.4	361.7	500.1
2014	196.8	273.2	470.0
2015	204.7	152.7	357.4
2016	264.7	243.0	507.7
2017	117.9	149.7	267.6
2018	126.5	128.3	254.8



NB. TVH (2018) =134.1 based on CDR

The reported catch by month for each sector of the TSRL for the 2004-2018 fishing seasons is shown in Table 1. The catch by month for the TVH sector is based on information reported in the TRLO04 logbook, while the catches for the TIB sector are based on information reported in the TBD01 docket-book and TDB02 CDR. Furthermore, for the TIB sector the catch by month for the 2013-2016 fishing seasons is an estimate as the catch month is not known for a substantive portion, *P*, of the total catch in these seasons (*P*=39%, 34%, 33%, 55% respectively). These relate to the aggregate catches reported by several processors on a seasonal basis to account for missing docket-book records. For these seasons the catch within each month was estimated by raising the known catch in each month by the factor $R= 1/(1-P)$. This assumes that the distribution of the catches by month in the aggregate catch data is the same as the distribution within the docket-book recorded catches.

Based on the catch-by-month estimates provided in Table 1, the time-series of catch by month for the eight months December-to- July is shown in Figure 3 for each sector of the TSRL over the seasons 2004-2018.

Table 1. Catch by month (kilograms) for (a) the TIB sector, (b) the TVH sector and (c) the total TSRL fishery for the 2004-2018 fishing seasons. Note, the catch by month for the TVH is based on information reported in the TRL04 logbook, while the catches for the TIB sector are based on information reported in the TBD01 docket-book and TDB02 CDR. Furthermore, for the TIB sector the catch by month for the 2013-2016 fishing seasons is an estimate as the catch month is not known for a substantive portion *P* of the total catch in these seasons (*P*=39%, 34%, 33%, 55% respectively). For these seasons the catch within each month was estimated by raising the known catch in each month by the factor *R*= *1/(1-P*).

(a) TIB (From TBD01 and TDB02 logbooks

SEASON	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
2004		15,542	24,309	35,574	17,737	30,356	28,516	26,449	18,976	12,873	24	25	210,381
2005	21,648	15,098	50,625	58,221	47,575	56,758	43,061	34,474	23,682	16,088	314	71	367,615
2006	12,507	9,447	24,018	26,814	19,091	18,380	9,814	9,910	7,672	2,747	0	51	140,451
2007	19,002	24,941	24,716	62,040	29,185	33,759	29,025	23,193	13,907	8,920	0	0	268,688
2008	10,435	13,461	31,237	36,127	24,110	16,711	14,805	23,516	9,277	5,969	18	0	185,666
2009	9,716	13,273	20,547	23,103	23,733	15,647	13,242	15,393	7,811	4,819	529	0	147,813
2010	5,764	6,198	21,259	15,829	14,995	12,180	16,348	19,073	17,001	9,782	1,610	0	140,039
2011	6,929	18,215	30,141	49,767	20,400	23,990	18,686	18,856	8,858	3,218	0	0	199,060
2012	9,036	13,403	19,028	24,718	19,606	9,689	22,874	11,194	10,836	1,996	0	0	142,380
2013	3,080	1,371	15,940	13,421	20,778	18,606	16,324	18,656	14,425	15,837	0	0	138,439
2014	10,773	13,339	18,379	38,920	28,385	25,455	16,908	17,455	17,388	9,639	187	0	196,827
2015	18,513	9,495	31,813	21,672	27,456	17,212	45,680	13,204	11,819	7,512	283	0	204,659
2016	10,156	15,604	52,833	36,406	23,176	34,192	33,687	25,025	22,438	10,821	220	168	264,725
2017	11,536	8,290	23,339	15,831	11,697	14,959	7,476	9,730	10,803	4,075	155	0	117,891
2018	15,097	13,067	20,950	19,104	17,075	10,137	10,629	20,418	0	0	0	0	126,477

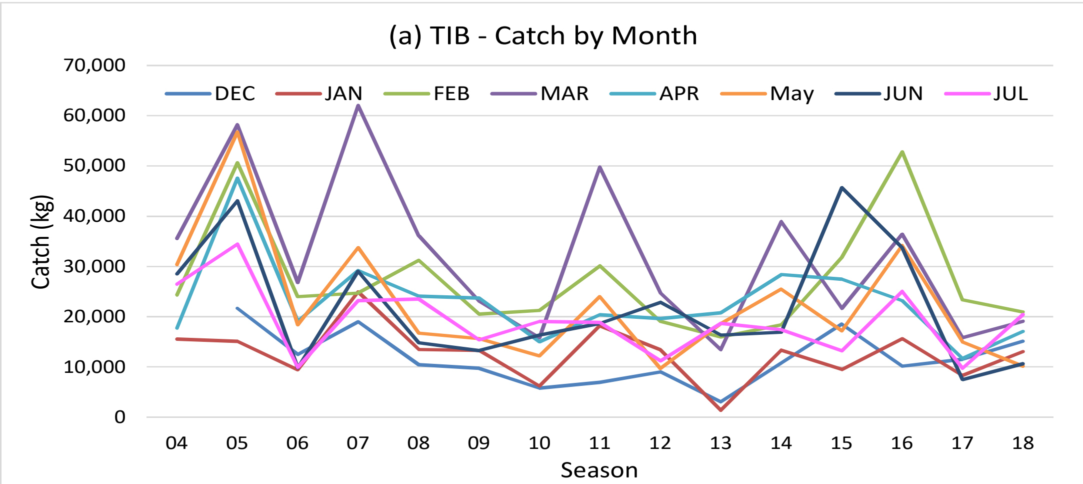
(b) TVH (From TRL04 logbook)

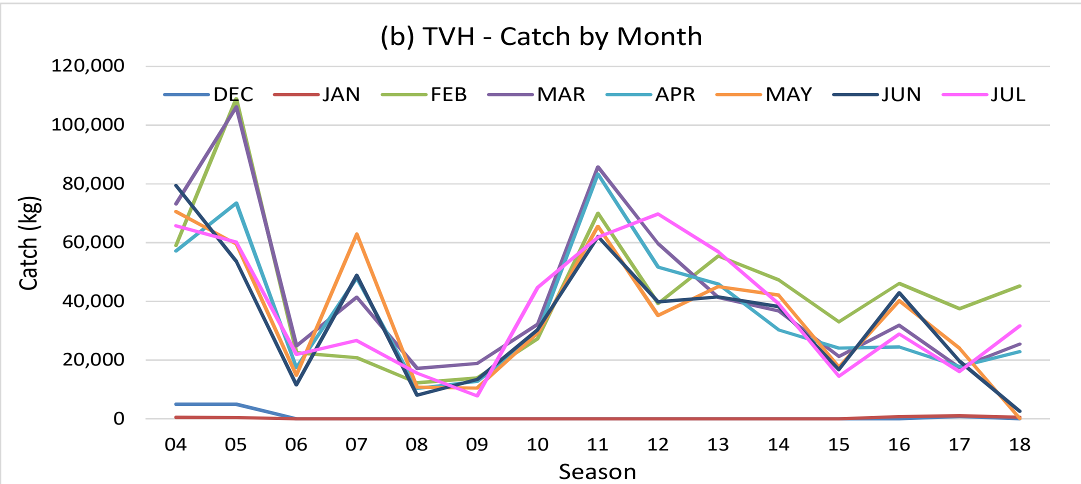
SEASON	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
2004	4,949	452	58,965	73,180	57,142	70,551	79,438	65,766	48,014	22,625	0	0	481,082
2005	4,984	398	108,962	106,276	73,510	59,475	53,618	60,103	51,795	30,814	0	0	549,935
2006	25	0	22,512	24,860	17,491	14,798	11,490	21,952	16,756	5,589	0	0	135,473
2007	0	0	20,768	41,389	47,980	62,933	48,836	26,689	13,633	6,368	0	0	268,596
2008	0	0	12,285	17,166	10,334	10,809	7,997	15,482	16,819	9,545	0	0	100,437
2009	0	0	13,905	18,881	12,748	10,479	13,408	7,824	10,345	3,470	0	0	91,060
2010	0	0	27,311	32,164	29,202	29,192	30,315	44,734	52,026	37,670	0	0	282,614
2011	0	0	69,994	85,730	83,334	65,515	62,084	61,867	45,097	29,913	0	0	503,534
2012	0	0	39,228	59,636	51,696	35,159	39,807	69,718	48,959	26,280	0	0	370,483
2013	0	0	55,428	41,275	45,929	45,030	41,502	56,818	47,621	28,058	0	0	361,661
2014	0	0	47,338	36,706	30,230	42,088	38,160	39,061	23,418	16,213	0	0	273,214
2015	0	0	32,992	21,166	24,051	17,623	16,745	14,460	19,782	5,891	0	0	152,710
2016	0	750	46,101	31,830	24,474	40,200	42,871	28,854	18,851	9,079	0	0	243,010
2017	690	1,051	37,432	17,478	17,701	23,982	19,559	16,105	12,939	2,801	0	0	149,738
2018	0	565	45,187	25,440	22,791	101	2,628	31,612	0	0	0	0	128,324
TDB02	34	0	42,429	28,610	23,390	3,115	2,967	33,563					134,108

(c) TOTAL

SEASON	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
2004	4,949	15,994	83,274	108,754	74,879	100,907	107,954	92,215	66,990	35,498	24	25	691,463
2005	26,632	15,496	159,587	164,497	121,085	116,233	96,679	94,577	75,477	46,902	314	71	917,550
2006	12,532	9,447	46,530	51,674	36,582	33,178	21,304	31,862	24,428	8,336	0	51	275,924
2007	19,002	24,941	45,484	103,429	77,165	96,692	77,861	49,882	27,540	15,288	0	0	537,284
2008	10,435	13,461	43,522	53,293	34,444	27,520	22,802	38,998	26,096	15,514	18	0	286,103
2009	9,716	13,273	34,452	41,984	36,481	26,126	26,650	23,217	18,156	8,289	529	0	238,873
2010	5,764	6,198	48,570	47,993	44,197	41,372	46,663	63,807	69,027	47,452	1,610	0	422,653
2011	6,929	18,215	100,135	135,497	103,734	89,505	80,770	80,723	53,955	33,131	0	0	702,594
2012	9,036	13,403	58,256	84,354	71,302	44,848	62,681	80,912	59,795	28,276	0	0	512,863
2013	3,080	1,371	71,368	54,696	66,707	63,636	57,826	75,474	62,046	43,895	0	0	500,100
2014	10,773	13,339	65,717	75,626	58,615	67,543	55,068	56,516	40,806	25,852	187	0	470,041
2015	18,513	9,495	64,805	42,838	51,507	34,835	62,425	27,664	31,601	13,403	283	0	357,369
2016	10,156	16,354	98,934	68,236	47,650	74,392	76,558	53,879	41,289	19,900	220	168	507,735
2017	12,226	9,341	60,771	33,309	29,398	38,941	27,035	25,835	23,742	6,876	155	0	267,629
2018	15,097	13,632	66,137	44,544	39,866	10,238	13,257	52,030	0	0	0	0	254,801

Figure 3. Time-series of catch by month for the eight months December-to-July for (a) the TIB sector, (b) the TVH sector and (c) the total TSRL fishery. Note, the catch by month for the TVH is based on information reported in the TRL04 logbook, while the catches for the TIB sector are based on information reported in the TBD01 docket-book and TDB02 CDR. Furthermore, the TIB sector the catch by month for the 2013-2016 fishing seasons is an estimate as the catch month is not known for a substantive portion *P* of the total catch in these seasons (*P*=39%, 34%, 33%, 55% respectively). For these seasons the catch within each month was estimated by raising the known catch in each month by the factor *R= 1/(1-P)*.





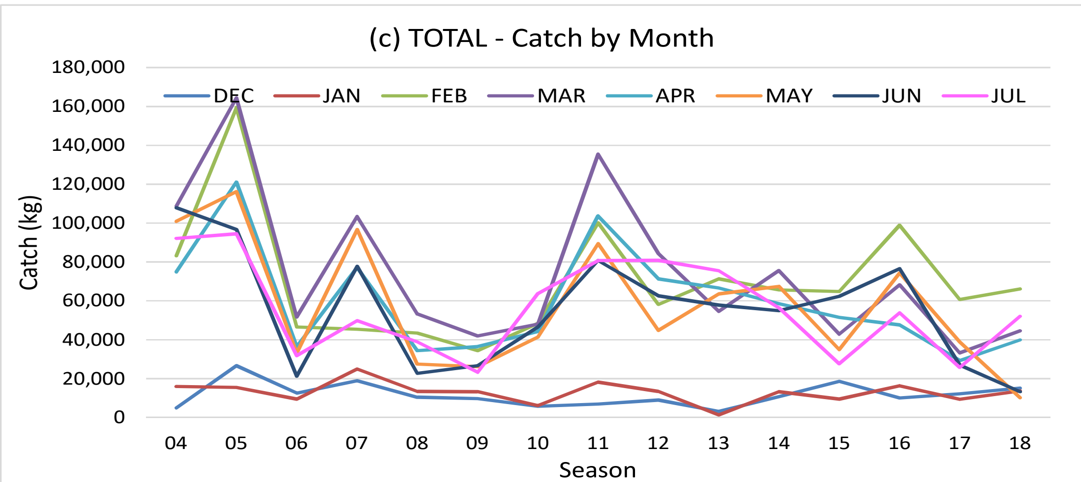


Figure 4. Map of the TIB fishing areas described in the analysis.

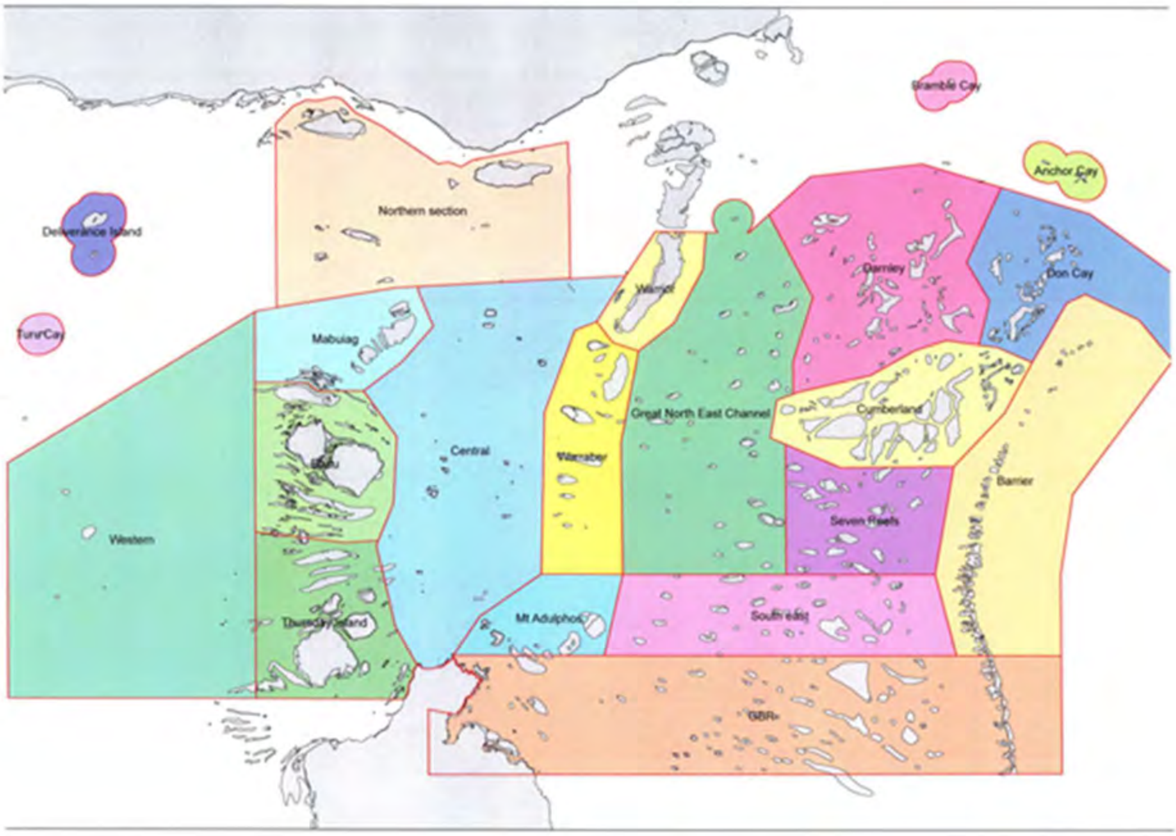


Table 2. (a) List of the area codes and names used in the TIB fishery together with the total number of data records associated with each area. A revised listing of area codes and names based on aggregating areas with few data records is shown in (b).

Area-Name	Area	Area-Rev	N-Records
Unknown	0	0	4,477
Turu Cay	1	6	249
Deliverance Island	2	6	29
Northern Section	3	6	269
Bramble Cay	4	16	19
Anchor Cay	5	16	9
Western	6	6	21
Mabuiag	7	7	6,181
Badu	8	8	5,915
Thursday Island	9	9	21,827
Central	10	10	763
Warrior	11	11	3,157
Warraber	12	12	4,319
Mt Adolphus	13	13	698
Great NE Channel	14	14	2,041
South East	15	15	118
Darnley	16	16	1,269
Cumberland	17	17	819
Seven Reefs	18	15	8
Don Cay	19	16	7
Barrier	20	15	10
GBR	21	15	155
		Total	52,360

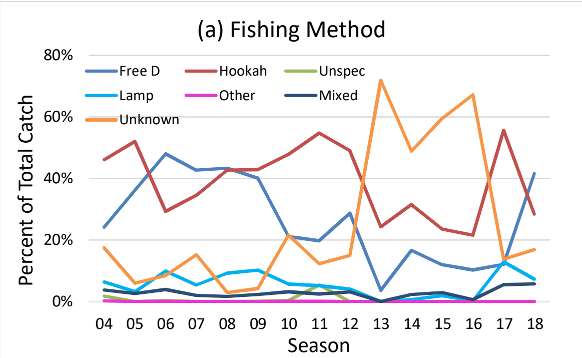
Area-Name	Area-Rev	N-Records
Unknown	0	4,477
North-Western	6	568
Mabuiag	7	6,181
Badu	8	5,915
Thursday Island	9	21,827
Central	10	763
Warrior	11	3,157
Warraber	12	4,319
Mt Adolphus	13	698
Great NE Channel	14	2,041
GBR/South-east	15	291
Darnley	16	1,304
Cumberland	17	819
	Total	52,360

4. TIB Sector Summary

The 21 areas used to record the spatial location of catch taken in the TIB sector are shown in Figure 4 and listed in Table 2(a). The total number of data records associated with each area for the 2004-2018 seasons is also shown. For the purpose of the following analyses, several areas where the data coverage was low were combined. A revised listing of area codes and names based on aggregating some areas is shown in Table 2(b). These are the areas and names referred to in the following Figures.

A comparison of the percent of the total TIB catch within each fishing season by (a) fishing method and (b) processed form is shown in Figure 5 while a comparison by area fished is shown in Figure 6. Note these results are based on all data available for each season, i.e. they are not limited to the temporal period (December-July) covered by the data for the 2018 season. Also note that some concerns were expressed at the RAG meeting held in May 2018 that the area-fished recorded on the TDB02 logbook may not coincide with the area where the actual fishing took place (it may instead coincide where the lobsters were sold). As such, the reader is reminded that the area-fished associated with catches in the TIB-sector may not be correct.

Figure 5. Time-series of percent of the total TIB catch within each fishing season by (a) fishing method and (b) processed form.



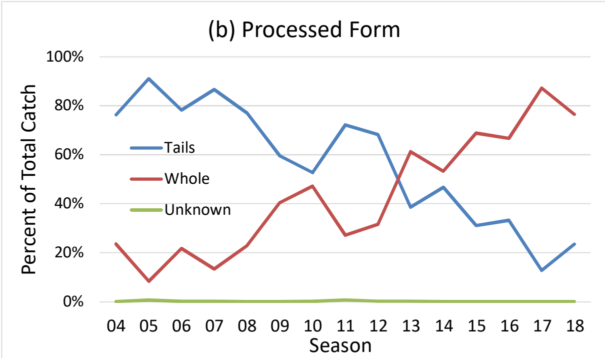


Figure 6. Time-series of percent of the total TIB catch within each fishing season taken in each area fished (as recorded on the TDB01 and TDB02 docket-books).

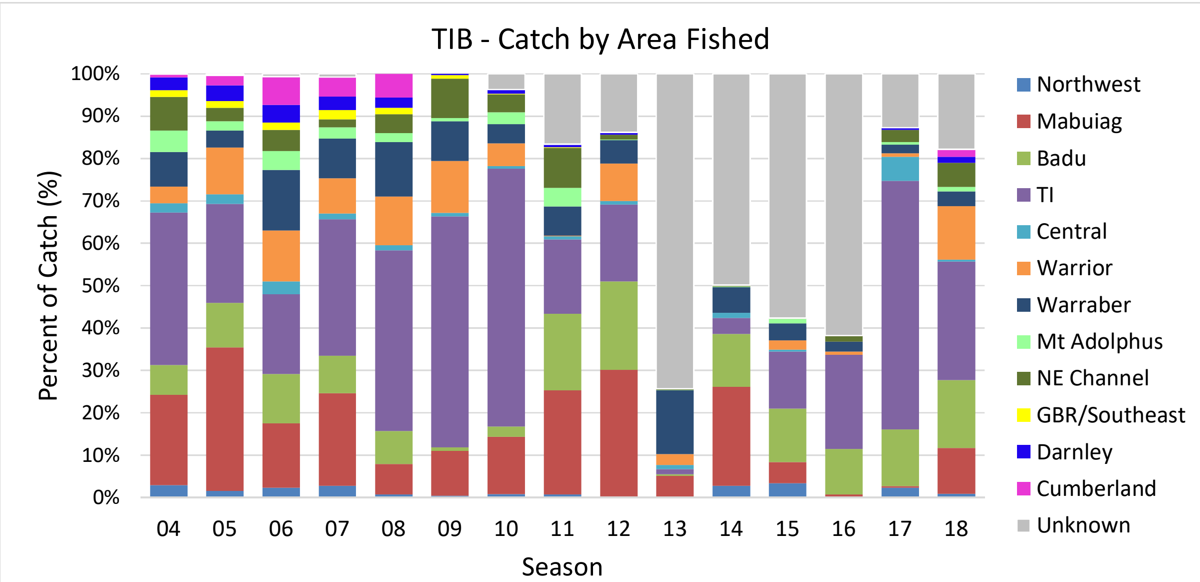
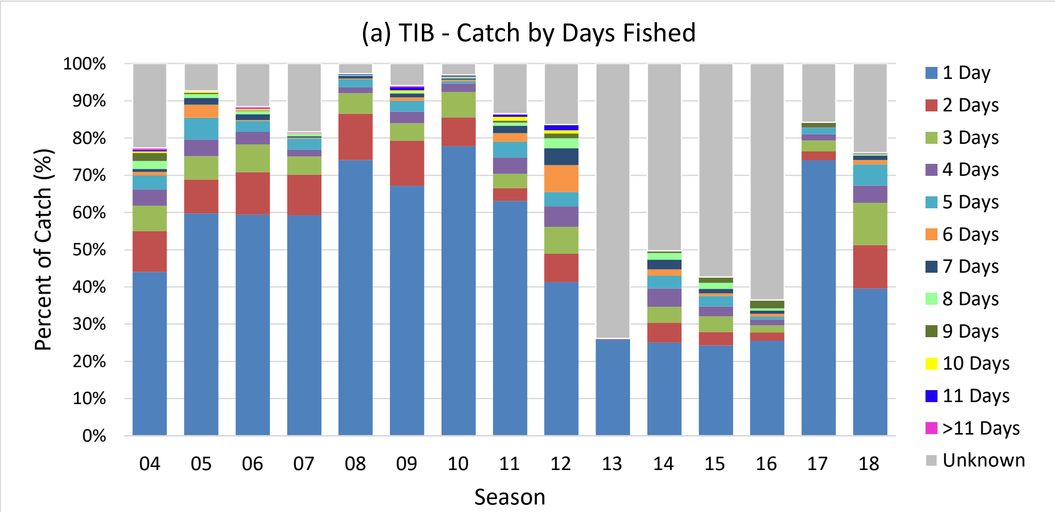


Figure 7. Comparison of percent of the TIB total annual catch stratified by the number of days fished per trip based on (a) all records including those where the days fished is unknown, and (b) those records where the unknown days fished are excluded.



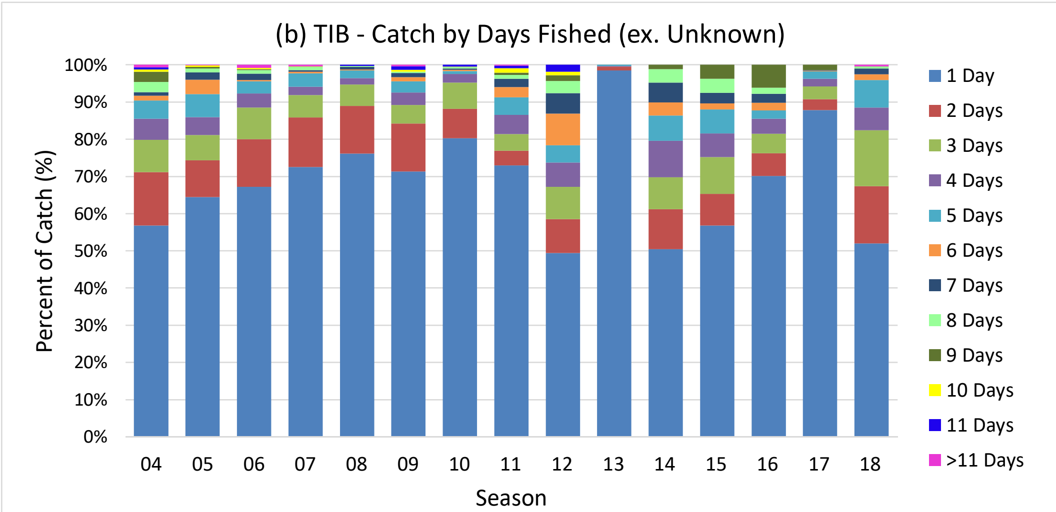
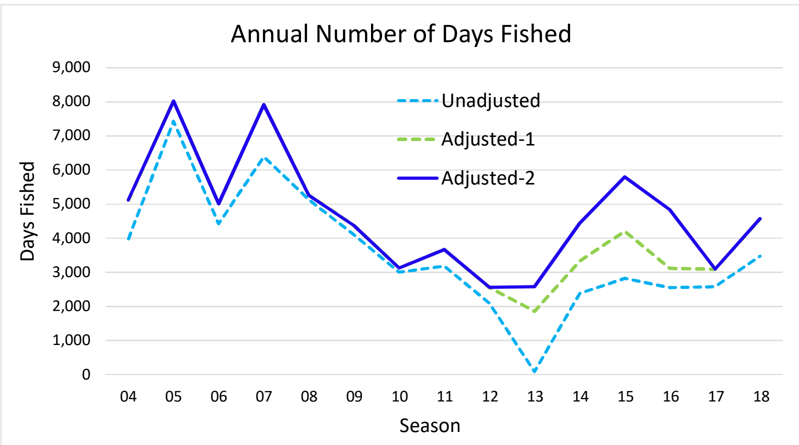


Figure 8. Seasonal comparison of estimated effort in the TIB fishery during the eight month period December-July. Analysis based on the method outlined in Campbell (2017).



A comparison of percent of the TIB total annual catch stratified by the number of days fished per trip is shown in Figure 7. As the number of days fished was not recorded for all docket-book records, and was also not available for the TIB catch provided in aggregate form by several processes, the proportion of the catch where the days fished is unknown is included in the result shown in Figure 7a. If one assumes that the distribution of days fished associated with the catch for which the effort information remains unknown is the same as that associated with the catch for which the effort information is known, then one can ascertain an estimate of the effort distribution across the entire catch by just excluding that portion of the catch where the effort information remain unknown. This result is shown in Figure 7b and indicates an increase in the proportion of the catch associated with trips of length greater than 1 day during the 2018 season. Finally, a seasonal comparison of estimated effort in the TIB fishery during the eight month period December-July is shown in Figure 8 This estimate is based on the method outlined in Campbell (2017) and uses as the total catch during these eight months those estimates shown in Table 1.

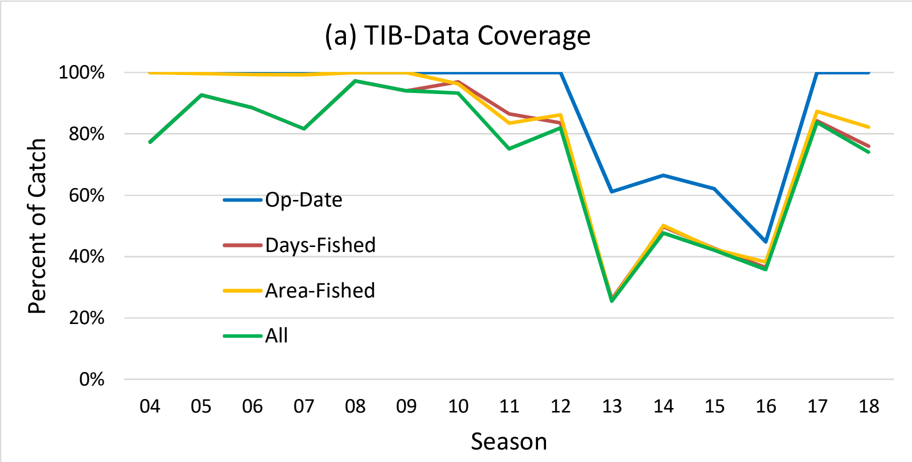
As noted above, not all the data fields on either the TBD01 or TDB02 logbooks are complete due to the voluntary nature of the provision of this information on both books. As noted above the incompleteness of these data fields creates problems in providing a complete analysis of the information for the TIB sector. An indication of availability of information is shown in Figure 9, which provides the annual percentage of the total TIB catch associated with records where various data fields are non-null. The data fields are, (i) Trip operation-date, (ii) Number of days fished, (iii) Area fished, (iv) Vessel-symbol and (v) Seller-name.

Another issue noted in previous analyses of the TIB data is the observation that while the structure of the Docket-Book would seem to indicate that there should be a unique Record-Number (Record-No) associated with each vessel, date and seller-name this structure is not strictly adhered to in the data. While analysis indicates that there is a single date, vessel and seller-name associated with each Record-No, further investigation also indicates that there are often multiple Record-Nos associated for a given vessel, date and seller-name. While the reason for these multiple records remains uncertain (they could be recording errors), in order to identity an appropriate data structure the following two sets of data were prepared for analysis:

First, the multiple Record-Nos associated for a given vessel, date and seller-name were assumed to be due to the recording of an incorrect date. As such the TIB data was aggregated by Record-No, which were each assumed to be associated with a unique record of sale for a given vessel, date and seller. Where the vessel or seller was not recorded, these fields were set to 'Unknown'. Records were not retained where the Days-Fished was unknown, and those records associated with TIB data recorded in the TVH logbook were also eliminated as the structure of the data for these records are different. In the following this data-set is known as the By-Rec data.

Second, the TIB data was aggregated over vessel-symbol, date and seller-name and any resulting data rows associated with more than one Record-No were eliminated. Again, where the vessel-symbol or seller-name was null these fields were set to 'Unknown'. Data where either the number of Days-Fished or the Area-Fished was not recorded, the record pertained to the TVH logbook, or the weight of the catch was zero or greater than 1000 kg were eliminated. Finally, only those data where the first fishing method listed was either 'Hookah diving' or 'Free diving' or 'Lamp fishing' were retained. In the following this data-set is known as the

Figure 9. Time-series of the percent of the total seasonal TIB catch associated with data records where various data fields are non-null. (a) Trip operation-date, number of days fished, area fished and all three together, and (b) vessel-symbol and seller-name.



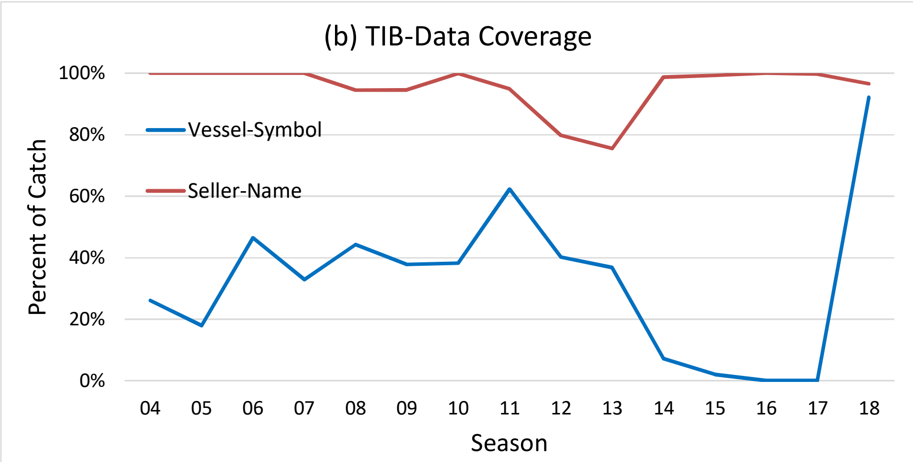
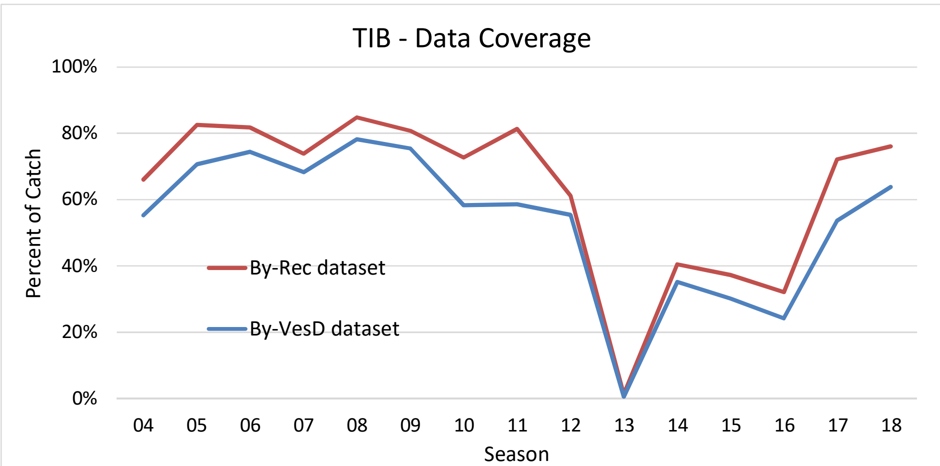


Figure 10. Time-series of the percent of the total TIB catch for the eight month period from December-to-July associated with data records included in the (a) By-Rec dataset and (b) By-VesD dataset.

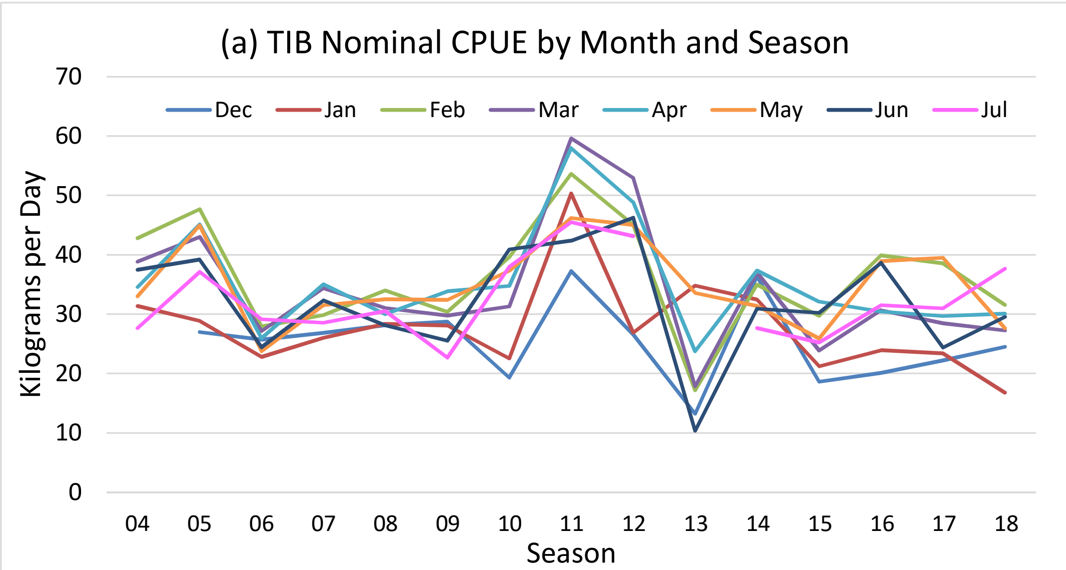


By-VesD data and is equivalent to the data sets used in previous GLM-analyses of the TIB-data.

The total number of data records pertaining to the eight month period December-to-July and over the 2004-to-2018 seasons was 40,068 and 34,814 for the By-Rec and By-VesD datasets respectively, while the respective coverage of the seasonal catch for these months by each data set is shown in Figure 10.

Using these two data sets, a series of analyses were undertaken to compare the nominal catch-rates (CPUE) according to various data stratifications. These results are shown on Figures 11 and 12. A comparison of the nominal CPUE within each area fished based on both data sets is shown in Figure 13.

Figure 11. Annual time-series of nominal CPUE for the TIB fleet within (a) month and (b) by fishing method during the eight month period December-July. Based on the By-Rec data set.



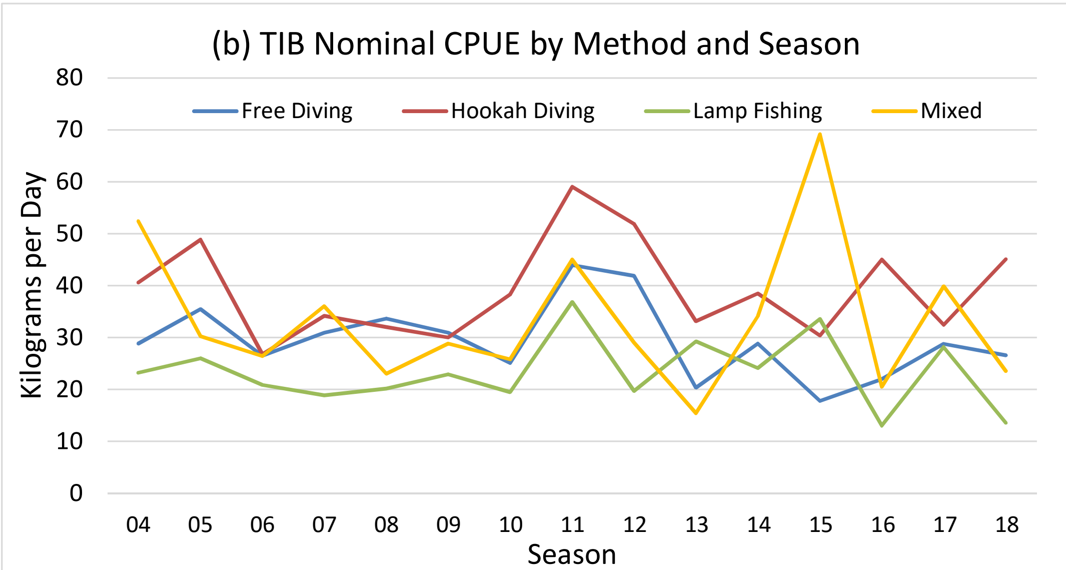


Figure 12. Annual time-series of nominal CPUE for the TIB fleet within each area fished during the eight month period December-July. For comparison, the mean nominal CPUE across all areas is also shown. Based on the By-Rec data set. Note, results are only shown for seasons and areas where five or more data records are available. Also, the reader is reminded that the area-fished associated with catches in the TIB-sector may not be correct.

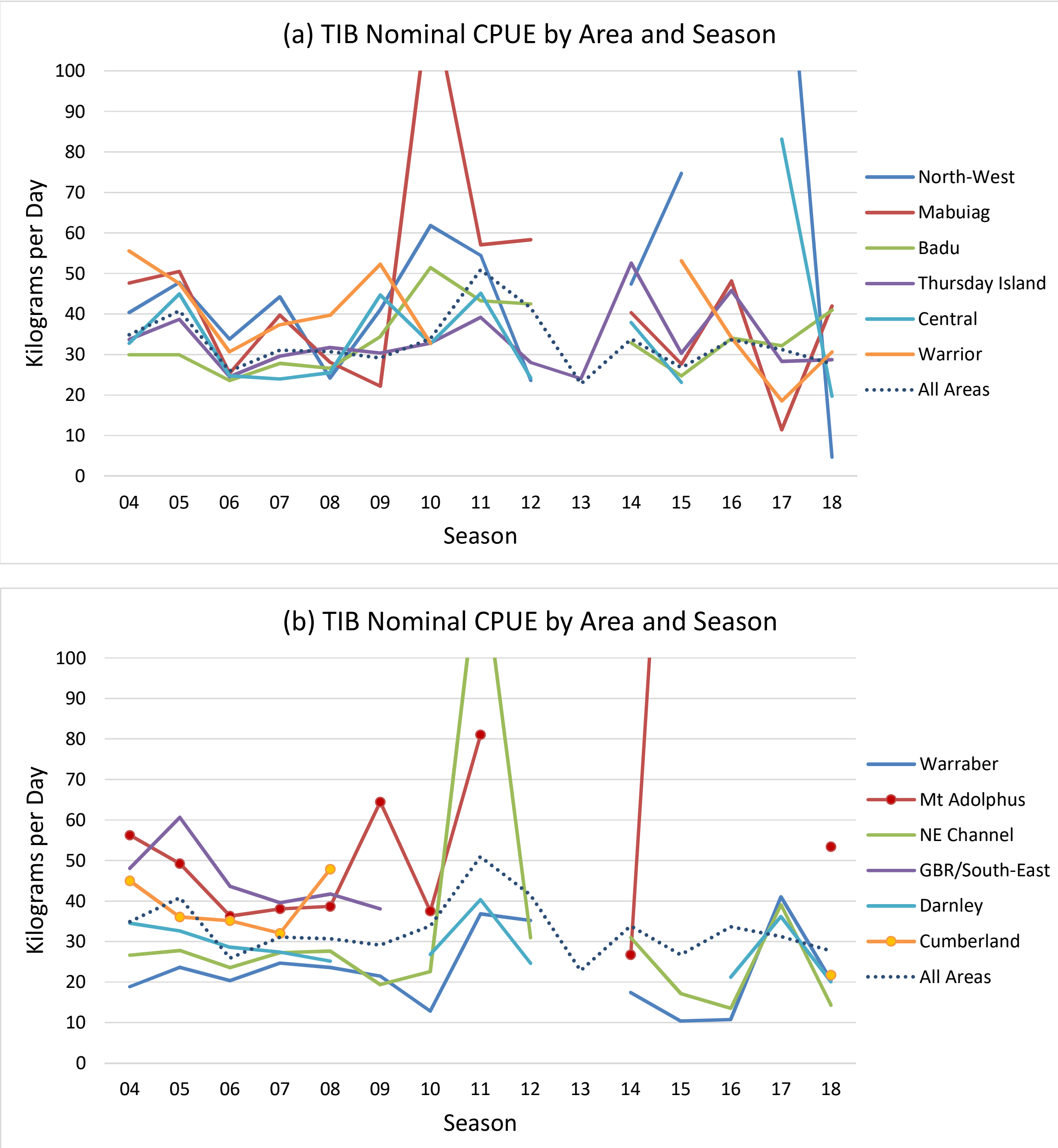
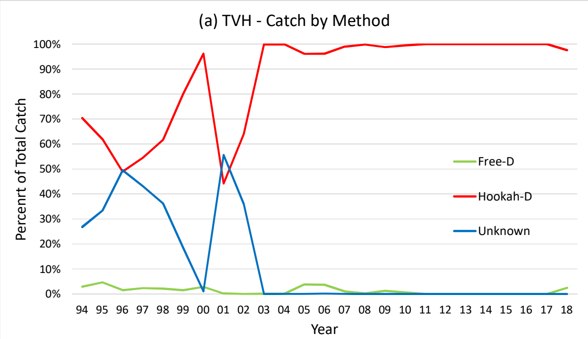


Figure 13. Comparison of the nominal TIB CPUE within each area fished (shown in Figure 12) based on both the By-Rec data set and the By-VesD data. For each area the mean CPUE across all seasons is also shown. For the 2018 season catch rates have been above the long term average in 3 areas, below the average in 8 areas, and there was no data in 1 area (GBR/Southeast). Note, results are only shown for seasons and areas where five or more data records are available. Also, the reader is reminded that the area-fished associated with catches in the TIB-sector may not be correct.

5. TVH Sector Summary

As for the TIB-sector, a series of analyses were undertaken of the catch and effort data for the TVH-sector to provide a comparison of fishery indicators for the 2018 season and previous seasons. As the TVH data is not plagued by the same level of non-reporting of information associated with many of the data fields note in the TIB-data (e.g. the fishing date is known for all catches in the TVH data) the analyses were able to be more focused on the six-month period between February and July each year. The results of these analyses are shown in Figures 14-22. The captions above each Figure should hopefully provide sufficient information to help the reader adequately interpret each result. Note, the TRL04 logbook limits the reporting of catch and effort to a single location, generally the location where the primary boat is anchored and not the location where tenders are actually fishing (which can range as far as 20 nm from the primary boat).

Figure 14. Annual time-series of the percent of the total TVH catch during the six month period February-July stratified by (a) fishing method and (b) process form.



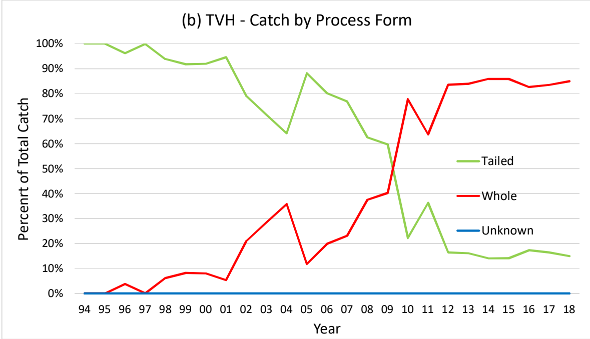
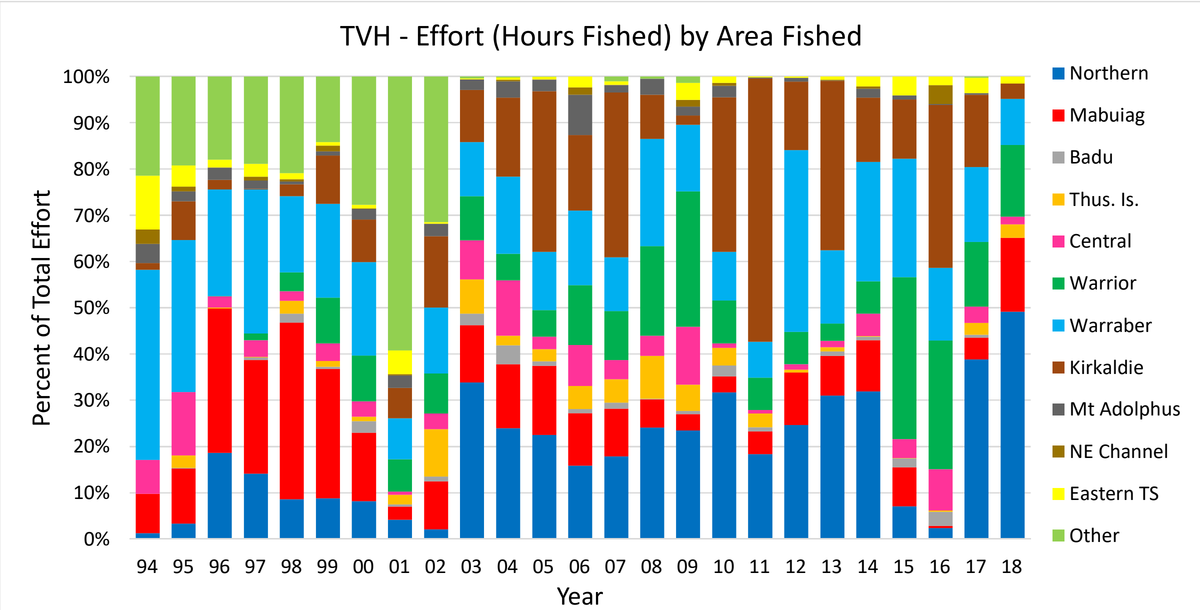


Figure 15. Annual time-series of percent of the total TVH effort (total hours fished by tenders) during the six month period February-July within each area fished. Note, this result is based only on those logbook data where effort has been recorded. The percent of the total TVH catch each year for which effort is not recorded is shown in the bottom figure. Note, during 2018 47% of total effort has been in the Northern area, 18% in the Warrior area, 15% in the Mabuiag area, and 12% in the Warraber area.



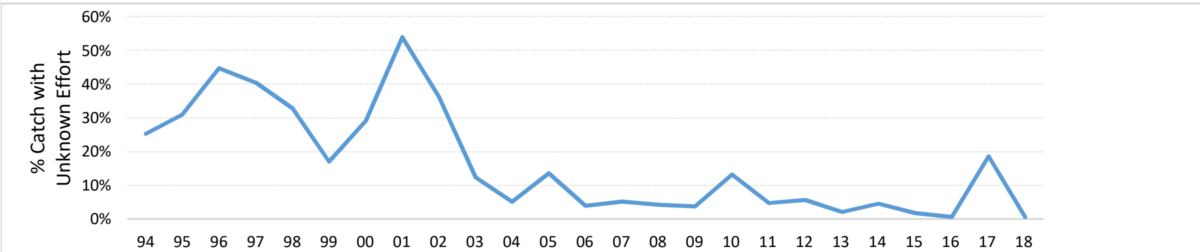


Figure 16. Map of the TVH fishing areas described in the analysis.

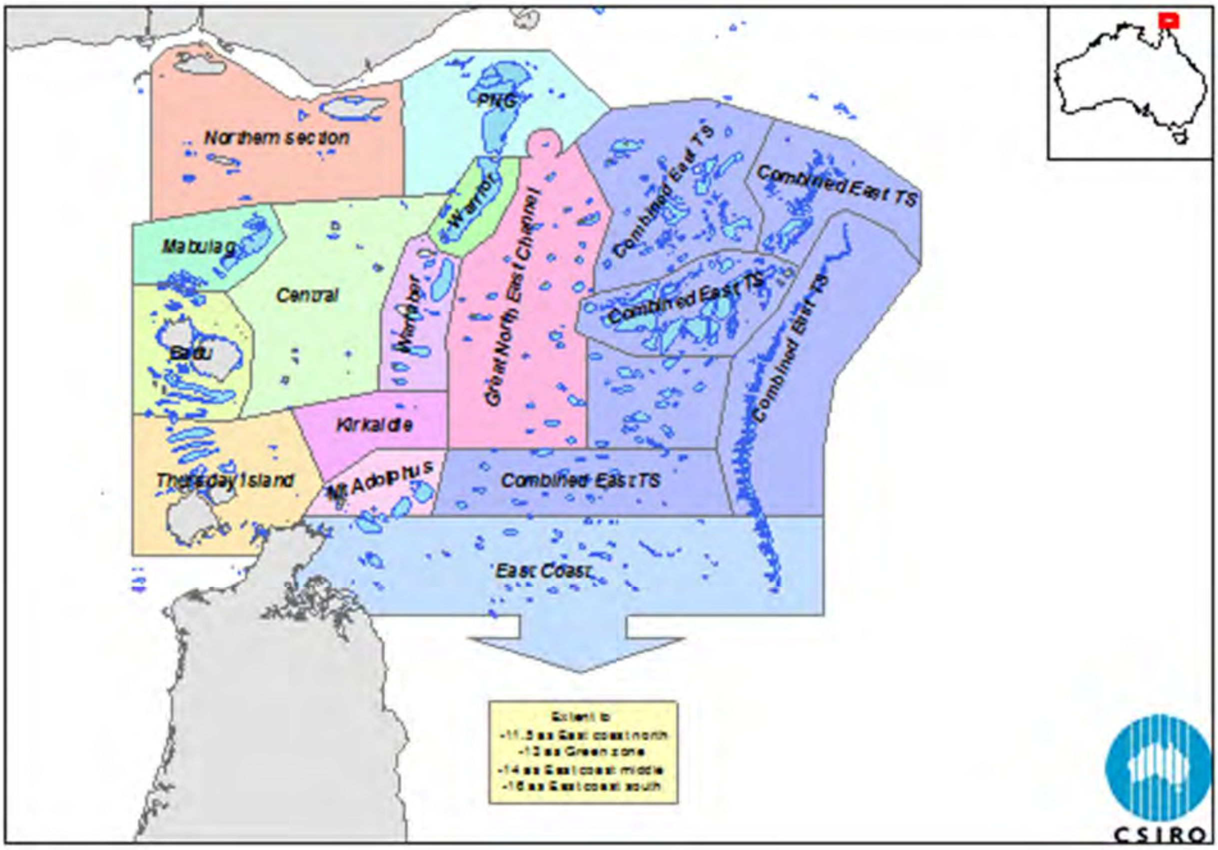


Figure 17. Annual time-series of percent of the total TVH catch during the six month period February-July taken within each area fished. Refer to Figure 16 for location of TVH areas. Note, during 2018 47% of total catch has been in the Northern area and 18% in Warrior.

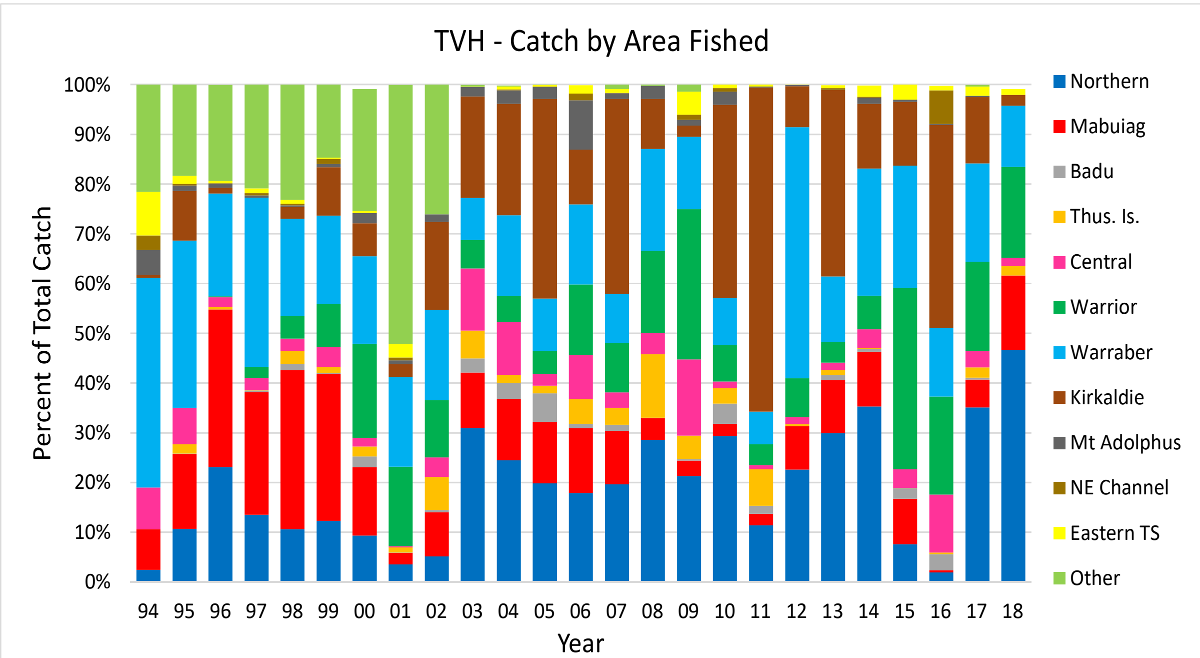
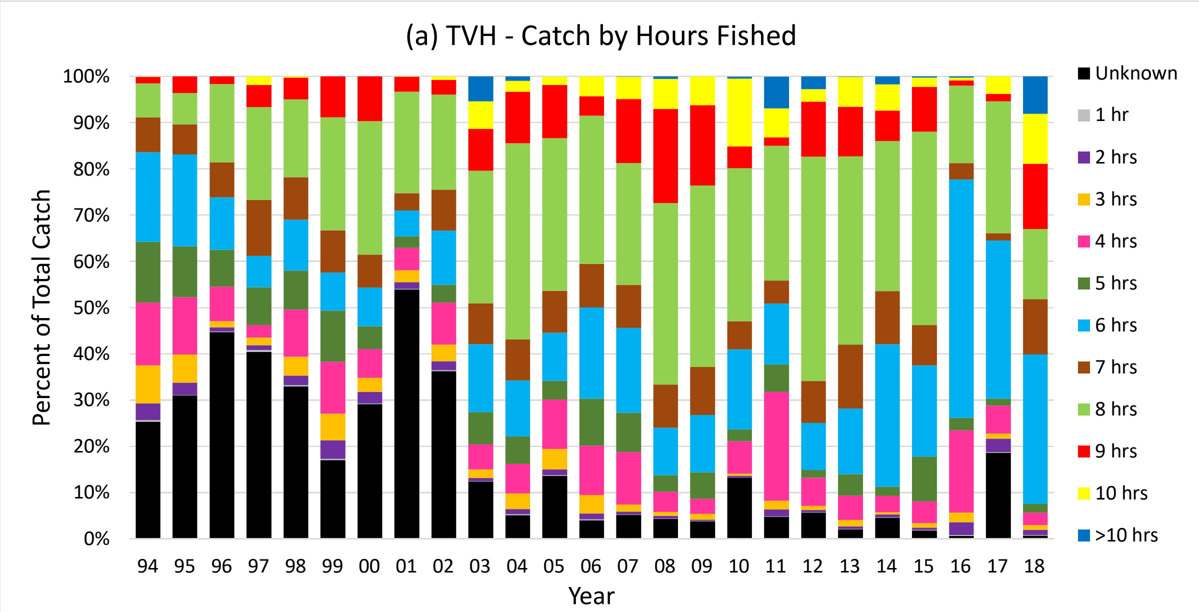


Figure 18. Comparison of percent of the TVH total catch in the six month period February-July stratified by the number of hours fished per tender-day based on (a) all records, including those where the hours fished is unknown, and (b) those records where the unknown days fished are excluded and the number of hours fished is limited to 1-9. Note, compared to the previous two years, during 2018 a higher proportion of the catch has been taken on sets with effort of more than 6 hours.



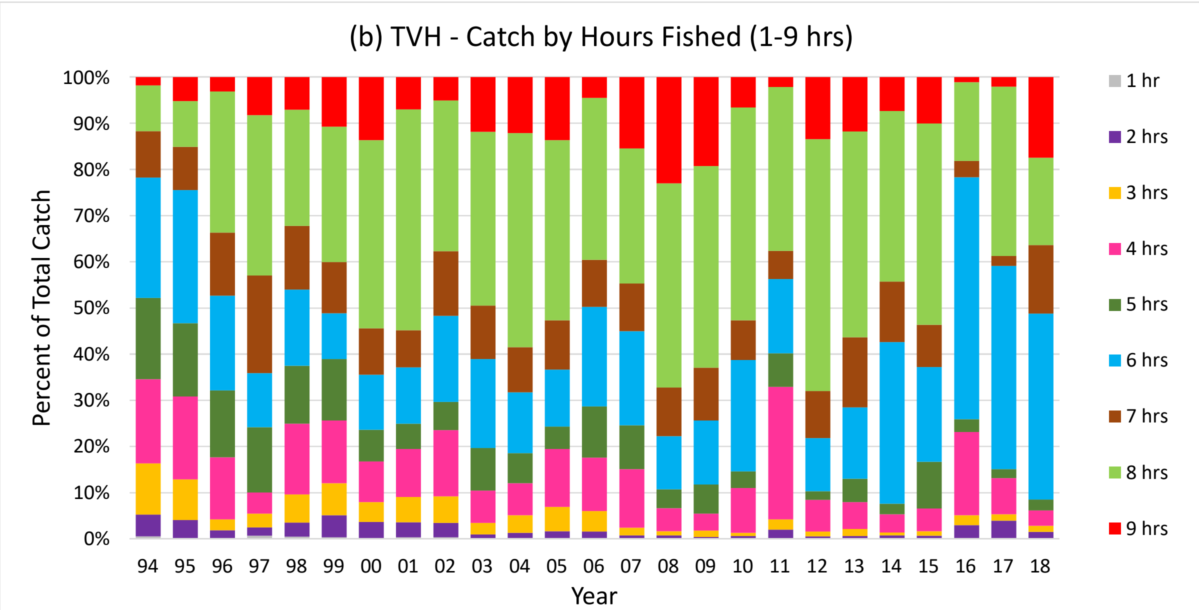
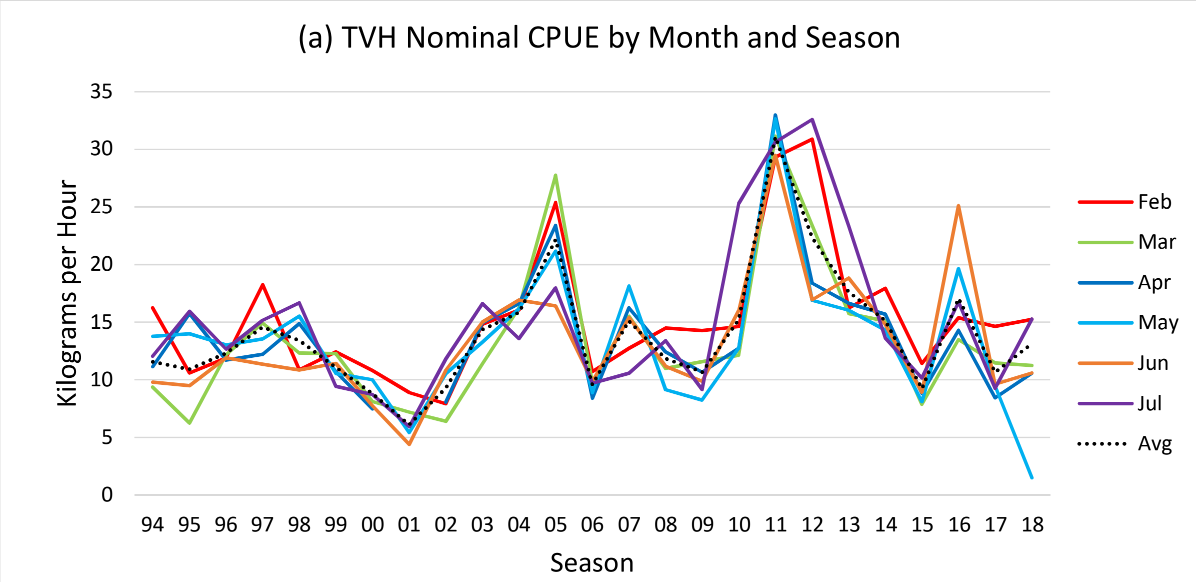


Figure 19. Annual time-series of nominal CPUE (kilograms per hour) for the TVH fleet within (a) month and (b) by fishing method during the six month period February-July. Note, generally CPUE decreases after February and in 2018 was similar in March, April and June. In 2018, the mean CPUE in March and April was 28.4% lower than in February (whereas the average decrease over the previous 6 years between 2012 and 2017 was 7.6%). Note, very little TVH fishing took place in May 2018.



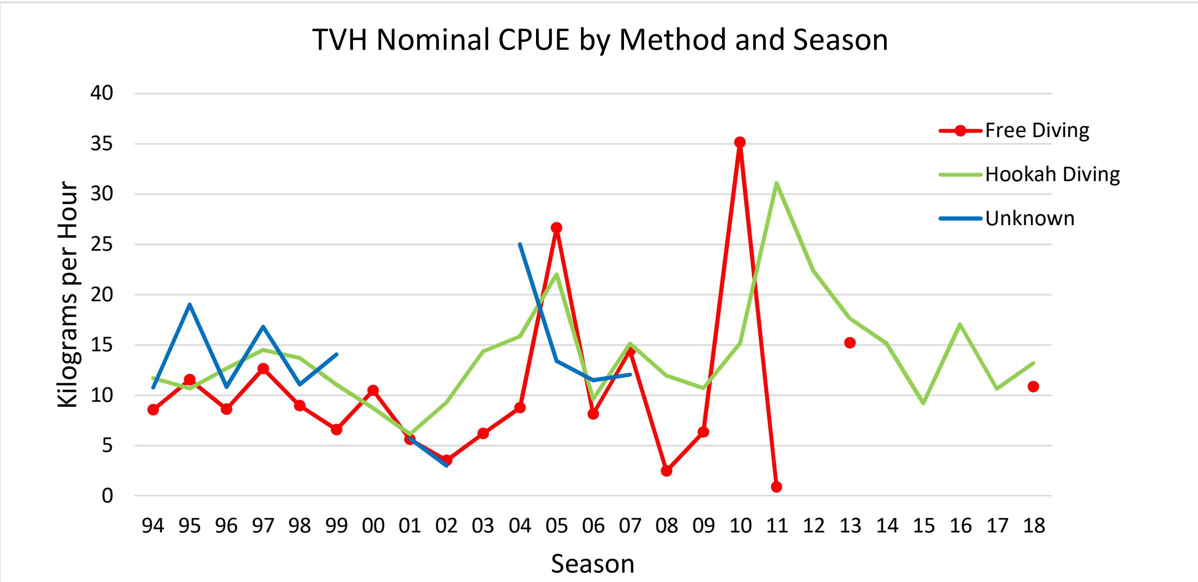
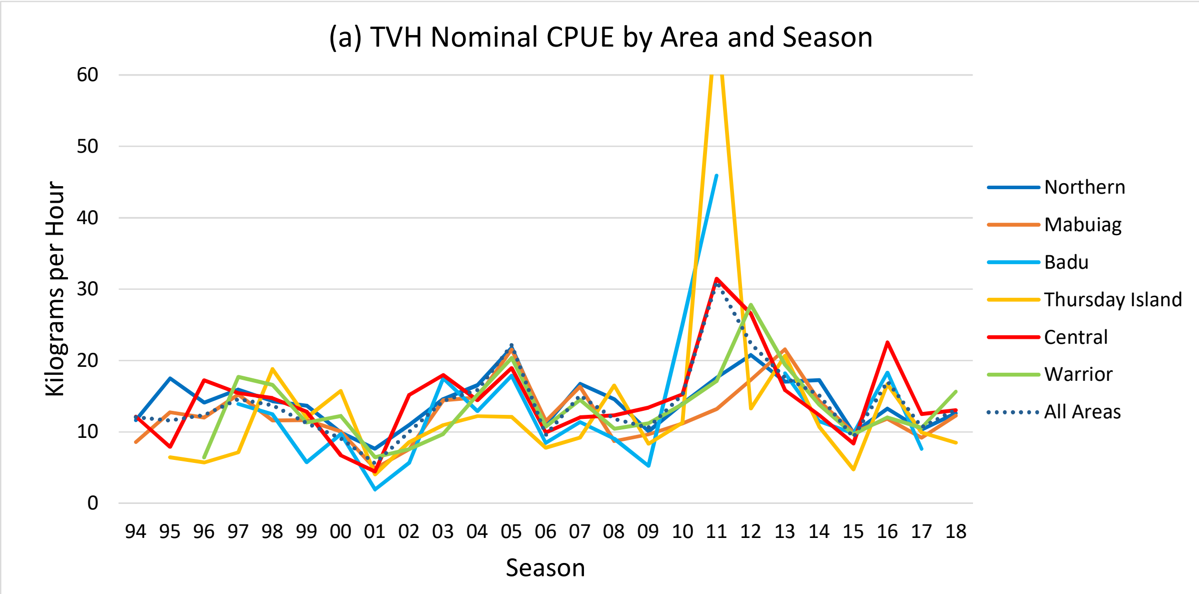


Figure 20. Annual time-series of nominal CPUE (kilograms per hour) for the TVH fleet within each area fished during the six month period February-July. For comparison, the mean nominal CPUE across all areas is also shown. Note, across all areas the mean CPUE in 2018 of 13.1 is lower than the mean catch rates over the previous 6 years (15.4), though slightly higher than in 2017 (10.7).



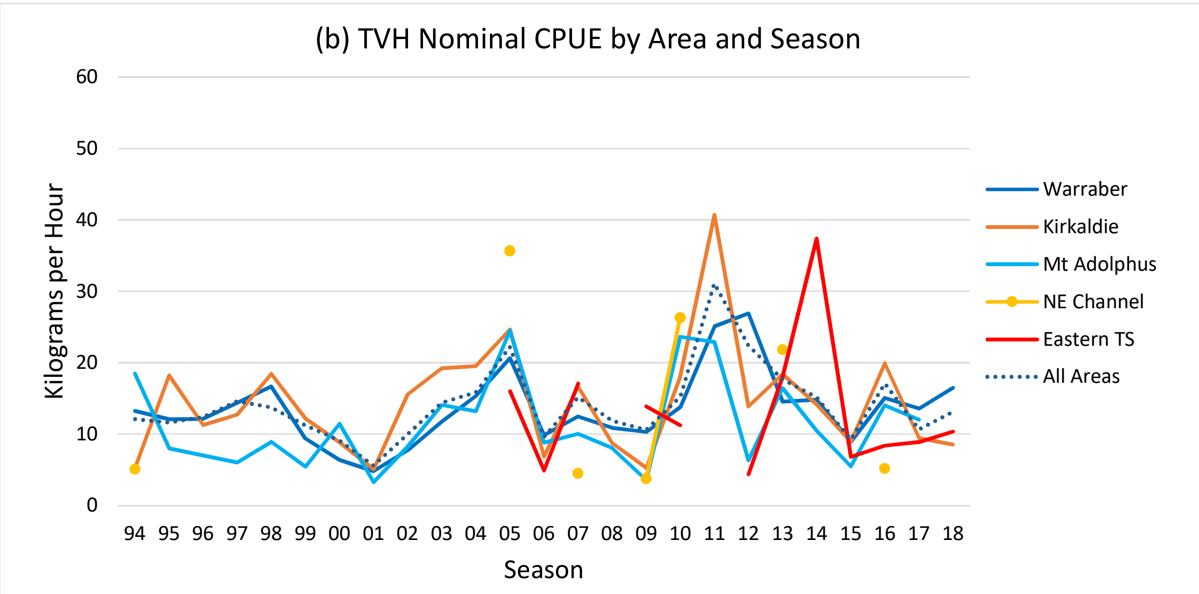


Figure 21. Annual comparison of effort in the TVH fishery during the six month period February-July. Analysis based on the method outlined in Campbell (2017).

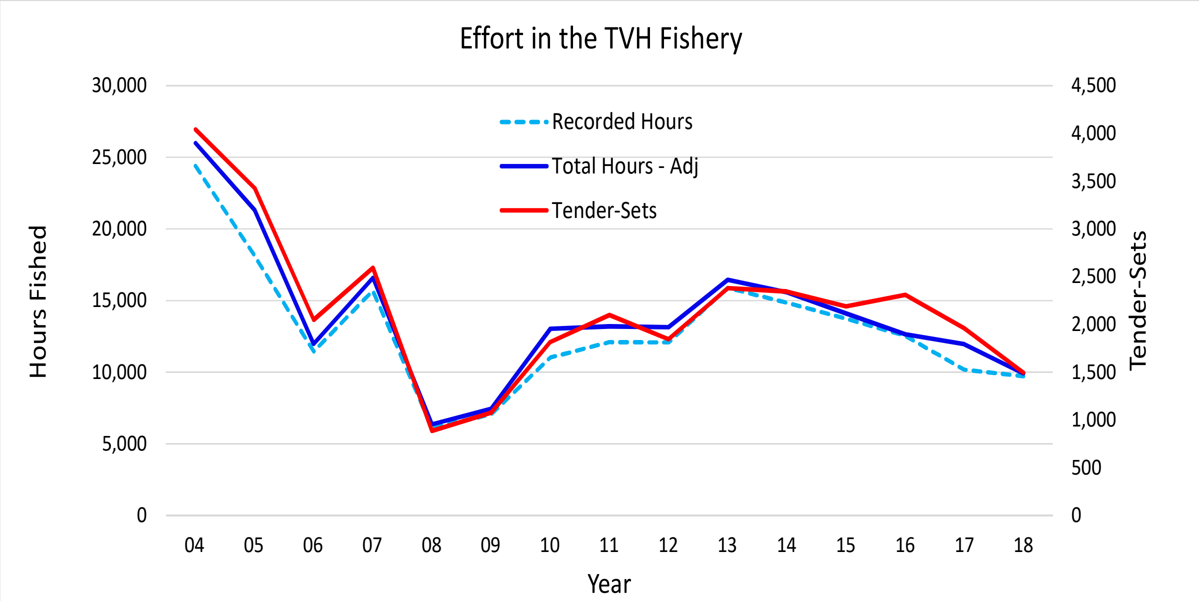
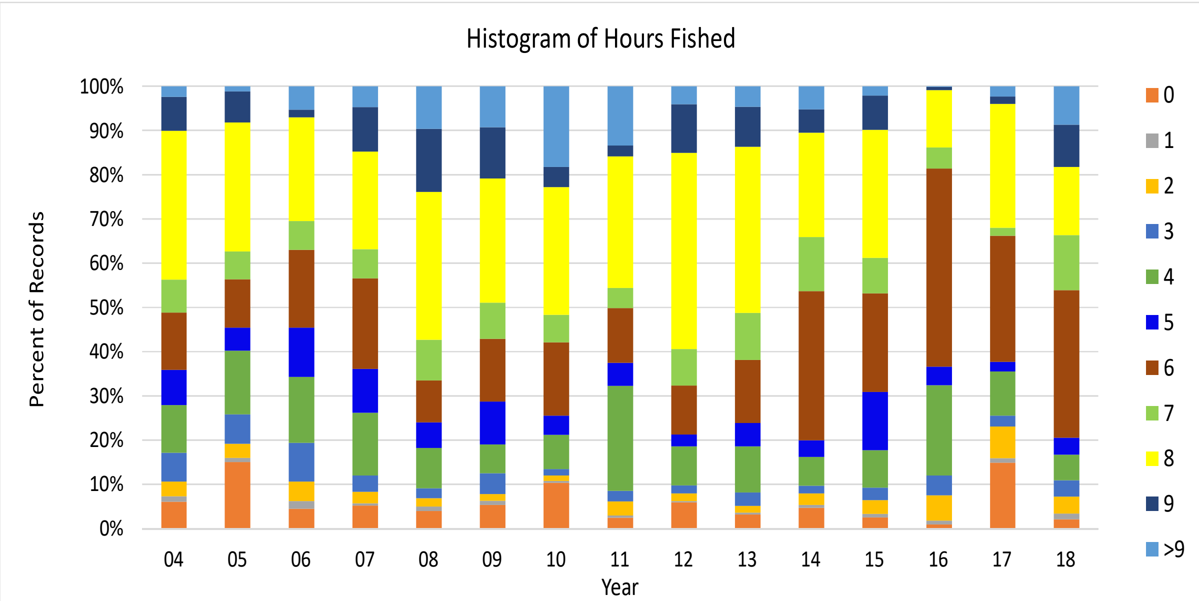


Figure 22. Annual comparison of the histogram of the number of hours fished per tender-day for the entire TVH fleet during the six month period February-July. Note, data where the hours fished was not reported have been excluded.



References.

Campbell, R.A. (2017) Estimation of total annual effort in the Torres Strait Rock Lobster Fishery – 2017 Update. Information paper presented to the 21st meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12- 13 December 2017, Cairns.

Campbell, R.A., Pease, D. 2017. Separating TIB, TVH and Processor catch records from Docket-Book Data. Report to AFMA – 2017 Update. Information paper presented to the 21st meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12- 13 December 2017, Cairns.

Campbell, R.A. Plaganyi, E, Deng, R., 2017a. Use of TIB Docket-Book Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2017 update. Information paper presented to the 21st meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12-13 December 2017, Cairns.

Campbell, R.A, Plaganyi, E., Deng, R., 2017b. Use of TVH Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2017 Update. Information paper presented to the 21st meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12-13 December 2017, Cairns.

Campbell, R.A., Plaganyi, E., Deng, R., Tonks, M, Haywood, M. 2018. Torres Strait Rock Lobster Fishery – Summary of the Catch and Effort Data pertaining to the 2018 Fishing Season (Dec-17 to Apr-18). Information paper presented to the 23rd meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 15 May 2018, Cairns

Use of TVH Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2018 Update

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CSIRO Oceans and Atmosphere Flagship

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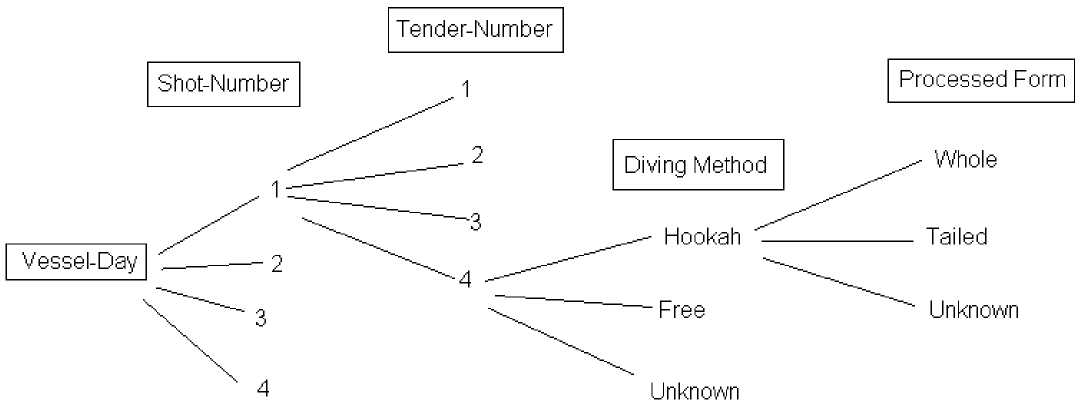
1. TVH Data

The Torres Strait Tropical Rock Lobster Fishery Daily Fishing Log (TRL04) is used to record the catches taken in the TVH sector of the Torres Strait rock lobster fishery. Logbook data obtained from AFMA consists of 99,267 individual catch records for the TVH rock-lobster fishery for the 25 years from 1994 to 2018. The structure of the data is shown in Figure 1. For each vessel-day there can be multiple shots (up to 4) with each shot consisting of up to 8 tenders. Each tender has a catch recorded by diving method (hookah, free or unknown) and the catch is recorded by processed form (whole, tailed or unknown). The data was aggregated so that each record refers to the catch for a unique vessel-day, shot, tender and diving method. This gave 70,283 records.

Figure 1. Structure of the TVH data



The distribution of these 70,283 catch records by year and month, diving method, processed state of catch and MSE-area are given in Tables 1-3. There has been little if any effort during October and November before 2006 and since 2006 there has been little effort in the months October-to-January. As such the analysis was limited to the 8 months between February and September. Similarly the analysis was also limited to those records with a known MSE-area (i.e. areas designated A0 and A99 were excluded) though areas 201 and 202 were combined (to provide a better data coverage, and designated as area 110) and area 401 (GBR) was also excluded.

In the past CPUE has been recorded as the catch-per-tender-set. However, as there can be multiple shots-per-day the duration of a tender-set can obviously vary and each tender-set cannot be assumed to be equivalent to a tender-day. The catch data also contains a field "Hours-Fished" which records the duration of the fishing trip for each tender-set and this was deemed to be a better measure of tender effort than assuming

Table 1. Number of TVH catch records by year and month.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1994	84	105	236	448	347	364	227	310	270			54	2445
1995	23	116	123	147	185	220	121	239	238	3		220	1635
1996	366	237	447	247	378	264	356	517	411			324	3547
1997	383	232	307	239	598	333	438	538	327	18		598	4011
1998	445	739	551	484	486	587	553	603	493		9	231	5181
1999	117	98	262	242	208	214	161	132	146			235	1815
2000	196	240	349	215	328	370	342	232	99		66	274	2711
2001	375	97	223	65	259	270	206	174	119	9	1	87	1885
2002	26	285	365	295	401	400	360	492	398			89	3111
2003	100	461	488	393	490	518	527	596	413			176	4162
2004	24	607	712	571	662	761	729	633	395			106	5200
2005	13	662	615	543	519	538	552	533	323			4	4302
2006		409	436	361	286	206	349	289	92				2428
2007		288	427	446	542	489	402	184	91				2869
2008		133	222	113	161	96	159	175	152				1211
2009		148	227	174	201	200	125	163	70				1308
2010		255	333	302	324	292	309	294	253		6		2368
2011		286	384	371	322	380	356	310	261				2670
2012		166	344	371	311	336	318	264	201				2311
2013		461	383	414	424	324	374	385	243				3008
2014		357	404	297	433	408	445	274	291		1		2910
2015		419	408	441	355	313	253	357	137				2683
2016	12	500	444	315	379	349	323	191	141			9	2663
2017	7	397	254	322	383	310	292	277	101				2343
2018	10	436	360	335	10	47	308						1506
Total	2,181	8,134	9,304	8,151	8,992	8,589	8,585	8,162	5,665	30	83	2,407	70,283

Table 2. Annual number of TVH catch records by diving method and TVH catch by processed state.

	Number of Vessel by -			Diving Method			Total	Catch by Processed State (kg)			Total		
Year	Name	Symbol	Both#	Hookah	Free	Unknown	Records	Tails	Whole	Unknown	Catch	%Tails	%Whole
1994	11	11	11	1,505	136	804	2,445	123,006	0	0	123,006	100.0%	0.0%
1995	14	14	14	947	59	629	1,635	100,407	635	0	101,042	99.4%	0.6%
1996	20	20	20	1,609	87	1,851	3,547	219,045	7,810	0	226,855	96.6%	3.4%
1997	20	20	20	1,890	112	2,009	4,011	273,151	1,880	8	275,040	99.3%	0.7%
1998	23	22	23	2,681	169	2,331	5,181	310,635	18,922	0	329,556	94.3%	5.7%
1999	15	14	15	1,412	38	365	1,815	88,416	6,681	0	95,097	93.0%	7.0%
2000	20	19	20	2,330	114	267	2,711	118,824	10,038	0	128,862	92.2%	7.8%
2001	14	14	14	812	26	1,047	1,885	66,347	2,729	0	69,076	96.0%	4.0%
2002	17	17	17	1,721	10	1,380	3,111	108,216	39,471	0	147,687	73.3%	26.7%
2003	21	21	21	3,958	104	100	4,162	255,447	105,964	0	361,411	70.7%	29.3%
2004	25	24	25	5,045	154	1	5,200	317,467	163,651	0	481,118	66.0%	34.0%
2005	22	23	23	4,101	199	2	4,302	484,497	60,480	0	544,977	88.9%	11.1%
2006	22	20	22	2,307	119	2	2,428	108,909	26,539	0	135,448	80.4%	19.6%
2007	20	20	20	2,829	39	1	2,869	207,463	61,133	0	268,596	77.2%	22.8%
2008	13	12	14	1,205	6	0	1,211	63,378	37,060	0	100,438	63.1%	36.9%
2009	10	10	10	1,281	27	0	1,308	51,322	39,729	10	91,061	56.4%	43.6%
2010	13	12	13	2,356	12	0	2,368	67,817	214,797	0	282,614	24.0%	76.0%
2011	14	13	14	2,668	1	1	2,670	171,469	332,064	0	503,533	34.1%	65.9%
2012	14	13	14	2,311	0	0	2,311	65,282	305,198	2	370,482	17.6%	82.4%
2013	11	12	12	3,006	2	0	3,008	61,631	300,030	0	361,661	17.0%	83.0%
2014	13	13	13	2,910	0	0	2,910	42,105	230,961	120	273,186	15.4%	84.5%
2015	13	12	13	2,682	1	0	2,683	22,479	130,231	0	152,709	14.7%	85.3%
2016	12	11	12	2,642	21	0	2,663	42,714	200,986	0	243,700	14.7%	85.3%
2017	11	12	12	2,340	3	0	2,343	23,885	125,163	0	149,048	14.7%	85.3%
2018	9	9	9	1,434	72	0	1,506	19,159	109,142	22	128,323	14.9%	85.1%
Total				57,982	1,511	10,790	70,283	3,413,071	2,531,294	162	5,944,526	57.4%	42.6%

Table 3. Number of TVH catch records by MSE-area.

	Northern	Mabuiag	Badu	Thurs Is.	Central	Warrior	Warraber	Kirkaldie	Adolphus	East TS	East TS	GBR	East Coast	NR	
YEAR	A101	A102	A103	A104	A105	A106	A107	A108	A109	A201	A202	A401	A0	A-99	TOTAL
1994	51	257		11	119		926	64	89	106	177	1		392	2445
1995	106	289	2	41	83		487	111	26	36	32	4		223	1635
1996	620	1152	2	11	51	11	719	41	37	1	32			608	3547
1997	425	1324	21	19	73	100	881	4	21	52	33	3	1	630	4011
1998	463	1681	51	128	107	200	1042	160	16	31	45		2	794	5181
1999	158	457	34	33	66	177	348	177	17	14	30	15		212	1815
2000	137	252	66	48	51	404	605	229	59	7	22	35		370	2711
2001	42	70	5	44	26	329	366	83	40	3	41	44		405	1885
2002	107	278	18	176	44	351	592	718	48		17	16		401	3111
2003	1080	442	112	315	344	396	432	832	96	7	49	4	4	33	4162
2004	1072	612	209	159	551	343	980	970	208	15	51	8		9	5200
2005	803	466	161	194	156	211	511	1680	90	3	18	6			4302
2006	362	267	20	131	187	300	440	351	280	34	48	4			2428
2007	483	293	42	146	120	311	367	980	62	6	28	2			2869
2008	236	58	6	91	52	235	240	206	48	2	31	3		2	1211
2009	268	46	5	80	145	365	231	47	26	23	59	7			1308
2010	564	67	103	103	33	197	206	992	43	12	32	14			2368
2011	389	111	34	83	17	159	430	1406	25		14				2670
2012	417	217		14	46	155	1166	267	18	5	5				2311
2013	718	239	34	16	63	168	469	1267	6	6	21				3008
2014	777	263	15	27	165	268	786	445	47	14	93				2910
2015	176	173	45	5	117	874	661	486	25		121				2683
2016	66	12	62	7	202	681	454	950	18	131	60				2663
2017	726	108	9	43	67	401	461	422	15		74				2343
2018	735	218		34	32	233	164	55			22				1506
Total	10,981	9,352	1,056	1,959	2,917	6,869	13,964	12,943	1,360	508	1,155	166	7	4,079	70,283

Figure 2. The total number of TVH catch records each year and the number of records for which the corresponding effort data is available. The percentage of records for which no effort is recorded is also shown (right hand axis).

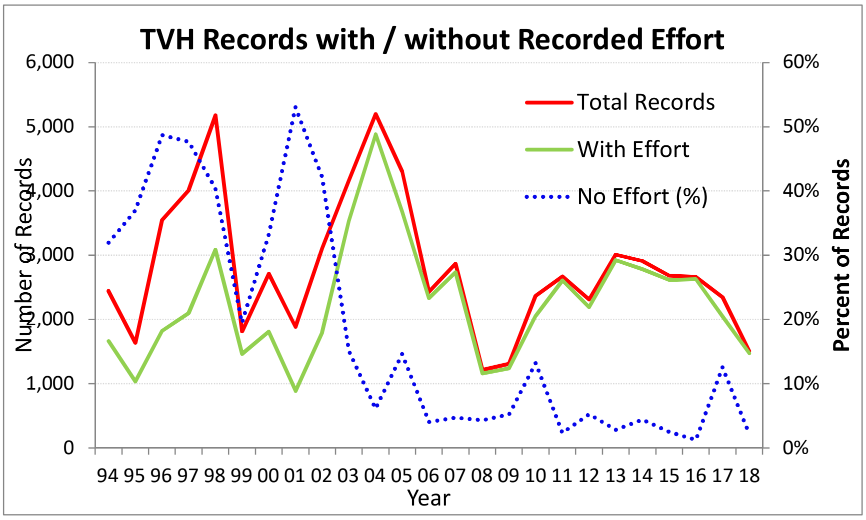


Figure 3. The percent of total TVH catch each year (a) caught by each fishing method, and (b) landed as Tails or Whole weight.

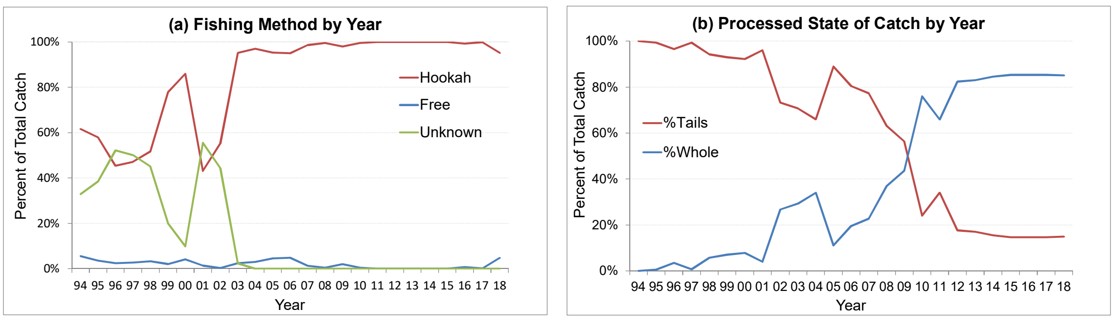


Figure 4. Distribution of (a) effort, (b) catch and (c) CPUE for the 56,534 records for which effort was recorded on TVH logbooks.

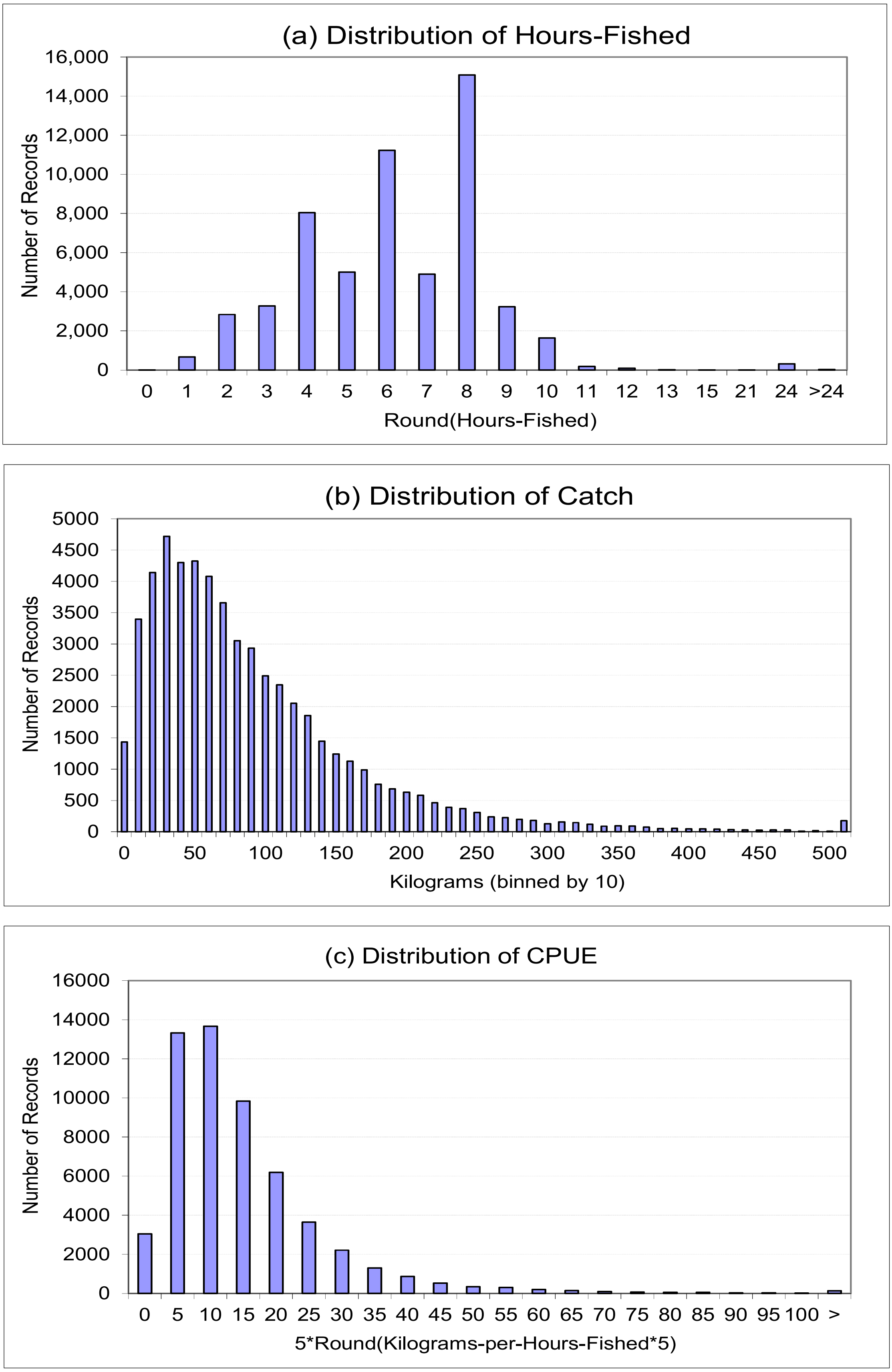
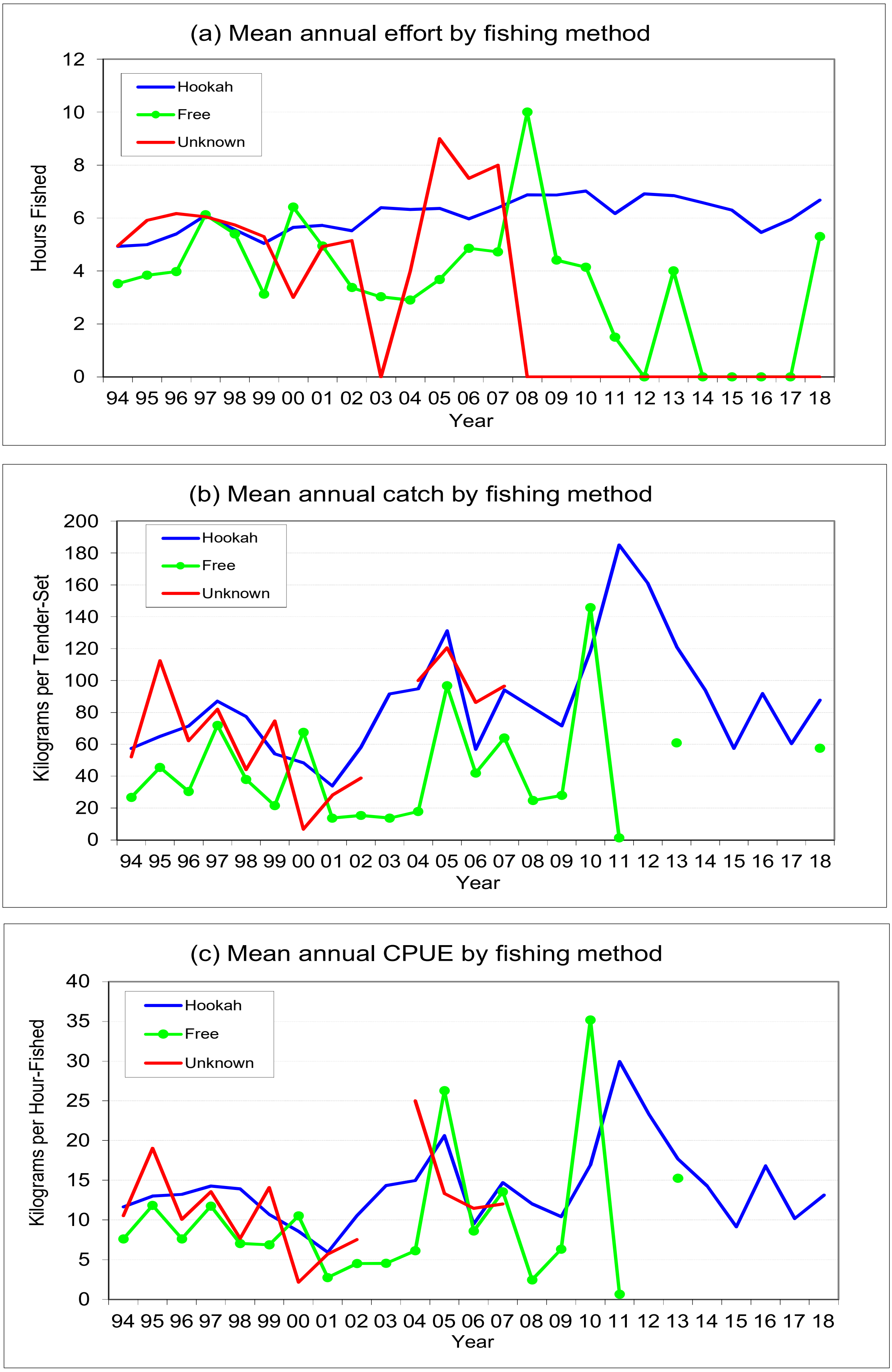


Figure 5. Mean (a) effort, (b) catch and (c) CPUE by fishing method and year for the 51,643 unique vessel-day, shot, tender and diving method records for which this effort was between 0 and 12 hours and areas and months restricted as described in the text.



each tender-set is equivalent to a day's effort. However, unfortunately this field has not been completed for all tender-sets, with the number of hours fished recorded for only 56,534 (80.4%) of the 70,283 records. (Note, the proportion of records where the effort was not recorded averaged 32% between 1994 and 2005, but has been less than 5% for most years since 2006, but was 13% in 2010 and again increased to 12.5% in 2017, c.f. Figure 2). The distribution of hours fished for these records is shown in Figure 4. The number of recorded hours fished is between 0.15 hours and 96 hours, though was 12 hours or less for 99.4% of all records. All records where the recorded hours-fished was greater than 12 hours were considered suspect and as such only those records where the hours-fished was 12 hours or less were included in the analysis. The five records where effort was less than 0.5 hours were also excluded. Note, the number of hours fished was recorded as 24 hours for 315 records and was assumed to represent a "day's" fishing.

After applying each of the following filters to the data:

- Exclude MSE-areas 0, 401 and -99
- Exclude Month<2 and Month>9
- Exclude Hours-Fished less than 0.5 hour and greater than 12 hours

the number records included in the data for further analysis was reduced to 51,643. The mean (a) effort, (b) catch and (c) CPUE by fishing method and year for these records are shown in Figure 5.

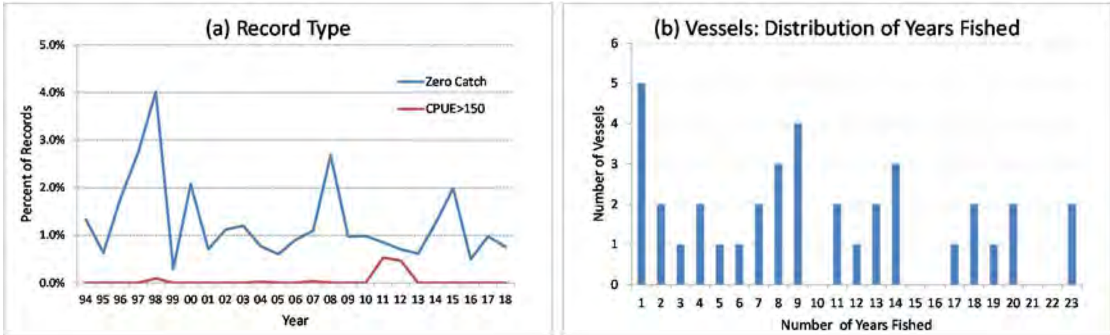
2. GLM Analysis

i) Fitted Data

Of the 51,643 records selected above for analysis it was noted that there were a small percentage of records (618 or 1.2%) where the catch was zero. The inclusion of such records in the GLM analyses can cause problems. The percentage of such records each year is shown in Figure 5a and varies from a high of 4.0% in 1998 to a low of 0.29% in 1999. Nevertheless, apart from the four years when this percent was greater than 2% there does not appear to be a trend in the percentage of zero catches in the data over time. As such, and as recommended for the analyses undertaken previously, these zero catch records were excluded from the analyses. Note, to retain the zero-catch records in the analysis a two-stage analysis of the data can be undertaken where one first models the probability of obtaining a positive catch following by a separate analysis where one models the size of the positive catch. The results of each analysis can then be combined to obtain the required standardised CPUE index. Such an approach was not considered appropriate for this data due to the small percentage of zero-catch records in the data.

Further inspection of the data also indicated a number of records having a very high CPUE (kilograms of catch per hour fished) value and which could be considered outliers in the data, possibly due to errors in either the recording of the catch or effort. To exclude these possibilities the 27 records having a CPUE>150 kgs/hour were deleted from the data (cf. Figure 6a). Finally, due to the observation that Vessel-Names and Vessel-Symbols are not always matched (likely due to the switching of licences between vessels) a combination of Vessel-Name and Vessel-Symbol was adopted to identify vessels in the data. Of the 94 vessels identified in this manner in the selected data, only the data pertaining to the 48 vessels which had fished for 3 or more years and for which there were 50 or more data records were included in the analysed data (c.f. Figure 6b. Note only 4 vessels are selected for 2018). Combined with the other two filters the total number of records remaining in the data for analysis was 45,427.

Figure 6. (a) Percentage of records in the data, by year, where either the catch is zero, or the CPUE>150 kg/hour, and (b) histogram of the number of vessels (distinguished by vessel symbol) by the number of years they have fished in the fishery.



The number of *Area-Month* strata fished each year and the number of vessels fishing each year in the data selected for inclusion in the GLM analyses is shown in Figure 7 while a bubble plot displaying the number of observations for each vessel each year in this data is shown in Figure 8. A summary of the number of observations and nominal CPUE (kilograms per hour) within each *Year*Area*, *Year*Month* and *Area*Month* strata is provided in the Appendix.

Figure 7. (a) Number of *Area-Month* strata fished each year and (b) the number of vessels fishing each year in the data selected for inclusion in the GLM analyses.

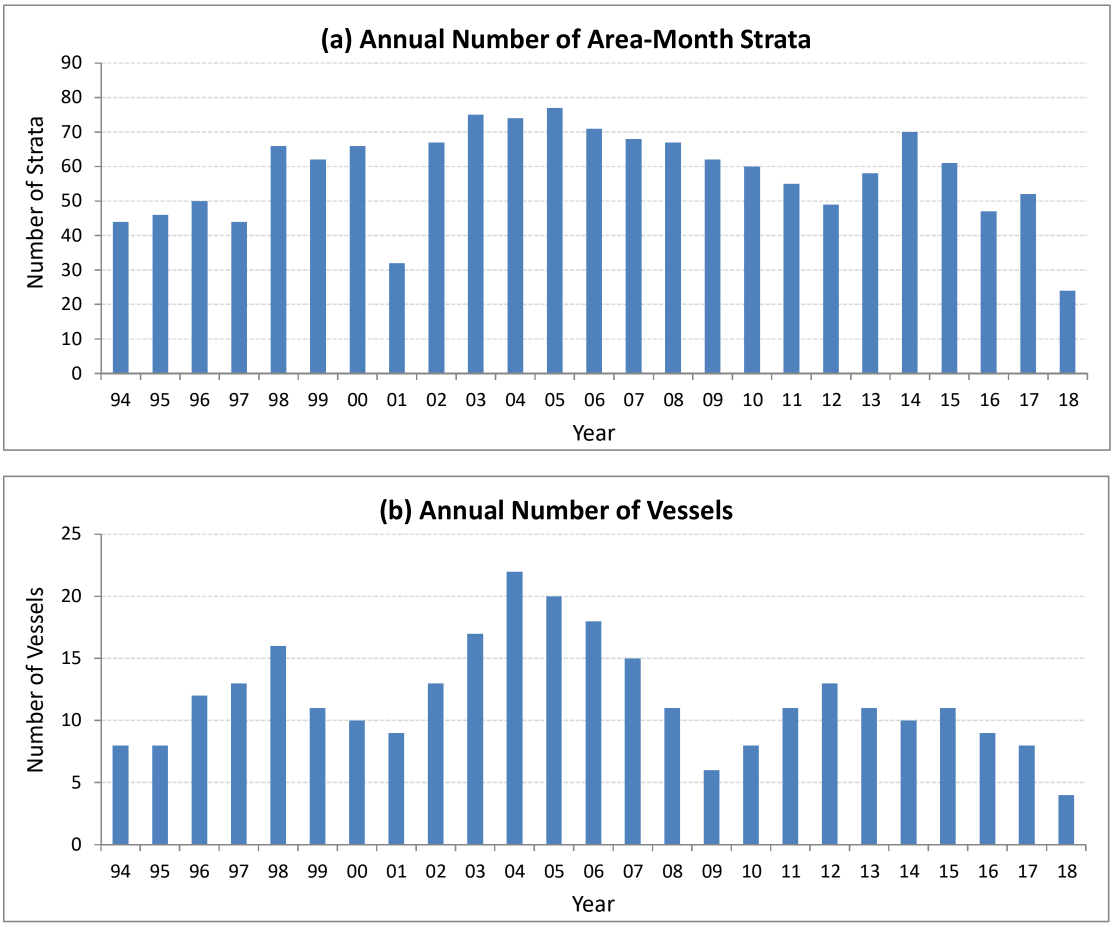
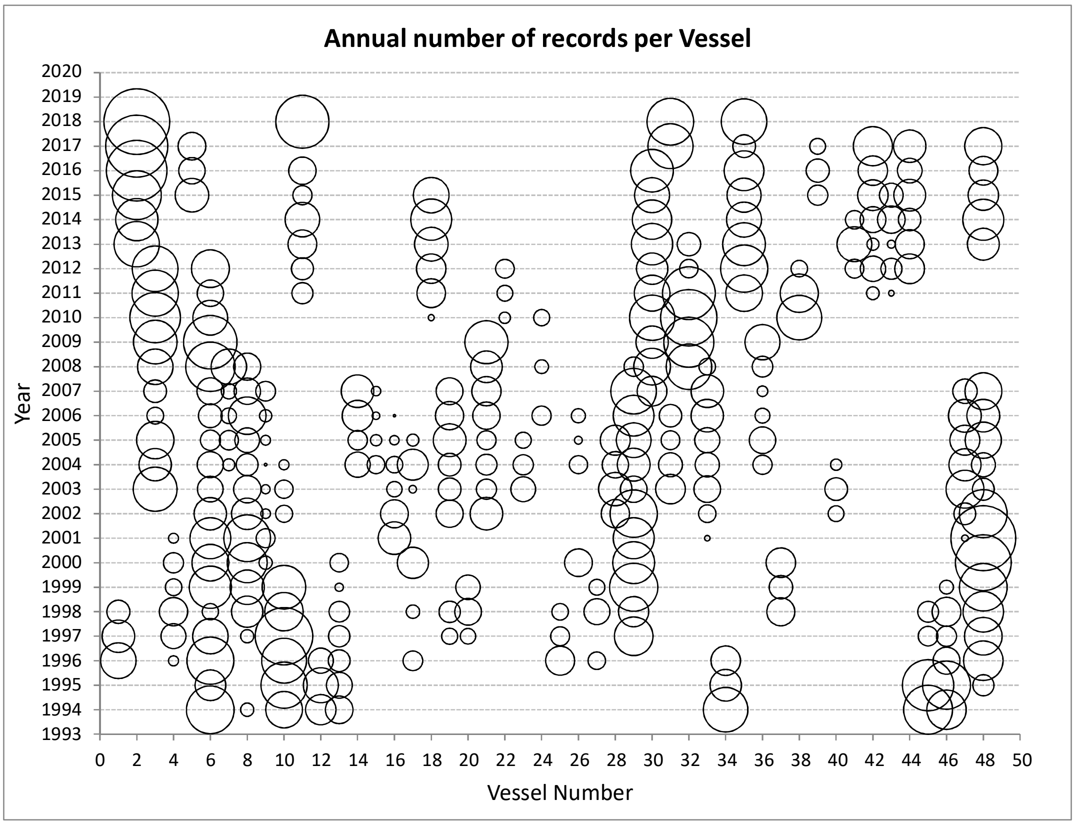


Figure 8. Bubble plot displaying the number of observations for each vessel each year in the data selected for inclusion in the GLM analyses.



ii) GLM Models

Several different General Linear Models (GLMs) were adopted for analysing the data in order to obtain a standardised index of stock abundance in each year.

Main Effects Model

In order to explore the impact of each fitted effect, the first set of analyses were based on the following model where no interactions between main effects were included:

CPUE = *Intercept* + *Year* + *Month* +*Area* + *Vessel* +*Fishing-Method*
+ *Proportion of Catch Landed as Tails*
+ *Southern Oscillation Index* + *Moon-Phase*
/ distribution = gamma, link = log

= *I* + *Y* + *M* + *A* + *V* + *F* + *P* + *SOI* + *Moon* / dist= gamma, link=log

The SAS GENMOD procedure was used to fit the model. All effects *Year, Month, Area*, *Vessel* and *Method* (Hookah, Free and Unknown) were fitted as class variables except for the SOI index which was fitted as a continuous variable. The *Proportion-Tails* was also fitted as a class variable with each record classified as one of the following five levels: (<20%, 20% to <40%, 40% to <60%, 60% to <80%, >=80%). The monthly values of the *Southern Oscillation Index (SOI)* were used and *Moon-Phase* was modelled as the number of days (0-29) since the last full moon. A log-gamma distribution was assumed for the distribution of CPUE values. The annual index and abundance was determined using the method described in the section below.

For each of the main effects, a measure of the impact of each level on the modelled CPUE was obtained by taking the exponent of the estimated parameter for each level. The impact of each level was then compared to the impact of a reference level. For each main effect these reference levels were:

Month	September
Area	Eastern Torres Strait
Method	Hookah diving
Vessel	Vessel with the largest number of records
Proportion-tails	>80%

Finally, the annual influence of each of the main effects on the resulting index of abundance was calculated using the method described in Bentley et al (2012).

As shown in Campbell (2004) a bias in the annual abundance index can result when there is an unequal number of observations within each spatial-temporal strata used for calculating the abundance index. In order to overcome this problem a weighting of the observations needs to be incorporated when fitting the data to the GLM. Each observation was therefore weighted such that the sum of the weights for all observations in each of the *Year-Month-Area* strata was the same for all strata. Furthermore, in order to account for the weighting given each observation in determination of the annual influence of each main effect the sum of the weights for all observation within a given level was used instead of just the number of observations.

Interactions Models

The second set of analyses was undertaken in order to explore whether the inclusion of 2-way interactions between the main spatial-temporal effects improved the model fit to the data. Specifically, the following five models were examined:

Int-1:

*CPUE = Intercept + Year +Month + Month*Area*
+ Vessel +Fishing-Method + Proportion-Tails + SOI + Moon
/ distribution = gamma, link = log

Int-2A:

*CPUE = Intercept + Year*Month + Month*Area*
+ Vessel +Fishing-Method + Proportion-Tails + SOI + Moon
/ distribution = gamma, link = log

Int-2B:

*CPUE = Intercept + Year*Area + Month*Area*
+ Vessel +Fishing-Method + Proportion-Tails + SOI + Moon
/ distribution = gamma, link = log

Int-2C:

*CPUE = Intercept + Year*Month +Year*Area*
+ Vessel +Fishing-Method + Proportion-Tails + SOI + Moon
/ distribution = gamma, link = log

Int-3:

*CPUE = Intercept + Year*Month +Year*Area + Month*Area*
+ Vessel +Fishing-Method + Proportion-Tails + SOI + Moon
/ distribution = gamma, link = log

where * indicates an interaction between the related effects. The inclusion in these 2-way interactions allows for the relative distribution of the resource between the different areas and months to be different between years.

ii) Derivation of Annual Index

Using the results from each GLM an annual abundance index was constructed based on the standardised CPUE.

For the model which included the three 2-way interactions the standardised CPUE within each Year-Month-Area strata was calculated as follows:

$$stdCPUE(year = y, month = m, area = a) =$$
$$\exp(I + Y.M_{ym} + Y.A_{ya} + M.A_{ma} + F_h + V_{ref} + P_{ref})$$

where $Y.M_{ym}$, $Y.A_{ya}$, $M.A_{ma}$, F_h, V_{ref} and P_{ref} are the parameters estimates relating to each of the terms included in the model. Note, due to the over-parameterization inherent in the GLM both F_h=0, V_{ref}=0 and P_{ref}=0 as these respectfully to relate the last levels in each of the *Fishing-Method*, *Vessel* and *Proportion-Tails* factors included in the model. In total there are 1840 (=23 years x 8 months x 10 areas) *Year-Month-Area* strata. As the standardised-CPUE is taken as an index of the density of fish within each strata, an index of the abundance of lobsters across the fishery in each year and month is given by:

$$Index(year = y, month = m) = \frac{1}{\sum_{a=1}^{NA} Area_a} \sum_{a=1}^{NA} Area_a.stdCPUE(y, m, a)$$

where $Area_a$ is the spatial size of each of the *NA Area* effects included in the GLM. Finally, an index of abundance for each year can be obtained by taking the average of the *NM* monthly indices in each year.

$$Index(year = y) = \frac{1}{NM} \sum_{m=1}^{NM} \left[\frac{1}{\sum_{a=1}^{NA} Area_a} \sum_{a=1}^{NA} Area_a.stdCPUE(y, m, a) \right]$$

Finally, a relative annual abundance index, B_y, was calculated such that the mean index over all years equals 1, i..e:

$$B_y = \frac{Index(year = y)}{\frac{1}{NY} \sum_{i=1}^{NY} Index(year = i)}$$

The total spatial size of the each MSE area shown in Figure 9 is unlikely to represent suitable habitat for rock lobsters. As such, in order to ascertain the spatial size of each MSE area to be used in the GLM-analysis, the number of 0.1x0.1-degree squares fished (based on the location of the mother ship recorded in the TVH logbook) within each MSE area was determined for each year. For those squares which included more than one MSE area, the square was apportioned between the different MSE areas based on the proportion of records in each area. Across the entire Torres-Strait region the number of squares fished each year between 1994 and 2018 has varied between 29 (in 2018) and 94 (in 2004) with a mean of 49.3 (c.f. Figure 10). The size of each MSE area $Area_a$, was set to the mean number of squares fished across all years, and then expressed as a percentage of the combined total across all areas so that $\sum Area_a = 1$.

Figure 9. Map of the MSE regions used as the area effects in the GLM.

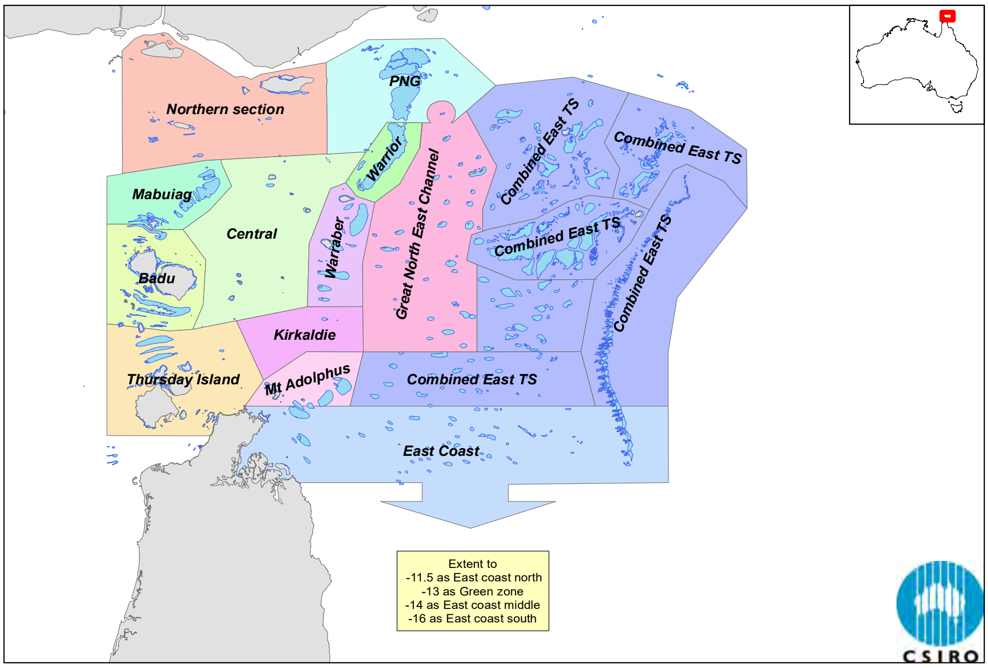
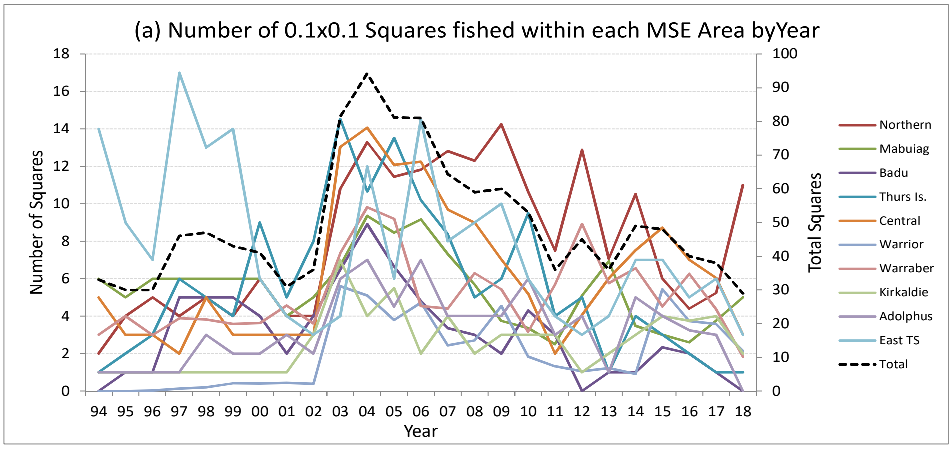
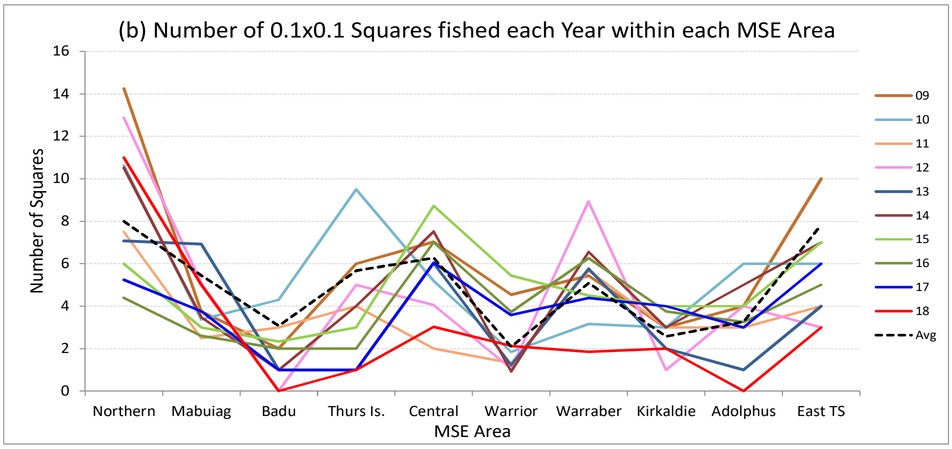


Figure 10. Number of 0.1x0.1-degree squares fished (a) within each MSW area by year, and (b) each year within each MSW area between 2009 and 2018. The average over all years (1994-2018) is also shown in both figures.





The derivation of the abundance index based on the GLMs which included less than three 2-way interaction terms is similar to that shown above. However, it can be noted that for those models which do not included an interaction with the Year effect (i.e. the main effects and Int-1 models), the relative abundance index, B_y, reduces to the simpler form:

$$B_y = \frac{\exp(Y_Y)}{\frac{1}{NY}\sum_{i=1}^{NY}\exp(Y_i)}$$

where Y_i , $i=1, NY$ are the parameters estimates relating to the *NY Year* effects included in the model. In these situations the abundance is independent of the relative size of each *Area* effect included in the GLM.

3. Results

(a) Standardising Effects

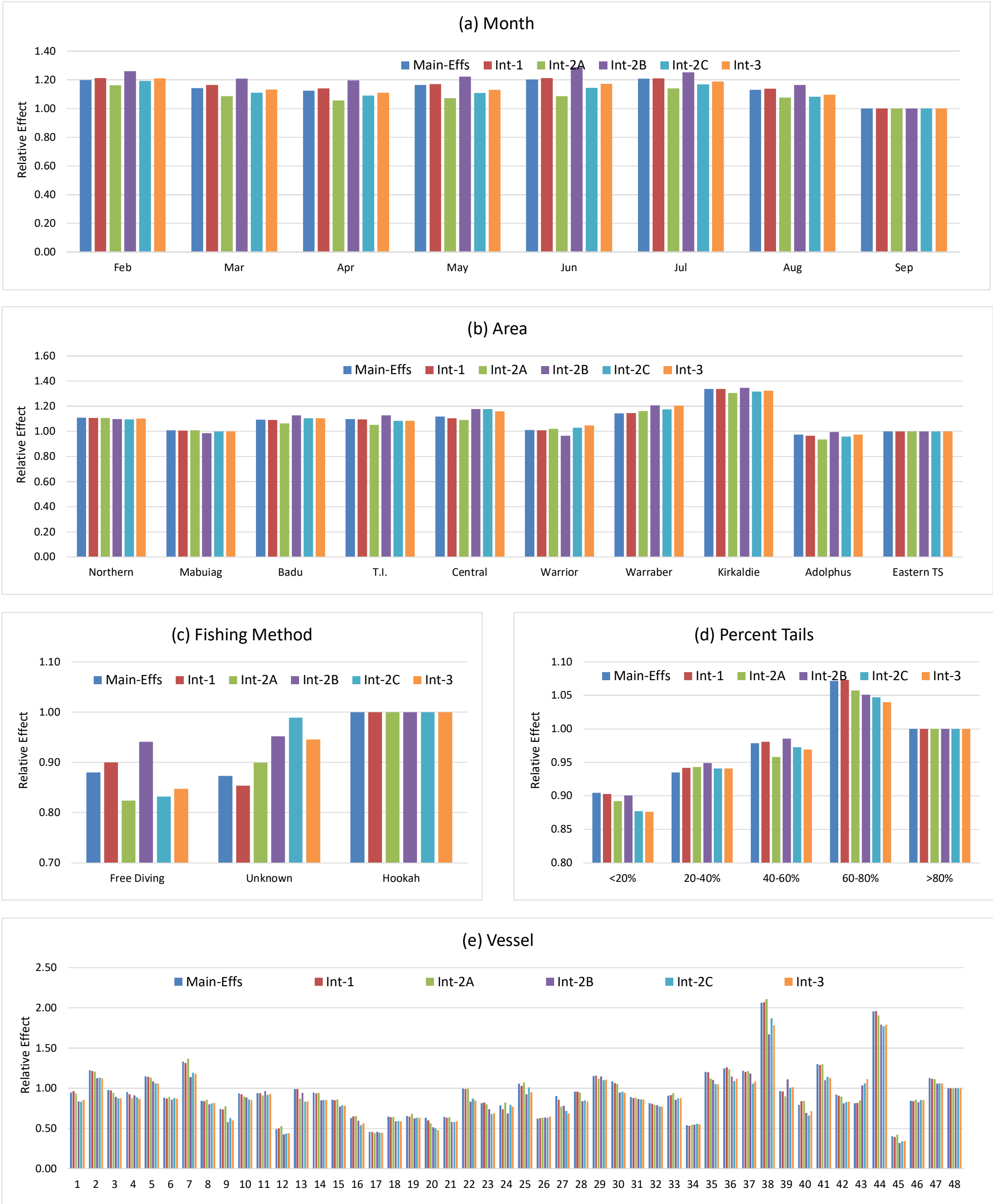
Statistics for the Type 3 contrasts computed for each fitted effect indicated that each effect was highly significant. The relative impact of each level for all effects fitted to each GLM model is shown in Figure 11. For each effect the values have been scaled so that the influence of each level is relative to that of the last level (i.e, *Month*=Sep, *Area*=Eastern TS, *Method*= Hookah and *Proportion-Tail*s >80%). For those models which included interactions the *Quarter* and *Area* effects were determined by calculating the mean effect across all *Year*, *Month* and *Area* strata respectively.

Relative CPUE is relatively constant across the eight months of the year and displays only small variation across the six GLM models, though the CPUE in September is the lowest across all models (c.f. Figure 11a). Taking the average of the relative effect across the results for the six models for each month indicates that the CPUE is highest during February, June and July (18-21% higher than the CPUE in September) while during March, April and May the CPUE is 12-14% higher than the CPUE in September. The greatest variation (as measured by the standard deviation, σ) between models in the relative CPUE across all months is between the results for the 2Ints-A (σ=0.05) and 2Ints-B models (σ =0.09). For all other models σ=0.07.

The relative CPUE across the various areas included in the GLM also do not display large variation across the six GLM models, though there is some degree of variation across the ten areas (c.f. Figure 11b). Taking the mean of the relative effect across the results for the six models for each area indicates that the relative CPUE is, on average, lowest in Mt Adolphus (97%), Eastern TS (100%, the reference area) and Warrior (101%) and highest in Kirkaldie (133%), Warraber (117%) and Central (114%).

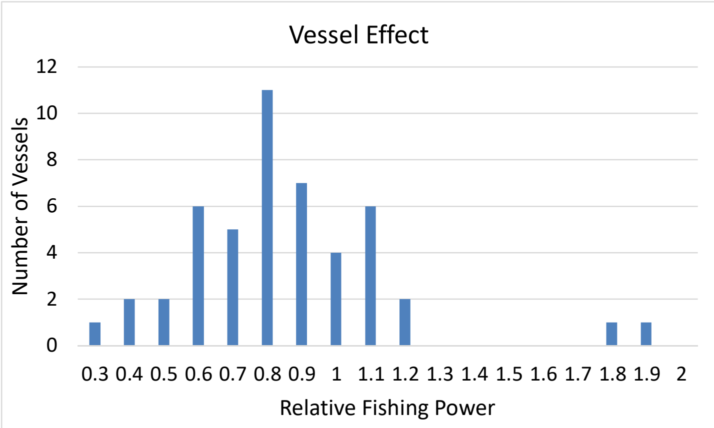
Unlike the previous results, the relative CPUE across the three fishing methods displays larger variation across the six GLM models (c.f. Figure 11c). For example, the relative effect of the free-diving method relative to hookah diving varies between 82% and 94% while that for the unknown method varies between 85% and 99%. Across all models, the CPUE for hookah fishing is found to be around 13% higher than for free diving and 8% higher than for unknown method. This latter result is to be expected if this fishing method is likely to be a combination of the two other fishing methods

Figure 11. Relative impact of each level of the main effects fitted to the each GLM.



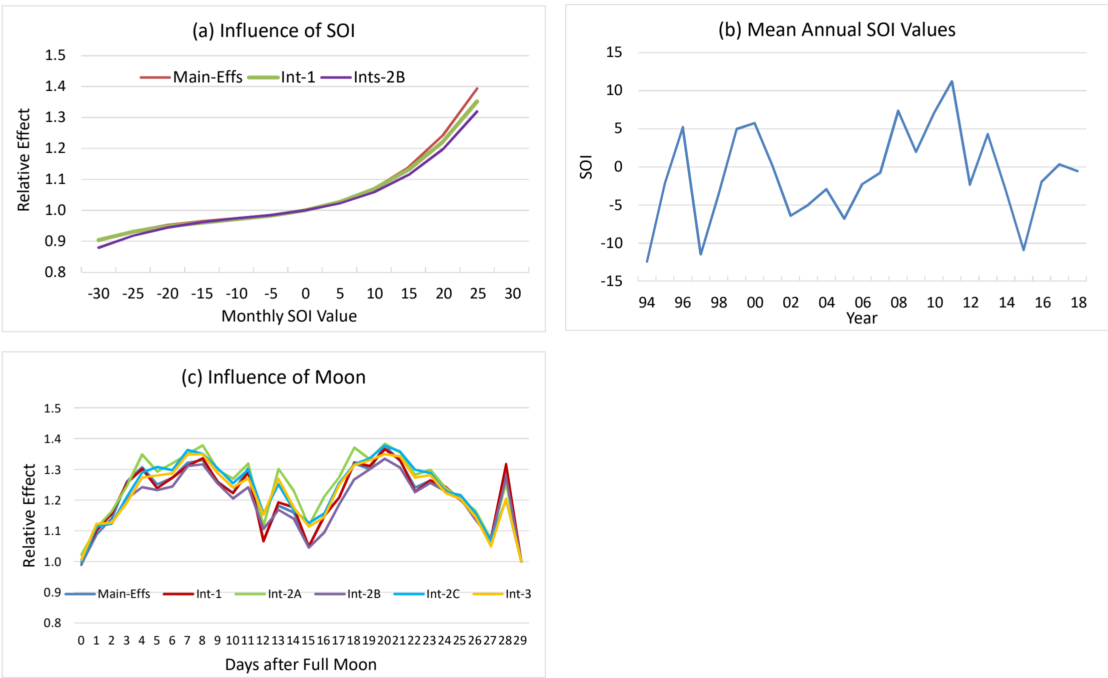
The relative CPUE across all models is similar for each category of the proportion of the catch which is tails with the relative CPUE generally increasing as the *Proportion-Tails* increases in the catch (c.f. Figure 11d). However, the highest CPUE is found for those catches which include 60-80% tails. Across all models, the relative CPUE within each *Proportion-Tails* category is 89%, 94%, 97%, 106% and 100% respectively. Finally, there is substantial variation in the relative CPUE across the 48 vessels included in the GLM models, though the relative effect of each vessel is less sensitive to the GLM model used (c.f. Figure 11e). Across all models, the relative fishing power across the fleet varies more than four-fold from 37% to 193% of the standard vessel and the distribution of these effects is shown in Figure 12.

Figure 12. Histogram of the distribution of the relative fishing power of the 48 vessels included in the GLM models.



The monthly value of the SOI was fitted as a cubic function and the estimated influence of this effect on CPUE based on the results from three of the fitted GLM models is shown in Figure 13a. Note, the influence of SOI on CPUE cannot be estimated for several models as the related parameter is aliased when the GLM model includes a *Year.Month* interaction term. The influence of the SOI is seen to be similar for the three models shown, with negative values of the SOI (El Nino conditions) decreasing CPUE while positive values of the SOI (La Nina conditions) increasing CPUE. This indicates that oceanographic conditions may have influenced the high CPUEs experienced in the fishery in 2011 (when the mean SOI value was 12.7, c.f. Figure 13b) and the low CPUE experienced in the fishery in 2015 (when the mean SOI value was -10.8). However, based on the results shown in Figure 13 the influence on CPUE of the conditions prevailing in these years should have been only 6-7%. Further exploration of the influence of this and other environmental variables is warranted.

Figure 13 (a) Relative influence of the values of the SOI on CPUE and (b) mean annual values of the SOI since 1994. (Note, SOI value for 2017 only mean from Jan to Nov).



Finally, the influence of the daily moon-phase across each of the GLM models is shown in Figure 13c. The influence is seen to be similar across all models and displays an interesting bi-modal distribution across the days between successive full moons. CPUE is lowest during days near a full moon and also low around a new moon, while CPUE is highest mid-way between these two phases (i.e. around the first and last quarters). During this latter periods CPUE is around 30% higher than at the time of a full moon.

(b) Annual Abundance Indices

The relative abundance indices based on each of the six GLM models are listed and displayed in Table 4 and Figure 14 respectively. Relative to the nominal index, each of the standardised indices is similar but is higher at the start of the time-series and lower after 2012. The reasons for these differences can be investigated using the annual influence of each main effect which is shown in Figure 15 for the Main-Effects and Int-1 models. The influence on the annual index is seen to be greatest for the *Vessel* effect followed by the *Proportion-Tails* effect, with the influence of each effect showing an opposing trend over time. The change in the influence of the *Proportion-Tails* effect correlates with the shift from the catch being all tails to now being predominantly whole (c.f. Figure 3b), which decreases CPUE (c.f. Figure 11d), while the change in the influence of the *Vessel* effect is most likely due to an (expected) increase in the relative fishing power of vessels over time. The relative influence of the *Vessel* effect is seen to be greatest towards the start and end of the time- series and explains the divergence seen between the nominal and standardised indices at these times.

Table 4. Annual abundance indices for Torres Strait rock lobsters based on the standardised CPUE from the weighted GLM models. The nominal CPUE is also shown for comparison.

Year	Nominal	Main-Effs	Int-1	Int-2A	Int-2B	Int-2C	Int-3
94	0.89	1.40	1.41	1.32	1.38	1.35	1.35
95	0.97	1.39	1.38	1.30	1.35	1.32	1.33
96	0.94	1.01	1.01	1.01	1.03	1.00	1.01
97	1.04	1.17	1.16	1.11	1.11	1.08	1.08
98	0.98	1.07	1.07	1.07	1.09	1.10	1.09
99	0.77	0.67	0.67	0.68	0.66	0.67	0.67
00	0.62	0.68	0.67	0.74	0.65	0.72	0.73
01	0.44	0.44	0.44	0.43	0.47	0.47	0.47
02	0.77	0.69	0.69	0.66	0.67	0.63	0.63
03	1.03	1.08	1.07	1.03	1.05	1.02	1.01
04	1.09	1.17	1.17	1.16	1.16	1.12	1.14
05	1.49	1.49	1.49	1.42	1.47	1.38	1.40
06	0.68	0.69	0.70	0.68	0.67	0.65	0.65
07	1.08	1.00	1.00	0.97	1.00	0.96	0.96
08	0.87	0.84	0.84	0.87	0.89	0.91	0.90
09	0.62	0.65	0.65	0.64	0.69	0.69	0.69
10	1.24	1.09	1.10	1.24	1.14	1.24	1.27
11	2.11	1.75	1.75	1.93	1.94	2.13	2.09
12	1.64	1.46	1.46	1.43	1.36	1.33	1.30
13	1.27	1.23	1.23	1.28	1.24	1.29	1.30
14	1.04	0.94	0.94	0.93	0.94	0.92	0.92
15	0.63	0.58	0.58	0.56	0.54	0.52	0.52
16	1.19	1.04	1.05	1.09	1.05	1.05	1.08
17	0.75	0.68	0.68	0.66	0.70	0.66	0.64
18	0.88	0.79	0.78	0.79	0.77	0.79	0.78
Mean	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Figure 14. Annual abundance indices for Torres Strait rock lobsters based on the standardised CPUE from the Main-Effects and several interaction models. The nominal CPUE is also shown for comparison.

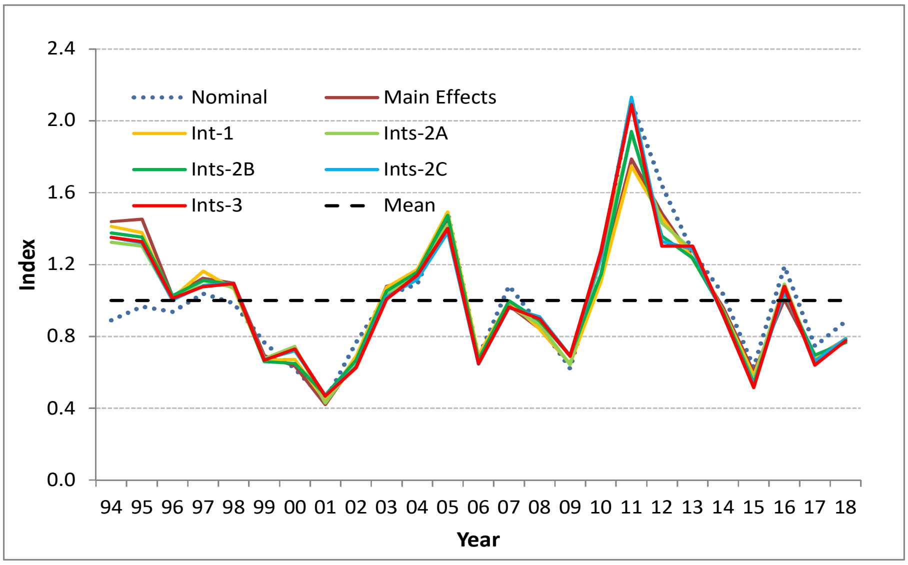


Figure 15. Annual influence of the fixed effects fitted to (a) the Main-Effects model and (b) the Int-1 model.

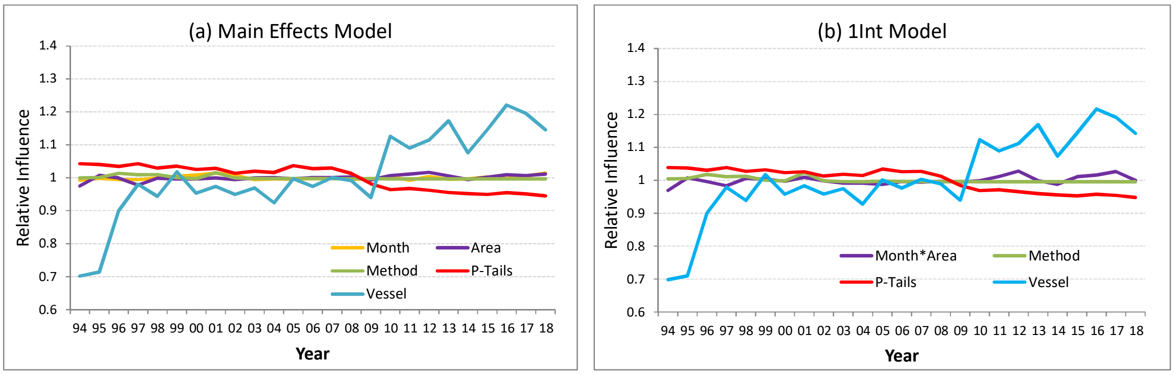


Table 5. Criteria for assessing the goodness-of-fit of each GLM.

GLM	Main	Int-1	Int-2A	Int-2B	Int-2C	Int-3
N-records	45,427	45,427	45,427	45,427	45,427	45,427
df	128	188	350	393	490	553
Deviance	20,133	19,810	18,467	17,923	17,084	16,739
Chi-sq	21,313	20,794	18,845	18,038	17,014	16,580
likelihood	-172,861	-172,443	-170,638	-169,874	-168,651	-168,132
AIC	345,975	345,266	341,977	340,534	338,282	337,370
BIC	347,083	346,923	345,030	343,963	342,556	342,194
N-Strata	2,000	2,000	2,000	2,000	2,000	2,000
Imputed	0	0	50	88	126	126

The influence of the other effects is seen to be relatively small. For the *Area* and *Month* effects this is likely to be due to the equal weighting given to each *Year-Month-Area* strata in the GLM model analysis. The small but positive trend in the influence of the *Method* effect over the time-series also relates to the fact that there may have been a slight increase in the proportion of catches using hookah diving over time (c.f. Figure 3a) which has the highest CPUE (c.f. Figure 11d).

Several criteria for assessing the goodness-of-fit for each of the GLM models are shown in Table 5. For each criteria shown (where smaller is better) there is an improvement in the fit between each successive model implying that the model which includes all three 2-way interactions provides the best fit to the data. The Int-3 model has considerably greatly flexibility in accounting for inter-annual changes in the distribution of the resource across the different months and areas in comparison to the Main-Effects model which assumes that these distributions are the same for all years. However, the number of parameters (553) estimated in the full interaction model Int-3 is considerably greater than the number of parameters (128) estimated in the Main-Effects model. A consequence of the increase in the number of parameters is that the number of observations on which some of the parameters rely to be estimated can be small (or in some instances zero). A small number of observations increases the likelihood that the corresponding parameter is poorly estimated.

Figures showing of the number of observations per 2-way strata (for which a separate parameter was estimated) are shown in the Appendix. For 36 (14.4%) of the 250 *Year*Area* strata the number of observations was less than 10 (with 13 of these strata having zero observations) while only six of the 200 *Year*Month* strata had less than 10 observations (being zero for five strata, four of which occurred in 2018). On the other hand, the number of observations was greater than 13 for all of the 80 *Area*Month* strata. For those strata for which the number of observations is zero, the related standardised CPUE for these strata needs to be imputed. (Note, the number of strata for which the standardised CPUE needs to be imputed for each model is shown in Table 5.) For this purpose, the corresponding value using the Int-1 model was used as this model allows the standardised CPUE to be calculated within all strata.

For the Int-3 and Int-2C models, the number of *Year-Month-Area* strata where no observations were available for estimating the related model parameters (which then needed to be imputed) was 126 (or 6.3% of the 2000 number of strata in total). For the Int-2B model the number of imputed strata was 88 (4.4%) while the number of imputed strata for the Int-2A model was 50 (or 2.5% of all strata). While it is can be considered best practice to select an abundance index where no parameters have had to be estimated (i.e. the Main-Effects or Int-1 models), the small number of estimated parameters in the Int-2A model reduces the potential for bias in the corresponding index.

4. Concluding Remarks

The above analyses, and the resulting indices of annual abundance, are based on the number of assumptions about the data and how these data describe fishing behaviour in the fishery. In particular, if there are features of the fishery which are not adequately captured by the data used in these analyses then the GLMs will not be able to standardise the CPUE for these particular features.

For example, even though the inclusion of interactions allows the model the freedom to the resolve differences in the distribution of the resource across the different areas within different years, the model has no ability to resolve changes in the fishery which may take place within any given area (or month). In particular, the models used to standardise CPUE assume that within each year the distribution of fishing effort within any area is relatively random or that the pattern of fishing across each area remains relatively consistent over time. However, it is possible that with the introduction of new technologies (such as GPS) that over time fishers have been able to more precisely target their fishing effort to sub-regions of preferred habitat (and higher abundance) within a given area. Such 'effort creep' would result in higher catches and higher CPUE compared to the situation where no new technologies were available. The maintenance of high CPUE in light of reduced resource abundance due to effort creep (known as hyper-stability) ultimately leads to a breakdown of the linear relationship assumed between CPUE and resource abundance.

This can be a particularly critical consideration for an aggregating species such as rock lobsters, when higher CPUE can be maintained when fishers can target known aggregating sites, or the number, size and the distribution of such aggregations within a season can change in response to changes in ambient conditions within a season not related to overall abundance (e.g. oceanographic conditions). It is interesting to note that the area fished across the fishery (as measured by the number of 0.lx0.1-degree squares, c.f. Figure 10a) has been decreasing over time, with the area fished reaching a minimum during the current year (2018). However, whether this indicates that the fishing effort was more aggregated during 2018 than in other years remain uncertain, as the location of fishing effort currently recorded in the logbook is the location of the primary vessel and not the associated tenders which can disperse themselves widely from the primary vessel.

While the fitted GLM models used in the analyses described in this report appear to capture increases in the fishing power of the fleet due to changes in the vessels leaving and entering the fishery, continual increases in the fishing power over time for individual vessels that remain in the fishery will not be captured by the available data and fitted models and as such could result in continual biases in the calculated indices of abundance.

To help overcome this problem it would be useful to further investigate whether or not there have been increases in fishing power over time which are not currently captured by the data. With such information in hand one could then decide whether the data currently available adequately captures the strategies used in the fishery. If not, there needs to be a further discussion as to what additional data may need to be collected so that these aspects of the fishery can be taken into account in the statistical analyses used to standardise the data. Of course, this is a discussion that is pertinent to all fisheries.

Finally, the catches and catch-rates achieved in a fishery are also likely to be influenced by changes in oceanographic and environmental conditions which are likely to change on both a seasonal and inter-annual basis. While the current analyses attempt to model the influence of the monthly value of the Southern Oscillation Index (used to distinguish El Nino and La Nina conditions) and the daily phase of the moon on catch rates, the influence of such environmental changes is likely to require a broader understanding of oceanographic processes that impact on the fishery (including those which may influence the aggregation dynamics of the rock lobsters and delayed effects such as those which influence recruitment success or failure and which subsequently propagate through the fishery over time). Again it would be useful to discuss how such processes can be incorporated into these models.

The use of standardised CPUE as an index of resource abundance is an important input to the stock assessments for many fisheries. This is particularly the situation for those fisheries where fishery independent surveys of the resource are not available or feasible (such in fisheries for highly migratory species such as tunas and billfish). However, as noted above the accuracy of these indices is premised on a number of assumptions, particularly the ability of the logbook data used in the analyses to readily capture the important aspects of the fishery which influence catch rates. In these instances, and where possible, it is useful to incorporate fisheries independent data into the stock assessments. In particular, annual indices of resource status based on fishery independent surveys are usually seen as an important adjunct to the fishery dependent data, and where possible their inclusion in the stock assessment is highly recommended. Where such surveys are not available then attention needs to be paid to ensuring that the logbook data from the fishery captures the information necessary to adequately standardise the catch rates in the fishery as discussed above.

For the Torres Strait rock lobster fishery there are currently two sources of catch and effort data, those for the TVH and TIB sectors. The logbook data from the TVH sector is believed to provide a relatively complete and good source of catch and effort data for this sector, though improvements in compliance to ensure that all fields in the logbook are completed (e.g. area fished and hours fished) would improve the utility of these data. Also, a better recording of the locations of the fishing effort (i.e. at the tender level) would also improve the accuracy of the data for standardising catch rates. On the other hand, the data for the TIB sector is considered to be less complete and the measure of effort (days fished) is less accurate and incomplete in many instances. While the utility of these data to provide a useful index of resource abundance has been investigated elsewhere (Campbell et al, 2017), again greater effort needs to be placed on ensuring the completeness and accuracy of these data for such purposes.

References

Bentley, N., Kendrick, T.H., Starr, P.J., Breen, P.A. 2012. Influence plots and metrics: tools for better understanding fisheries 1 catch per unit effort standardisations. ICES Journal of Marine Science: 69, 84-88.

Campbell, R.A., 2004. CPUE standardization and the construction of indices of stock abundance in a spatially varying fishery using general linear models. Fish. Res. 70, 209–227.

Campbell, R.A. Plaganyi, E, Deng, R., 2017. Use of TIB Docket-Book Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2017 update. Information paper presented to the 21st meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12-13 December 2017, Cairns.

Punsley, R.G., 1987. Estimation of the relative abundance of yellowfin tuna, *Thunnus albacares*, in the Eastern Pacific Ocean during 1970-1985. Inter-Amer. Trop. Tuna Comm. Bull. 19, 98-131.

Appendix: Data Summary

The following three spatial-temporal effects were included in the GLM used to standardise the CPUE for lobsters caught in the Torres Strait:

1) Year (all 25 years between 1994 and 2018)
2) Month (all 8 months between February and September)
3) MSE-Area (10 areas)

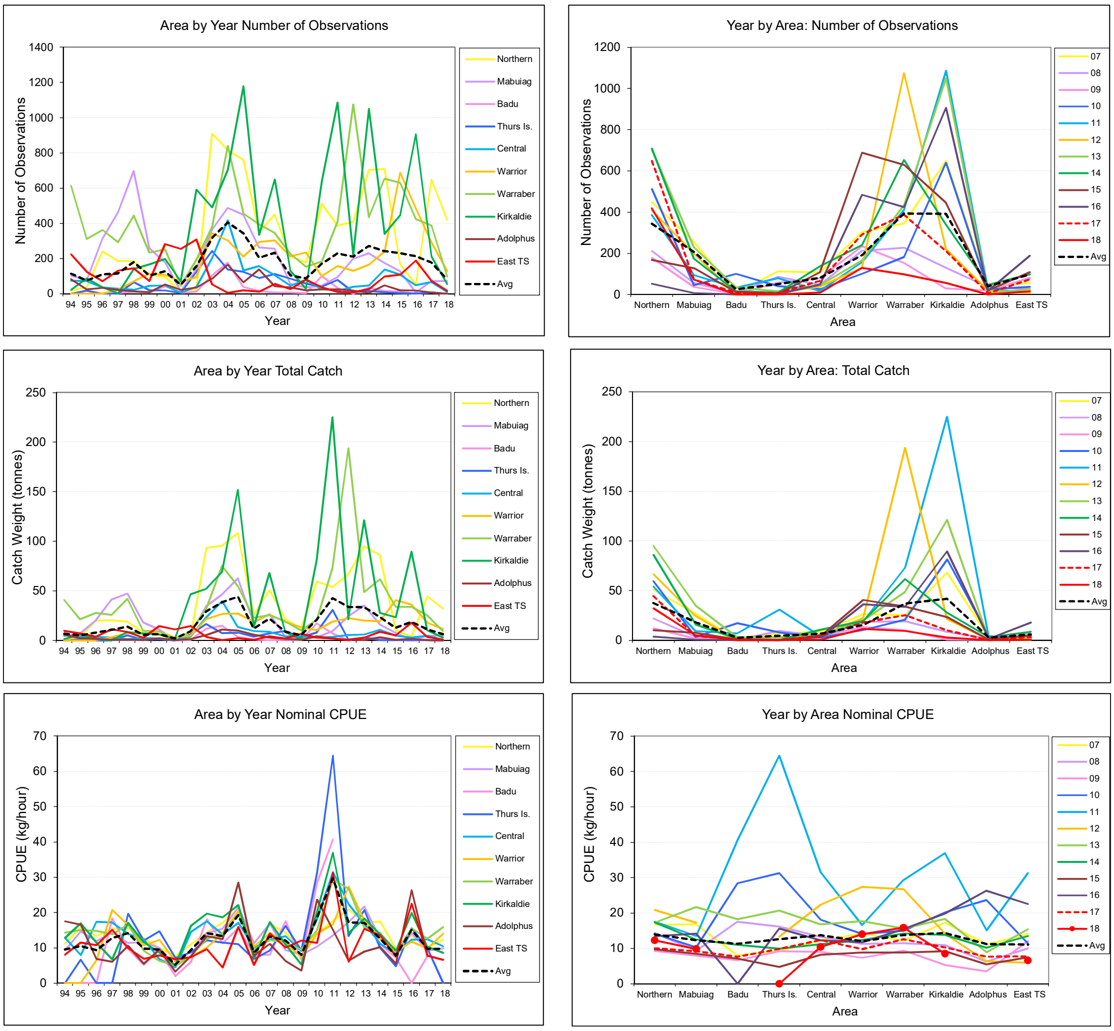
For each 2-way combination of these effects, the following figures provide:

1) Number of data observations
2) Total catch (kilograms of lobsters)
3) Nominal CPUE (kilograms per hour fished)

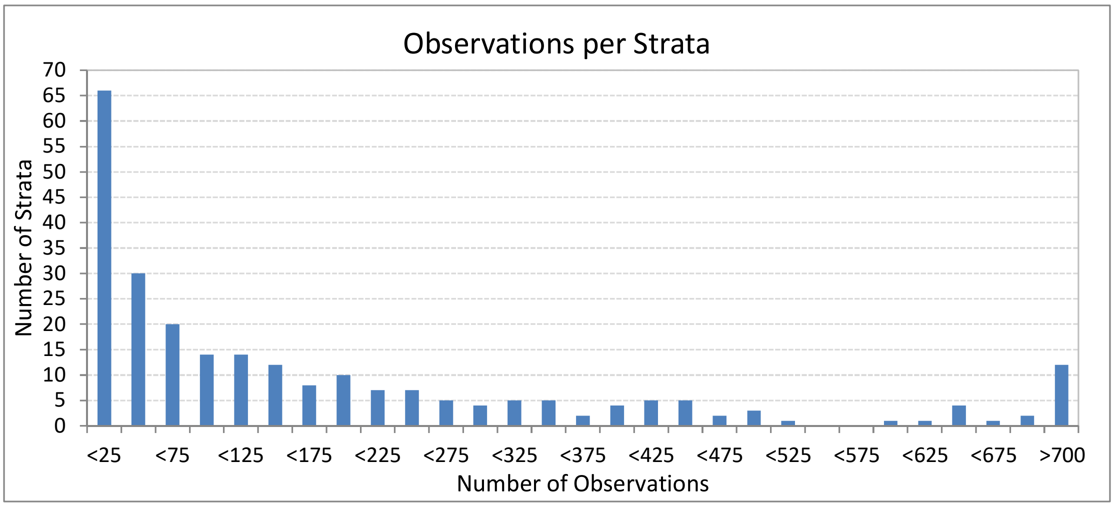
The data is limited to those records fitted to the GLMs and includes 45,427 records.

A histogram of the number of observations within each stratum is also shown for each of the above 2-way combination of these effects.

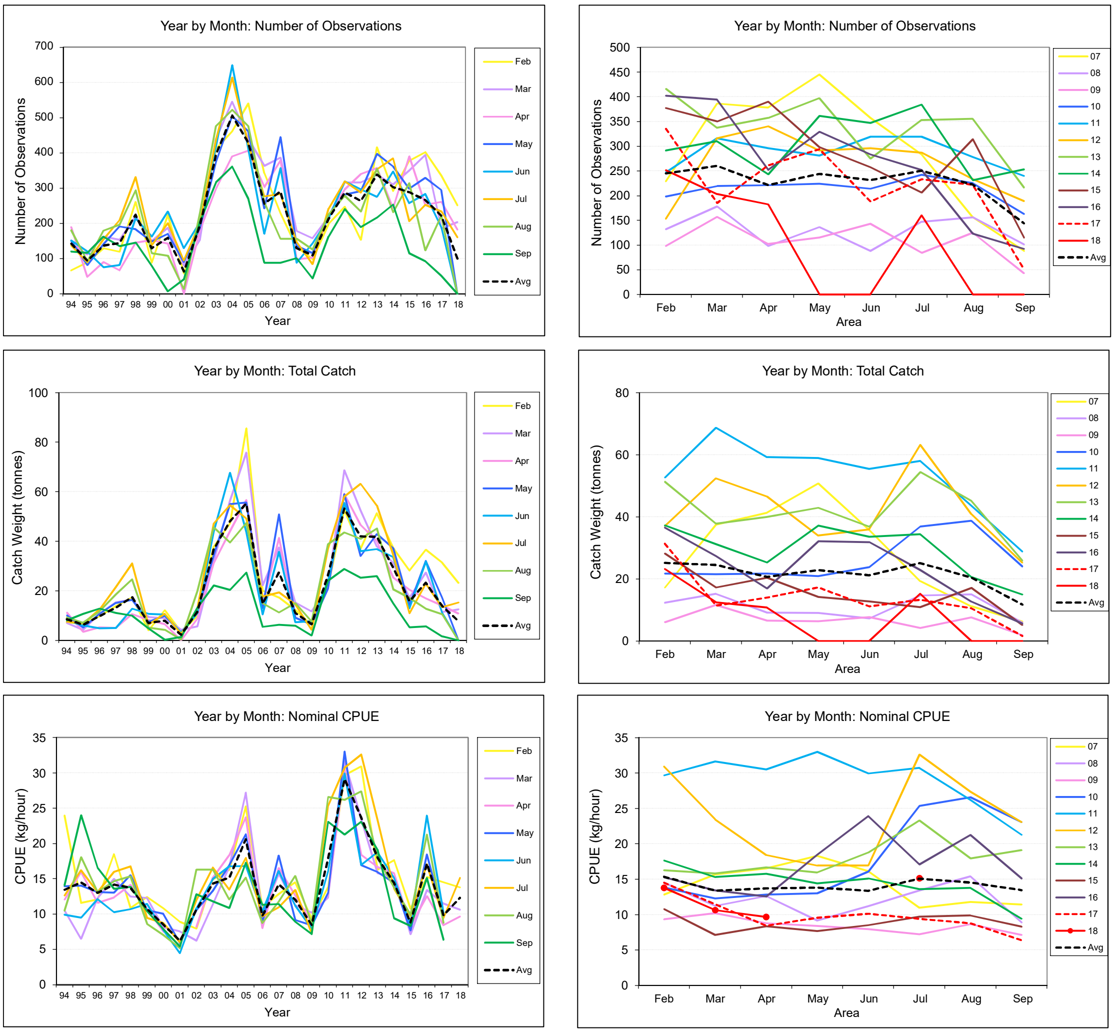
(a) Year*Area



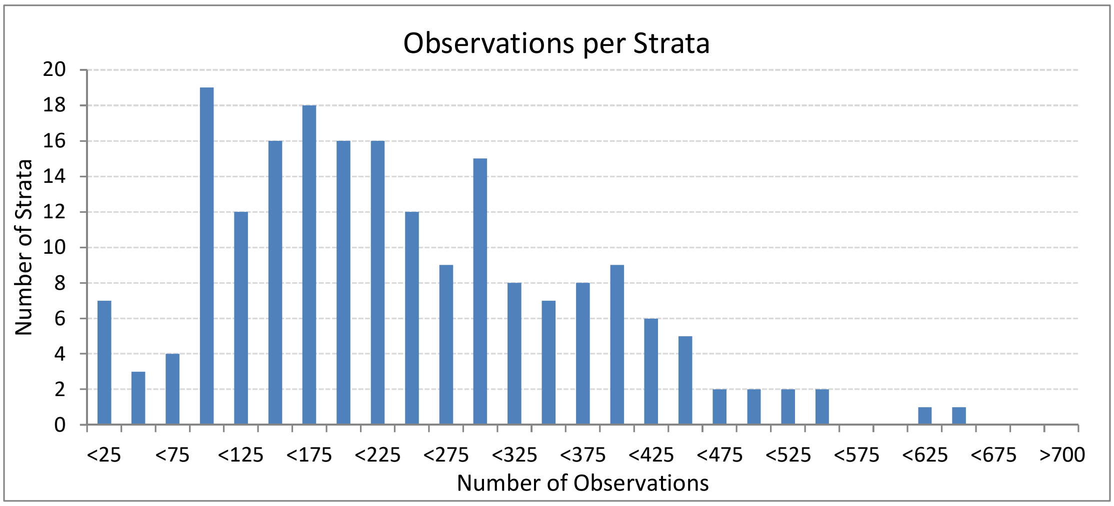
Of the 250 Year*Area strata (25 years x 10 areas) the number of observations is zero for 13 strata: There are a further 8 strata where the number of observations was between 1 and 4 and 15 strata where the number of observations was between 5 and 9. The number of observations for all other strata was between 10 and 1,178.



(b) Year*Month

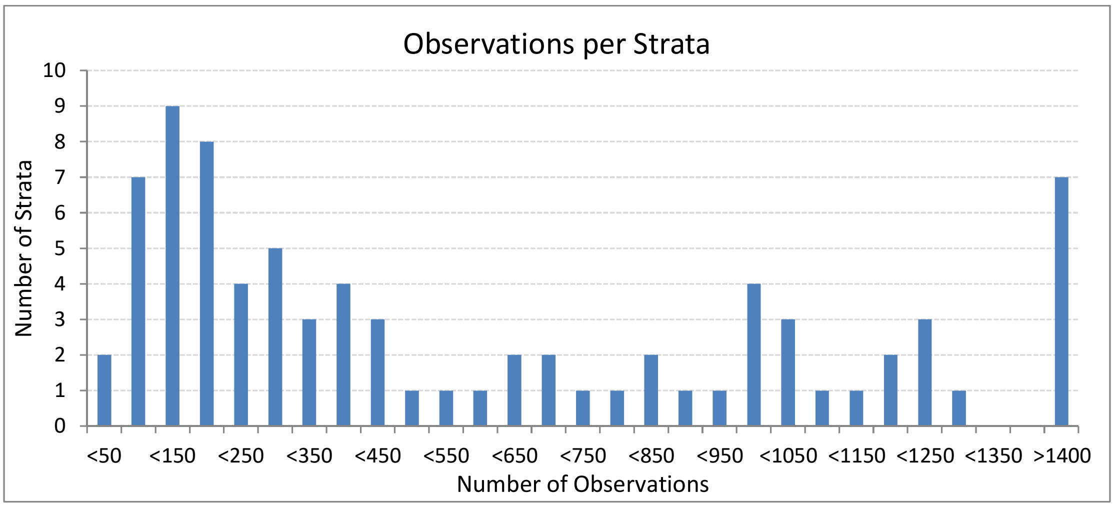


Of the 200 Year*Month strata (25 years x 8 months) the number of observations is zero for 5 strata (Apr-01 and May-Jun-18 & Aug-Sep-18). There was one strata (Sep-00) with only 7 observations. For the remaining 194 strata the number of observations was between 10 and 649.



(c) Month*Area

Of the 80 Month*Area strata (8 months x 10 areas) the number of observations for all strata was between 37 and 1,685.



Use of TIB Docket-Book Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2018 Update

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CSIRO Oceans and Atmosphere Flagship

October 2018

1. Introduction

The Torres Strait Seafood Buyers and Processors Docket Book (TDB01), until recently, was used in the TIB sector of the Torres Strait rock lobster fishery to record the catch sold by fishers (known as sellers on the Docket-Book) at the end of a fishing trip. It was replaced on 1 December 2017 by the mandatory Torres Strait Catch Disposal Record TDB02. However, unlike the Daily Fishing Log (TRL04) used in the TVH sector of fishery, which requires catch and effort data to be recorded for individual fishing operations related to each vessel tender, both the TDB01 and TDB02 Docket-Books require only aggregate catch and effort data to be recorded at the end of each trip. Nevertheless, both sets of catch and effort data recorded in each sector of the fishery have proven useful in constructing abundance indices for the fishery, and both are included in the Harvest Control Rule used to help determine an appropriate annual TAC. This document provides the latest update of the data and analyses undertaken for constructing the abundance index based on the Docket-Book data for the TIB sector (see Campbell *et al*, 2017).

2. Estimation of Total TIB Catch

A copy of both the TDB01 and TDB02 Docket-Books are shown in Appendix A. Each docket-book records the transaction date, the name of the seller, together with details of the catch (in weight). Additional information is also provided regarding the vessel, the number of crew, the number of days fished and the fishing methods used. This information therefore provides a measure of both the catch and effort for a given seller (or fisher) during a fishing trip and hence can be used to gain a measure of the catch rate (weight of lobsters caught per day fished) during that trip.

However, there were a number of issues with the TDB01 Docket-Book system which created problems with using this data for estimating the total catch and effort in the TIB fishery. These issues included:

i. The requirement that completion of this docket-book was only voluntary,
ii. The fact that catches recorded in this docket-book could also be reported elsewhere, including the TVH logbook,
iii. The fact that processors could also record catches in this docket-book, essentially creating duplicates.

Given the duplication of catch information from both the TVH sector and processors which occurred in the TDB01 docket-book data, several filters have been developed and applied to the data sourced from this docket-book in an attempt to identify and remove these duplicates. Further to these issues, several large TIB boats prior to 2016 only recorded their catch in the TVH-related logbook (TRL04) and these catch records need to be transferred to the TIB database. This occurred because some TIB operators believed the TRL04 Logbook was mandatory, though they later became aware reporting for TIB is currently voluntary.

Finally, between 2013 and 2016 several processors reported aggregate annual catch data to AFMA as these catches were not being recorded in the TDB01 Docket-Book. Each processor reported the catch for tailed and whole lobsters separately, so that for each season two catch records were added to the TIB database for each processor to account for these additional catches.

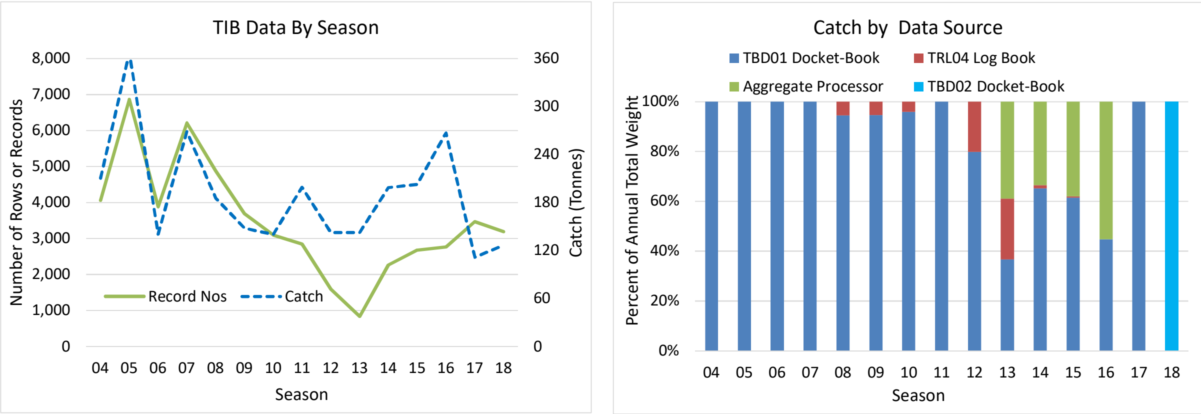
Considerable effort has gone into understanding the nature of both the TDB01 Docket-Book and TRL04 Logbook data so as to identify the catch records that should be assigned to the TIB sector of the fishery. A full description of the approach and data-rules used to identify and remove these duplicate records from the Docket-Book data is described in Campbell and Pease (2017). For the analyses described in this report, a total of 49,130 catch records have now been attributed to the TIB fishery covering the 2004 to 2017 seasons while an additional 3,193 TIB catch records have been sourced from the TBD02 docket-book for the 2018 season. Note, several (54) Docket-Book records having a zero catch of lobsters are not included in these totals as it is assumed that other species may have been targeted on these trips. Also, a catch record for the purpose of the data summarised in this report pertains to the catch and effort information provided on a single page in either the TDB01/TDB02 Docket-Books or TRL04 Logbook and for which a unique Record-Number (Record-No) is attributed. Within the TIB database there are usually multiple rows of catch information associated with each unique Record-No as the catch is separately recorded by process form and perhaps grade.

The number of catch records and the associated estimate of the total catch of rock lobsters in the TIB sector each season (starting 1-December), and by data source, is shown in Table 1 and Figure 1. Between 2004 and 2007 all TIB related catch is sourced from the TDB01 Docket-Book, and the number of catch records each season varied between 4,058 and 6,867, while between 2008 and 2015 a portion of the total catch was recorded in the TRL04 Logbook. While the related catch was small in some seasons (<10 tonnes) this catch nevertheless represented over 20% of the total TIB catch in both the 2012 and 2013 seasons. Finally, between 2013 and 2016 a significant portion of the total TIB catch (between 34% in 2014 and 55% in 2016) was attributed to the aggregate catch data provided by several processors (as this catch was not recorded in the TDB01 Docket-Book). For the 2017 season the catch data was sourced entirely

Table 1. Number of distinct TIB Record Nos by fishing season and the related catch by data source. Note, PRC relates to the aggregate catch provided by several processors.

	Records by Data Source				Total	Catch by Data Source				Total Catch
Season	TDB01	TDB02	TRL04	PRC	Records	TDB01	TDB02	TRL04	PRC	(kg)
2004	4058	0	0	0	4,058	210,383	0	0	0	210,383
2005	6867	0	0	0	6,867	367,615	0	0	0	367,615
2006	3882	0	0	0	3,882	140,451	0	0	0	140,451
2007	6212	0	0	0	6,212	268,689	0	0	0	268,689
2008	4768	0	114	0	4,882	175,442	0	10,223	0	185,665
2009	3596	0	95	0	3,691	139,850	0	7,964	0	147,814
2010	3033	0	62	0	3,095	134,353	0	5,686	0	140,039
2011	2845	0	0	0	2,845	199,061	0	0	0	199,061
2012	1424	0	168	0	1,592	113,622	0	28,757	0	142,379
2013	649	0	183	2	834	52,249	0	34,862	55,411	142,522
2014	2224	0	32	2	2,258	129,657	0	2,456	66,662	198,775
2015	2652	0	25	2	2,679	124,369	0	1,333	76,904	202,606
2016	2762	0	0	4	2,766	119,756	0	0	147,380	267,136
2017	3469	0	0	0	3,469	111,504	0	0	0	111,504
2018	0	3193	0	0	3,193	0	126,476	0	0	126,476
Total	48,441	3,193	679	10	52,323	2,287,001	126,476	91,281	346,357	2,851,115

Figure 1. (a) Number of distinct TIB catch records and associated catch (in tonnes) by fishing season, and (b) the proportion of the annual TIB catch by data source.



from the TDB01-Book data, being the first time since 2007, and this change was likely the result of requests by AFMA for the Docket-Book to be used for the recording all catches. While it has been noted that a substantive portion of the total TIB catch was reported in aggregate form between 2013 and 2016, and which helps to explain the lower number of Record-Nos during this period, the large reduction in Record-No in 2012 and 2013 appears anomalous. Whether or not other catches were also not been recorded in the Docket-Book during these or in other seasons remains unknown. Finally, for the 2018 season all catch data is sourced from the new TDB02 Docket-Book.

3. The TIB Docket-Book Data

The number of distinct vessel-symbols and seller-names associated with the 52,357 TIB catch records identified in the previous section is 1,278 and 2,433 respectively. However these numbers are inflated due to different spellings and mistakes often associated with a single vessel-symbol or seller-name. Attempts have been made to correct these names, and as a result the number of distinct vessel-symbols and seller-names has been reduced by nearly half, to 767 and 1,149 respectively. However, the percentage of all records (and total catch) without a vessel-symbol remains high at 68% (and 71% respectively). On the other hand, only 1.5% of all records (and 3.6% of the total catch) have no associated seller-name.

The frequency of the fishing methods associated with all Record Nos is shown in Table.2. Just over 40% of all records, and 39% of the total catch, are associated with hookah-diving, while free diving and lamp fishing are associated with 27% and 4.9% of the total catch respectively. Smaller amounts of the catch are also associated with handlining and trolling, and for around 2.5% of all records the catch is associated with some combination of these five fishing methods. However, the catch method for 12% of all catch records (and 26% of the total catch) remains unknown.

The distribution of all Record Nos (and catch) across each of the 21 TIB areas (shown in Figure 2) is given in Table 3. Around 42% of the records and slightly over a quarter (27%) of the catch have come from the Thursday Island region, with another 16% and 10% of the total catch coming from the Mabuiag and Badu regions respectively. Eleven of the 21 regions each account for less than one-percent of the total catch over all seasons (and only 2.4% in total). However, across all records the region fished remains unknown (i.e. not recorded) for 8.5% of all records (and 21% of the total catch). However, as noted by TSRL-RAG23 in May 2018, the

Table 2. Number of TIB catch records (and associated catch in kilograms) by fishing method.

METHOD	N-recs	%	Catch	%
HOOKAH DIVING	20974	40.1%	1,111,117	39.0%
FREE DIVING	18633	35.6%	772,128	27.1%
UNKNOWN	6495	12.4%	736,115	25.8%
LAMP FISHING	4903	9.37%	139,958	4.91%
FREE DIVING-LAMP FISHING	493	0.94%	30,698	1.08%
FREE DIVING-HOOKAH DIVING	260	0.50%	27,089	0.95%
DIVING UNSPECIFIED	214	0.41%	15,897	0.56%
HANDLINING-FREE DIVING	141	0.27%	7,182	0.25%
HOOKAH DIVING-LAMP FISHING	37	0.07%	3,422	0.12%
TROLLING-FREE DIVING	44	0.084%	1,293	0.045%
HANDLINING	33	0.063%	842	0.030%
UNKNOWN-HOOKAH DIVING	18	0.034%	933	0.033%
FREE DIVING-HOOKAH DIVING-LAMP FISHING	12	0.023%	1,567	0.055%
HANDLINING-TROLLING-FREE DIVING	18	0.034%	561	0.020%
UNKNOWN-FREE DIVING	13	0.025%	419	0.015%
FREE DIVING-UNKNOWN	12	0.023%	659	0.023%
HOOKAH DIVING-UNKNOWN	3	0.006%	284	0.010%
UNKNOWN-FREE DIVING-LAMP FISHING	3	0.006%	228	0.008%
UNKNOWN-LAMP FISHING	3	0.006%	49	0.002%
TROLLING	3	0.006%	202	0.007%
LAMP FISHING-FREE DIVING	1	0.002%	53	0.002%
FREE DIVING-TROLLING	3	0.006%	51	0.002%
DIVING UNSPECIFIED-LAMP FISHING	1	0.002%	32	0.001%
UNKNOWN-FREE DIVING-HOOKAH DIVING	1	0.002%	18	0.001%
HANDLINING-TROLLING	2	0.004%	22	0.001%
TROLLING-DIVING UNSPECIFIED	2	0.004%	146	0.005%
HANDLINING-FREE DIVING-UNKNOWN	2	0.004%	30	0.001%
FREE DIVING-HANDLINING	1	0.002%	13	0.000%
ROD AND REELING-FREE DIVING	1	0.002%	30	0.001%
HANDLINING-DIVING UNSPECIFIED	1	0.002%	2	0.000%
Total	52,327	1	2,851,041	1

Area fished information recorded on the TDB02 docket-book during the 2018 season did not align with knowledge of the main catch regions that season. This discrepancy raised the likelihood that the Area fished information recorded on the TIB Docket-Book records may not be correct in many instances. One possible explanation offered was that it may relate to where the catch was sold instead of where the catch was made. This may account for the high proportion of the catch recorded in the Thursday Island area.

The number of recorded days-fished associated with the above TIB catch records (c.f. Table 4) varies between 1 and 20 days, though is only one, two or three days for 74%, 6.4% and 3.2% of all catch records respectively. The days-fished remains unknown (i.e. not recorded) for 12.4% of these records (but for 26% of the total catch).

Finally, the number of crew recorded on the docket-books varies between 1 and 14 (c.f. Table 5), though is only numbers one or two for 58% and 27% of records respectively. The number of crew remains unknown for 13% of all records (and 28% of the total catch).

The seasonal percentage of the both the number of TIB catch records and total TIB catch for the various levels (a) fishing method, (b) area fished, (c) days fished and (d) number of crew are shown in Figure 3. The seasonal percent of blank (unknown) levels for each data field are

Figure 2. Spatial structure of the TIB data.

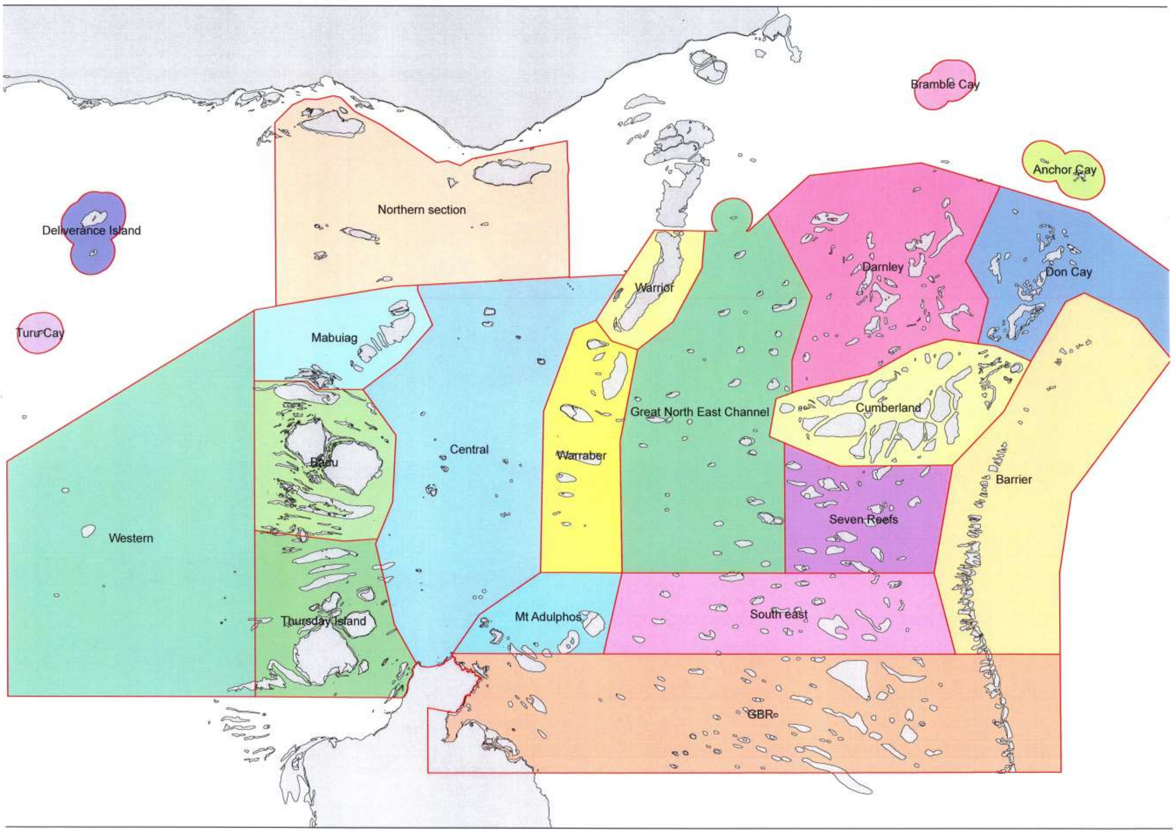


Table 3. Number of TIB records (and associated catch in kilograms) by region.

Area	Area-Name	N-recs	%	Catch	%
9	Thursday Island	21820	41.70%	776,711	27.24%
0	Unknown	4471	8.54%	585,767	20.55%
7	Mabuiag	6177	11.81%	468,239	16.42%
8	Badu	5910	11.30%	293,125	10.28%
12	Warraber	4310	8.24%	197,039	6.91%
11	Warrior	3155	6.03%	175,133	6.14%
14	Great NE Channel	2040	3.90%	103,804	3.64%
13	Mt Adolphus	698	1.3%	54,817	1.9%
17	Cumberland	818	1.56%	45,153	1.58%
16	Darnley	1269	2.4%	44,049	1.5%
10	Central	763	1.46%	39,201	1.37%
3	Northern Section	269	0.51%	28,325	0.99%
1	Turu Cay	248	0.47%	13,569	0.48%
15	South East	118	0.23%	10,947	0.38%
21	GBR	155	0.30%	10,083	0.35%
4	Bramble Cay	19	0.04%	1,481	0.05%
2	Deliverance Island	29	0.06%	1,348	0.05%
6	Western	21	0.04%	1,078	0.04%
18	Seven Reefs	8	0.02%	475	0.02%
20	Barrier	10	0.02%	345	0.01%
5	Anchor Cay	9	0.02%	238	0.01%
19	Don Cay	6	0.01%	189	0.01%
Total		52,323	1	2,851,116	1

Table 4. Number of TIB records (and associated catch in kilograms) by the number of days fished as recorded on docket-books.

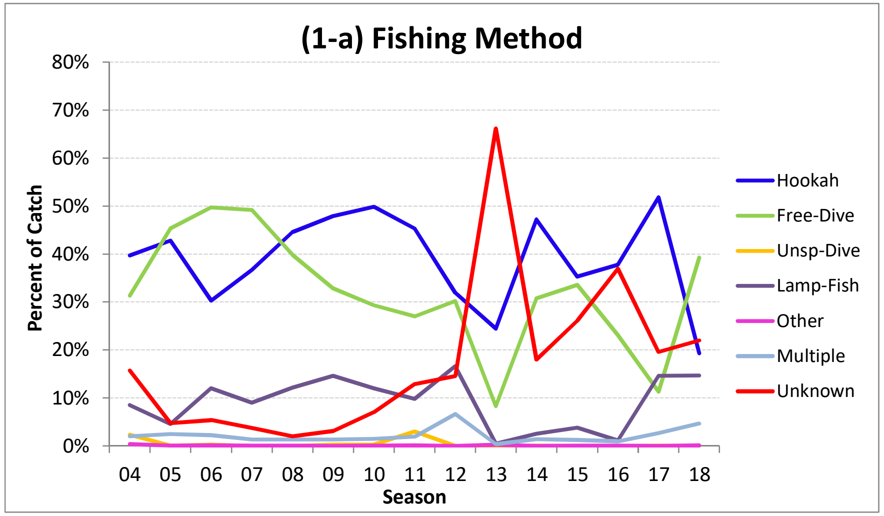
Days	N-recs	%	Catch	%
1	38,809	74.2%	1,421,609	49.9%
Unknown	6,509	12.4%	747,479	26.2%
2	3,350	6.4%	213,000	7.5%
3	1,686	3.2%	145,597	5.1%
4	756	1.4%	89,535	3.1%
5	585	1.1%	87,664	3.1%
6	195	0.4%	42,048	1.5%
7	176	0.3%	36,776	1.3%
8	97	0.2%	27,252	1.0%
9	72	0.1%	21,032	0.7%
10	32	0.1%	7,306	0.3%
11	20	0.0%	6,792	0.2%
13	8	0.0%	2,086	0.1%
14	13	0.0%	1,329	0.0%
12	8	0.0%	768	0.0%
16	3	0.0%	524	0.0%
15	2	0.0%	192	0.0%
17	2	0.0%	109	0.0%
20	1	0.0%	18	0.0%
	52,324	100.0%	2,851,116	100.0%

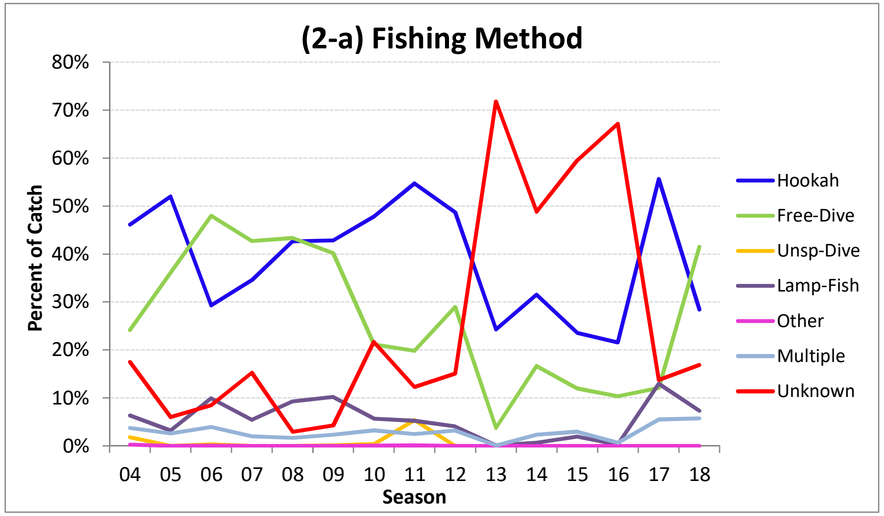
Table 5. Number of TIB records (and associated catch in kilograms) by the number of crew as recorded on docket-books.

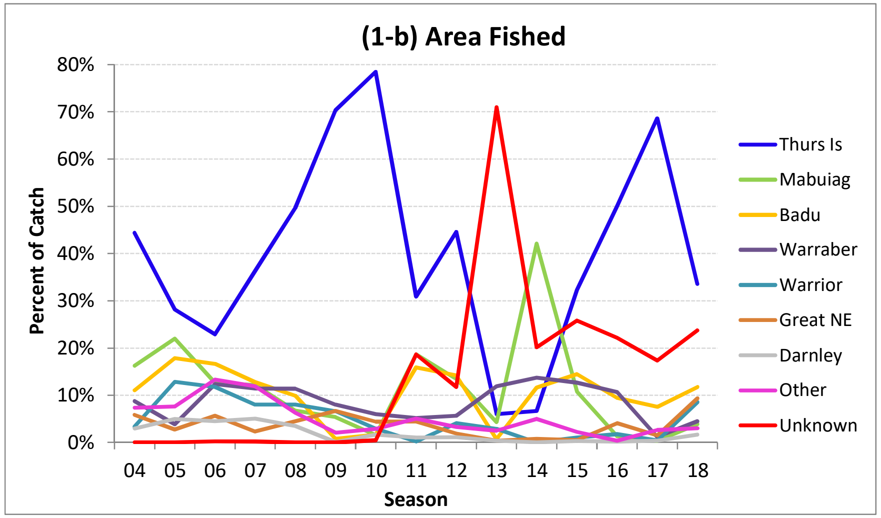
Crew	N-recs	%	Catch	%
1	30,405	58.1%	1,211,089	42.5%
Unknown	6,596	12.6%	793,554	27.8%
2	14,133	27.0%	772,013	27.1%
3	998	1.9%	57,758	2.0%
4	140	0.3%	7,536	0.3%
6	7	0.0%	3,927	0.1%
5	20	0.0%	3,597	0.1%
8	7	0.0%	1,096	0.0%
7	7	0.0%	285	0.0%
12	2	0.0%	99	0.0%
10	3	0.0%	77	0.0%
9	3	0.0%	41	0.0%
14	1	0.0%	37	0.0%
11	1	0.0%	9	0.0%
	52,323	100.0%	2,851,116	100.0%

also shown. Between 2012 and 2016 there was a significant increase in the proportion of the seasonal catch for which the information relating to these four effort variables remains unknown, and this lack of information impedes the ability to construct indices of resource abundance that represent the distribution of lobsters across the TIB fishery. While this situation has improved in recent seasons, nevertheless there is still room for improving the information recorded on the TDB-02 docket-book (e.g. the area fished and related effort information was still not completed for around 20% of records in 2017 and 2018, cf. Figures 3a,b).

Figure 3a. Seasonal percent of (1) number of TIB catch records and (2) total TIB catch for the various levels of: (a) fishing method, (b) area fished in the data. The percent of the annual catch for which each data field was not completed (and therefore remains unknown) is also shown.







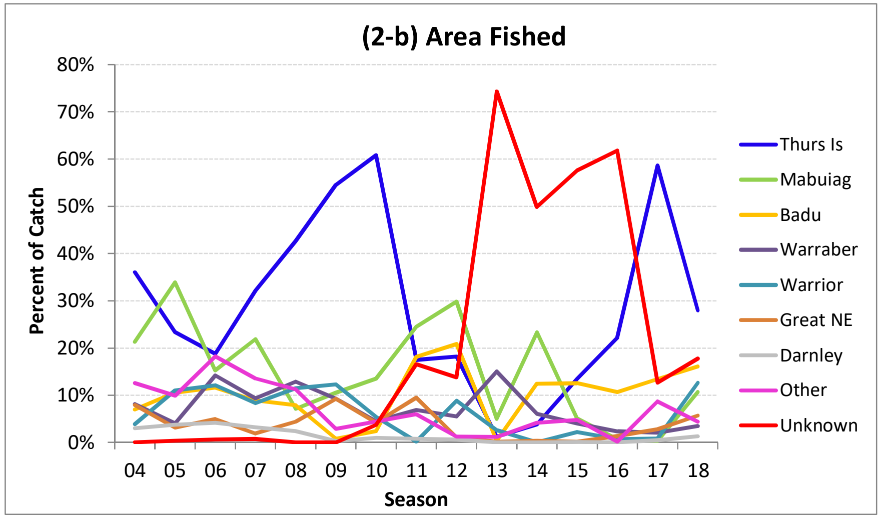
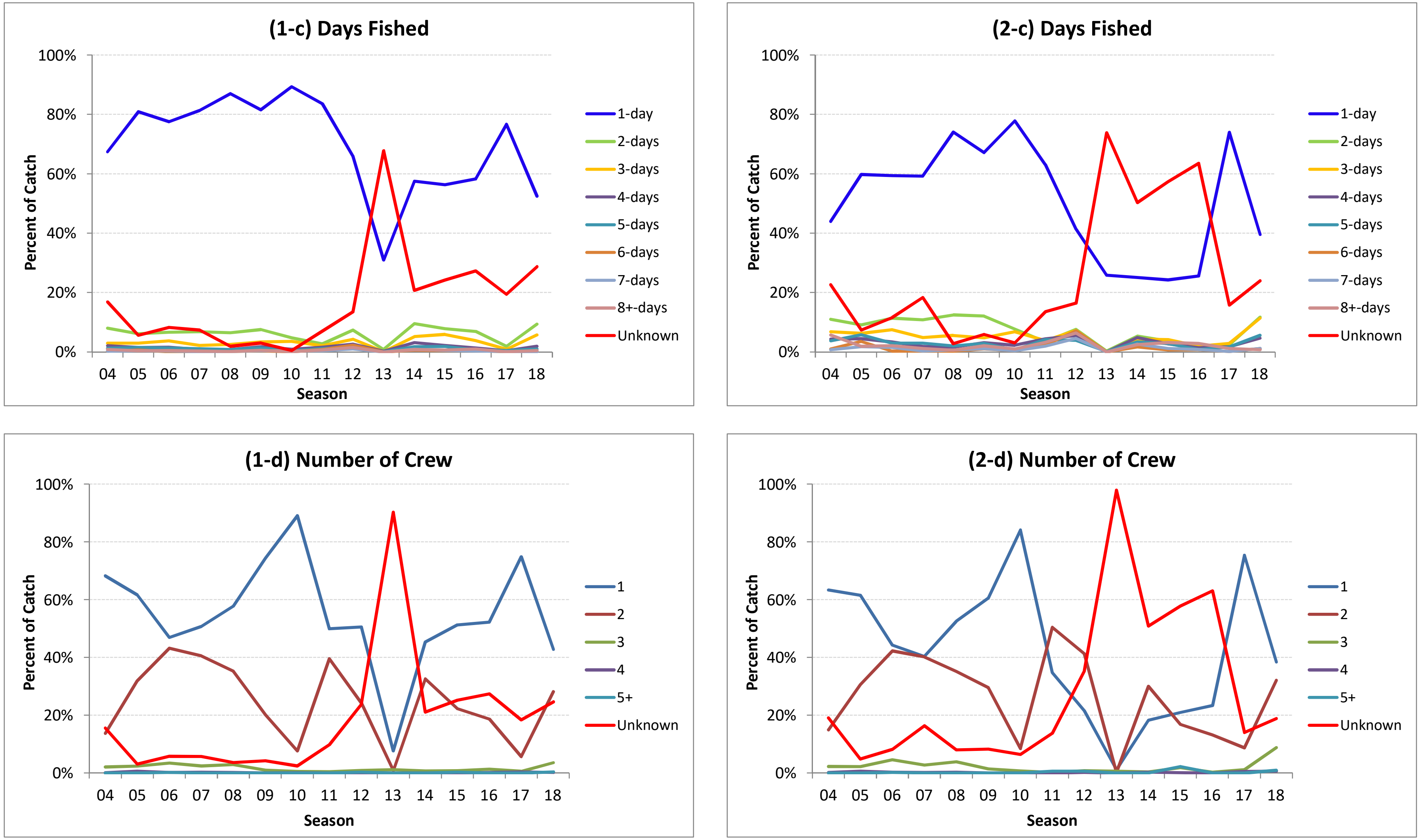


Figure 3b. Annual percent of (1) number of TIB catch records and (2) total TIB catch for the various levels of: (c) days fished and (d) number of crew. The percent of the annual catch for which each data field was not completed (and therefore remains unknown) is also shown.



3. Selection of data used for CPUE analysis

Each catch record in the TIB data is associated with a Record-No, and the structure of the Docket-Book would seem to indicate that there should be a unique Record-No for each vessel, date and seller-name. However, investigation of the data indicates that there are often multiple Record-Nos associated for a given vessel, date and seller-name. The reason for these multiple records remains unknown but may be due to incorrect recording of dates, etc. In order to identity an appropriate data structure for analysis, the following procedure was adopted to filter the data:

1. The TIB data was aggregated over vessel-symbol, date and seller-name. Where the vessel-symbol or seller-name was null these fields were set to 'Unknown';
2. Only those records where the first fishing method listed in Table 2 was either 'Hookah diving', 'Free diving' or 'Lamp fishing' were selected. This resulted in a total of 43,773 aggregate records (hence-forth known as GLM records);
3. Only those GLM records having a unique Record-No were selected for analysis – accounting for 42,308 (96.7%) of the GLM records identified in the previous step. It was assumed that where the vessel or seller were unknown, that selection of only those GLM records having a unique Record-No limited the GLM records chosen to those associated with a single vessel and a single seller;
4. An additional check was made to ensure that the number of days fished, the number of crew on the boat, the fishing method and the area fished was unique for each Record-No. This was done to help eliminate data errors. Five records were eliminated for having two methods each;
5. Finally, GLM records were also deleted where either the number of days fished was not recorded (1562), the area fished was not recorded (810), the record pertained to the TVH logbook data (704) as the structure of the data for these records was different, or the weight of the catch was zero (26) or greater than 1000 kg (17);
6. Finally, the records for the 2013 season were also deleted due to the small number of records for this season (47) compared to all other seasons (between 1,024 and 5,585). The small number for 2013 was due to the fact that many of the fields on the Docket-Book were left blank.
7. This process resulted in 39,271 GLM records being created and selected.

The number of GLM records, and associated nominal CPUE, within each season, month, quarter and TIB area and the distribution of records per fishing method, days-fished and the percent of the catch which are tailed lobsters are shown in Tables 6a&b (and for each 2-way combination of the season, month and area effects in Appendix B). Due to the small number of records in some TIB areas, these records were combined with the records in an adjacent area so that the minimum number of records in any area was more than 200. This resulted in twelve areas to be used as spatial effects in the GLM analysis. Furthermore, for all records where more than one fishing method was used the fishing method was termed Mixed. Consequently, only four types of fishing methods were in the data. There were also 1,005 distinct seller-names (unknown for only31 records) and 692 distinct vessels (but unknown for 68% of all records).

The substantive decline in the number of Records-Nos since 2010 has been noted earlier, with the average number of catch records per season decreasing from 3,898 between 2004 to 2010 to only 1,518 between 2011 and 2016. However, this situation improved substantially during 2017 with the greater use of the TDB01-Docket-Book when the number of records selected for the GLM analysis again exceeded 2,000 and has remained near this level during the shorter 2018 season.

Table 6a. Number of GLM records within each season, month and quarter and associated nominal catch rate.

Season	N-Recs	CPUE
2004	2,898	33.1
2005	5,585	39.3
2006	3,263	25.7
2007	5,330	31.1
2008	4,326	30.1
2009	3,240	27.5
2010	2,641	30.9
2011	1,841	51.2
2012	1,024	42.2
2014	1,491	32.5
2015	1,721	24.1
2016	1,513	31.5
2017	2,457	26.6
2018	1,941	27.6
Total	39,271	

Month	N-Recs	CPUE
1	3531	27.5986
2	5578	35.2989
3	6385	36.0666
4	4524	36.1713
5	4300	34.4775
6	3834	34.0037
7	3716	32.1566
8	2611	30.7584
9	1831	27.2811
10	39	23.3836
11	7	21.73
12	2915	26.4867
Total	39,271	

Qtr	N-Recs	CPUE
1	15494	33.8604
2	12658	34.9394
3	8158	30.6149
4	2961	26.4346
Total	39,271	

Table 6b. Number of GLM records within each TIB area and distribution across each recorded fishing method and days-fished and the associated nominal catch rate.

TIB-Area	GLM-Area	N-Recs
1	6	92
2	6	22
3	6	209
4	16	15
5	16	9
6	6	16
7	7	4810
8	8	5042
9	9	18462
10	10	632
11	11	2432
12	12	3349
13	13	593
14	14	1641
15	15	108
16	16	953
17	17	733
18	15	8
19	16	4
20	15	10
21	15	131
Total		39,271

GLM-Area	N-Recs	CPUE
6	339	44.2613
7	4810	41.7809
8	5042	30.9401
9	18462	31.1478
10	632	32.2396
11	2432	41.1091
12	3349	23.6417
13	593	47.6454
14	1641	31.4873
15	257	43.3771
16	981	30.9084
17	733	36.8099
Total	39,271	

%-Tails	N-Recs	CPUE
<20%	11,759	23.3
20-40%	2,962	35.4
40-60%	2,414	35.6
60-80%	2,137	38.5
>80%	19,999	37.4
Total	39,271	

Method	N-Recs	CPUE
FREE	16255	31.4946
HOOKAH	18293	36.7398
MIXED	4723	23.4807
Total	39,271	

Days	N-Recs	CPUE
1	33,019	33.5
2	2,976	31.7
3	1,497	28.5
4	679	29.7
5	545	29.3
6	176	36.0
7	157	28.0
8	83	36.4
9	66	31.4
10	28	22.6
11	18	27.5
12	6	10.5
13	7	18.5
14	9	5.2
15	2	5.8
16	3	10.9
Total	39,271	

Unlike the TVH data where the measure of effort is hours-fished, the measure of effort for the TIB data is coarser, being days-fished. Furthermore, and as noted above, it has been assumed that each selected GLM record pertains to the catch and effort of a single fisher (or seller) during a given trip, i.e. it is assumed that the measure of effort (i.e. days fished) associated with each GLM record also pertains to the actual effort expended by that seller in obtaining the recorded catch. While the number of days fished for each Record-No in the GLM data is unique, there are instances nevertheless where for the same vessel, date and seller there are multiple Record-Nos where the number of days fished is different. Investigation of this issue undertaken with the AFMA data section indicated that the dates associated with these docket-book forms were most likely not correct (Campbell 2016a).

4. General Linear Model Analysis

As with the analysis of the TVH data in previous years, General Linear Models (GLM) were fitted to the TIB data selected in the previous section in order to standardise the CPUE to account for changes in the distribution of records across a number of effects (e.g. Season, Month, Area and Fishing-Method). As mentioned previously, the measure of effort for the TIB data was taken to be days-fished. The catch rate associated with each GLM record was then defined to be the mean weight of lobsters caught per day-fished, i.e.

$$CPUE = \frac{Whole\ \ Weight\ of\ landed\ lobsters}{Number\ of\ days\ fished}$$

In order to investigate the influence of the various effects on the catch rate associated with each GLM data record, and to help account for the possible misreporting of the Area fished on Docket-Book records (as noted by TSRL-RAG23 in May 2018), the following two models were fitted to the data records described in the previous section. All GLMs were weighted as described in Campbell (2018c).

Model-1: Main Effects (labelled Main in the remainder of this report)

CPUE = Intercept + Season +Month +Method + Proportion-Tails + SOI + Moon-Phase
/ distribution = gamma, link = log

Model-2: Main Effects + Area Effect (labelled Main+A in the remainder of this report)

CPUE = Interc + Season + Month + Area +Method+ Proportion-Tails + SOI + Moon-Phase
/ distribution = gamma, link = log

where:

a) *Season* has 12 levels: 2004-2012, 2014-2018 (see below)
b) *Month* has 10 levels: December–to-September.
c) *Area* has the 12 levels as shown in Table 6b.
d) *Fishing-Method* has 4 levels: (1) Hookah, (2) Free Diving, (3) Lamp Fishing, and (4) Mixed methods
e) *Proportion*-Tails has 5 levels: (1) <20%, (2) 20-40%, (3) 40-60%, (4) 60-80%, and (5) ≥80%
f) *SOI* is the monthly value of the Southern Oscillation Index
g) *Moon-Phase* has 30 levels: the number of days after the last full moon.

All effects were fitted as categorical effects except for SOI which was fitted as a continuous cubic function.

Each of the above models were fitted to the TIB described in the previous section with the following filters: (a) the data for October and November were not included in the GLM due to the small number of records in each month (39 and 7 respectively), (b) the 75 data records where the number of days fished was greater than 9 were excluded as the mean catch rates for these records was substantially below those where the number of days fished was between 1 and 9 days, (c) the 512 records where the catch was less than 1.0 kg or greater than 300 kg as these could also be misreported catches or outliers. This left a total of 38,837 records.

Using the results from each GLM a seasonal abundance index was constructed based on the standardised CPUE calculated for each of the (Season, Month, Area) strata. As the standardised

-CPUE is taken as an index of the density of fish within each strata, an index of the abundance of lobsters across the fishery in each season and month is given by:

$$Index(season = s, month = m) = \frac{1}{\sum_{a=1}^{NA} Area_a} \sum_{a=1}^{NA} Area_a . stdCPUE(s, m, a)$$

where $Area_a$ is the spatial size of each of the *NA Area* effects included in the GLM. Finally, an index of abundance for each season can be obtained by taking the average across the *NM Month* indices in each season.

$$Index(season = s) = \frac{1}{NM} \sum_{m=1}^{NM} \left[\frac{1}{\sum_{a=1}^{NA} Area_a} \sum_{a=1}^{NA} Area_a . stdCPUE(s, m, a) \right]$$

Finally, a relative annual abundance index, B_s, was calculated such that the mean index over all seasons equals 1, i.e.

$$B_s = \frac{Index(season = s)}{\frac{1}{NS} \sum_{i=1}^{NS} Index(season = i)}$$

For those models which do not included an interaction with the Season effect the relative abundance index, B_s, reduces to the simpler form:

$$B_s = \frac{\exp(S_s)}{\frac{1}{NS} \sum_{i=1}^{NS} \exp(S_i)}$$

where S_i , *i=1, NS* are the parameters estimates relating to *NS Season* effects included in the model. In these situations the abundance is independent of the relative size of each *Area* effect included in the GLM.

No models including an interaction with the *Season*Area* interaction effect were fitted as 22% of the *Season *Area* strata have fewer than 10 records (with 12 having no data records, c.f. Appendix B) and construction of an abundance index from a model including a *Season*Area* interaction would entail the need to impute catch rates for those strata for which the number of records is zero or small (and, hence, maybe unrepresentative). While there was only three *Season*Month* strata having no data records (c.f. Appendix B), no models including an interaction with the *Season *Month* interaction effect were fitted due to the need to know the spatial extent occupied by lobsters within each TIB fishing region (required to construct the abundance index as explained above) and the related uncertainty noted in previous reports about the spatial size of each GLM-area.

Together with the two models described above, a second set of analyses was also undertaken where the Seller-Name (*Seller*) was also fitted as an additional effect to each of the models. To ensure that there was sufficient data for parameter estimation of each *Seller* effect only those sellers which had fished for three or more seasons and for which there were 30 or more data records where included in the analyses. This left a total of 32,360 records for 262 distinct Sellers. A summary of all models fitted in provided in Table 7.

Table 7. Summary of models fitted to the TIB data.

Model		# Fitted Parameters	# Seller Parameters	Records	AIC
1	Main Effects	63	0	38,837	342,753
2	Main Effects + Area	74	0	38,837	346,966
3	Model 1 + Seller-Name	324	262	32,360	280,371
4	Model 2 + Seller-Name	335	262	32,360	282,956

5. Results and Abundance Indices

(a) Standardising Effects

Statistics for the Type 3 contrasts computed for each fitted effect indicated that each effect was highly significant. A comparison of relative influence of each level of the *Month*, *Area*, *Method*, *Proportion-Tails, SOI and Moon-Phase* effects for each model is shown in Figure 4. For each effect the values have been scaled so that the influence of each effect is relative to a selected reference level.

Relative CPUE between months is seen to increase at the start of the season from December to March (by 15-20% depending on the model) then remain fairly stable before declining during August before reaching a seasonal low during September (~15% less than at the start of the season).

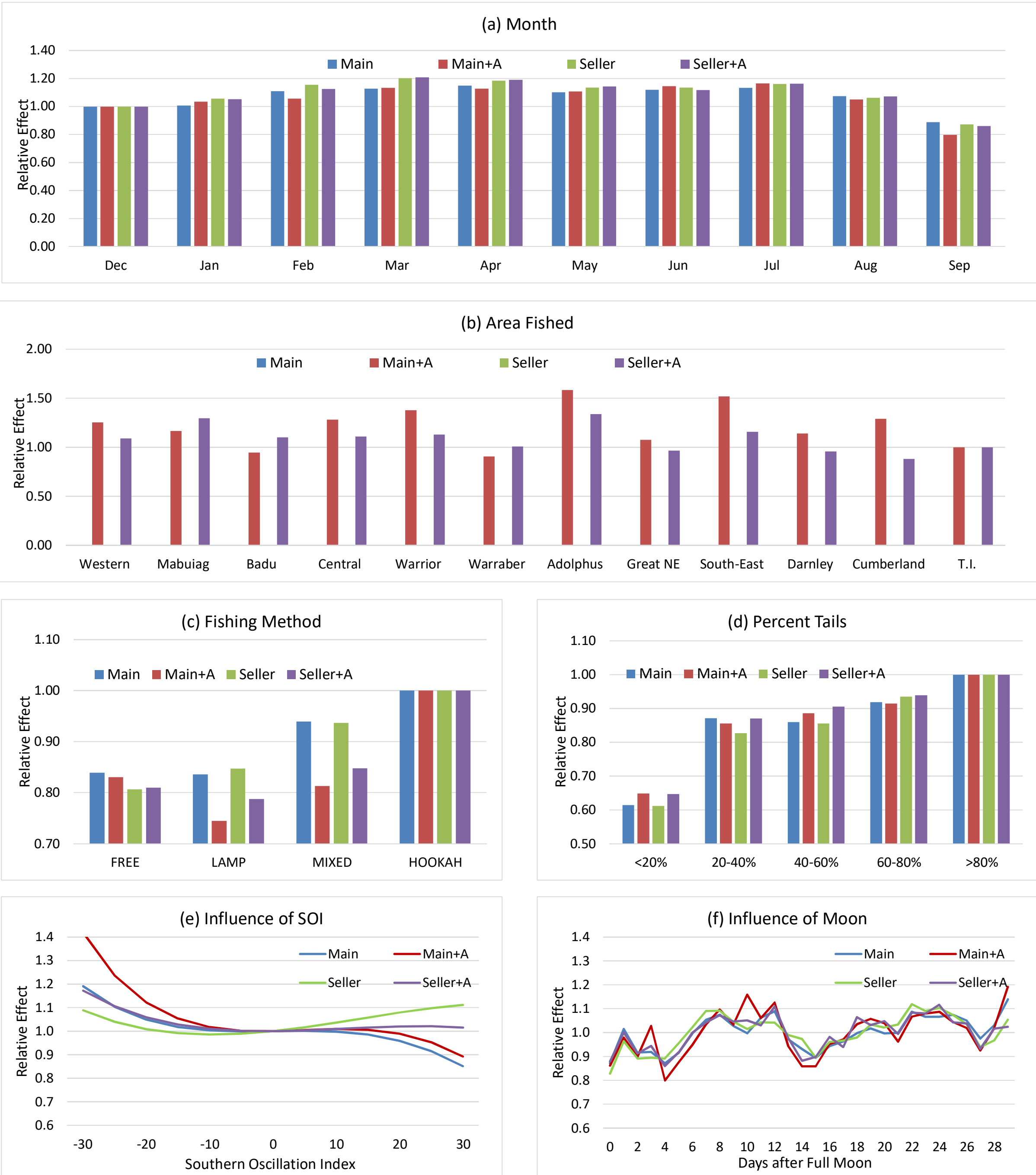
Relative CPUE varies considerably between the various areas included in the models. There is also considerable variation in the relative effect for a particular area between the different models. For example, for the *Main*-effects the relative CPUE's vary between 158% (for Adolphus) to 91% (for Warraber), while for the *Seller*-effects model, the relative CPUE's varies between 134% (again for Adolphus) to 88% (for Cumberland). However, the uncertainty over the meaning the Area-fished field needs to be taken into consideration.

The relative CPUE of each fishing method also shows some differences across all models, though are similar for the two sets of models with and without the *Area*-effect included. For the two models without the *Area*-effect included, the CPUE for hookah fishing is found to be around 22% higher than for free diving, 19% higher than for lamp fishing, and 7% higher than for mixed fishing. This latter result is to be expected if mixed fishing is a combination of the two other fishing methods.

Finally, the relative CPUE across all models is similar for each category of the proportion of the catch which is tails with the relative CPUE increasing as the *Proportion-Tails* increases in the catch. Across all models, the relative CPUE within each *Proportion-Tails* category is 63%, 86%, 88%, 93%and 100% respectively.

Of the two environmental effects, the results shown in Figure 4e indicate that high negative values of the SOI (i.e. strong El Nino conditions) tend to increase CPUE while the influence of high positive values of the SOI (i.e. strong La Nina conditions) is less clear. This result is different from that found when analysing the TVH data. However, there is a high level of uncertainty associated with these results as over the 175 months between January 2004 and July 2018 there have been only 3 months where the mean monthly value of the SOI has been

Figure 4. Comparison of relative influence of each level of the Month, Area, Method, Percent-Tails, SOI and Moon-Phase effects for each fitted model. Results are shown for all four model runs. Note, for each effect the values have been scaled so that the influence of each effect is relative to that of the last level of each effect (i.e, Month=December, Area=T.I., Method= Hookah, %-Tails= '>80%', and Moon-Phase=Mean over all phases).



less than -20 and 6 months where this value has been greater than 20, and between these values the influence of the SOI is seen to be relatively small. The influence of the Moon-Phase on CPUE, shown in Figure 4(f), is seen to be similar across all models, and while displaying a degree of variability indicates a bi-modal distribution across the days between successive full moons similar to that found with the TVH analysis. CPUE is lowest during days near a full and new moon, while CPUE is highest mid-way between these two phases (i.e. around the first and

Table 8. Relative abundance indices based on standardised CPUE data for the TIB fishery. Note, each index is scaled so that the mean of the index over the all seasons is equal to 1.

Season	Nominal	Main+A	Main	Seller+A	Seller
2004	0.98	0.85	0.90	0.93	0.94
2005	1.16	0.94	0.99	1.04	1.05
2006	0.82	0.74	0.78	0.78	0.78
2007	0.97	0.90	0.88	0.91	0.87
2008	0.95	0.85	0.85	0.85	0.83
2009	0.93	1.02	0.93	0.96	0.90
2010	0.98	1.01	0.95	1.05	0.99
2011	1.52	1.37	1.40	1.35	1.36
2012	1.11	1.13	1.21	1.22	1.26
2013					
2014	1.00	0.97	1.01	0.99	1.08
2015	0.76	0.88	0.85	0.89	0.92
2016	1.09	1.22	1.14	1.19	1.15
2017	0.82	1.12	0.99	0.95	0.91
2018	0.89	1.00	1.10	0.89	0.94
Mean	1.00	1.00	1.00	1.00	1.00

Figure 5. Relative indices of resource availability based on each the models fitted to the catch and effort data for the TIB fishery.

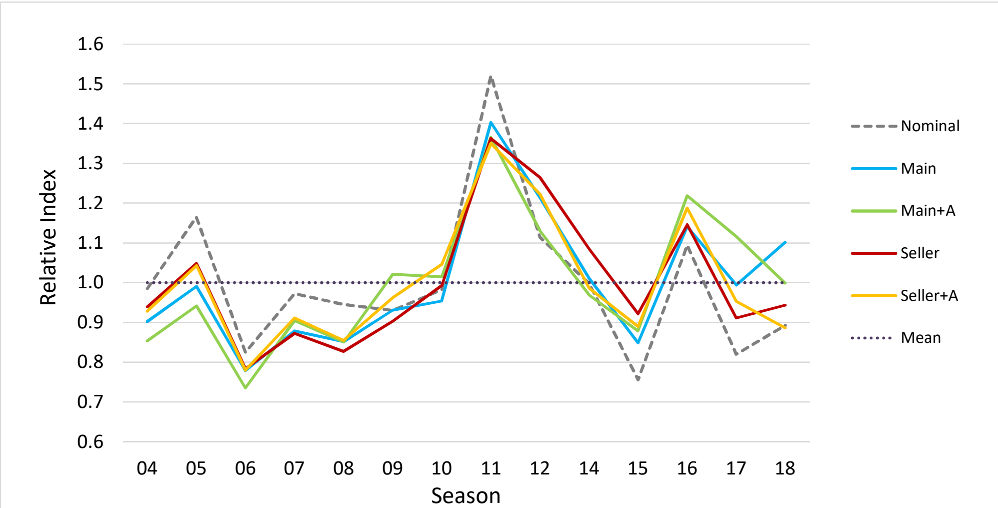


Figure 6. Annual influence of the fixed effects fitted to (a) the Main-Effects model and (b) the Seller-Effects model.

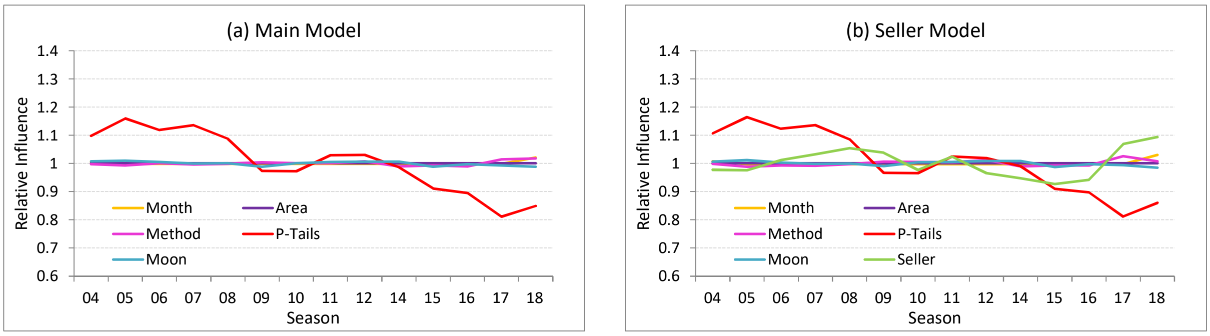
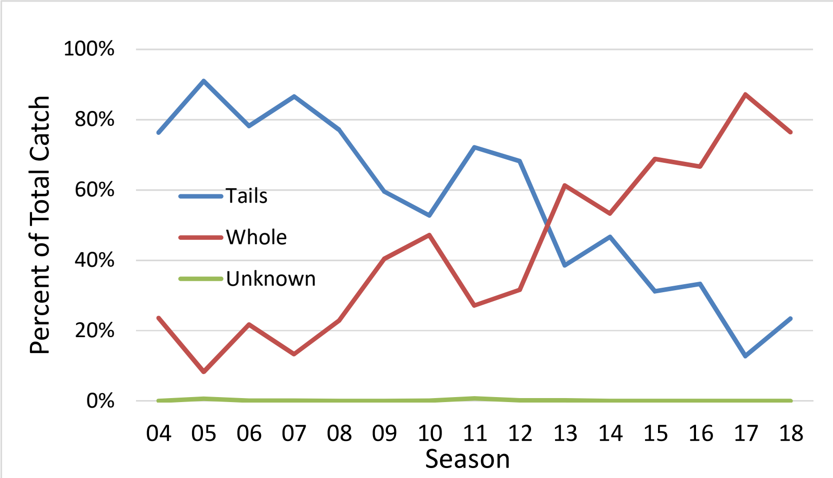


Figure 7.Percent of total annual catch (whole weight) by processed form.



last quarters). Average across all models, during this latter periods CPUE is around 30% higher than during the periods of lowest CPUE.

(b) Annual Abundance Indices

The seasonal abundance indices based on each of the four GLM models listed in the previous section are listed and displayed and in Table 8 and Figure 6 respectively. Relative to the nominal index, each of the standardised indices displays a number of substantive shifts, generally being lower than the nominal index over the first half of the time-series and higher than the nominal index during the second half (i.e. since 2012).

The reasons for these changes can be investigated using the seasonal influence of each main effect which is shown in Figure 7 for the Main and Seller models. The influence on the seasonal index is seen to be greatest for the *Proportion-Tails* effect, and the decreasing trend observed over time is correlated with the shift from the catch being predominantly tails to now being predominantly whole lobsters (c.f. Figure 7), with the latter process type decreasing CPUE (c.f. Figure 4(d)). The other effect having a substantive influence on the annual index is the *Seller* effect, and while displaying a variable influence over time the influence of this effect has increased in recent seasons resulting in an increase in catch rates. This indicates that there has been an increase in the relative fishing efficiency of *Sellers* in recent seasons, which when accounted for in the standardising model leads to a decrease in the standardised CPUE. The influence of the *Seller* effect in recent seasons therefore explains the divergence seen between the standardised indices based on the Main and Seller models during this period. The annual influence of the other effects included in the standardising models is seen to be negligible, likely due to the fact that there has been no systematic shift in the relative degree of fishing within each level of these effects over time. For example, the proportion of fishing during each level of Moon-phase is likely to have remained unchanged over time (likely being relatively equal each season).

Using the Akaike Information Criteria (AIC) as a measure to select the relative quality of the different statistical models fitted to a given set of data (where a lower value is better), then based on the results shown in Table 7, and across the two sets of models (i.e. Main vs Seller), the models without the *Area* effect included are found to provide a better fit to the data. Although using an *Area* effect would usually be seen as a good explanatory variable to account for changes in CPUE due to the spatial variation in the distribution of the lobster resource, this otherwise unintuitive result may be influenced by the poor quality of the data related to the Area fished recorded on the TIB docket-books. Furthermore, and while not shown in Table 7, the AIC measure also indicates that between the two models with and without the *Seller*-effect included and fitted to the same set of data as Model 3 (i.e. 32,360 records) that the model including the *Seller*-effect provides the better fit (AIC=280,371 vs 287,500). Based on these observations, Model 3 is therefore seen as the preferred model.

6. Comparison with other indices

A comparison of the TIB abundance indices with two of the preferred indices based on the standardised CPUE from the TVH fishery is shown in Figure 8 while the Pearson correlation, ρ, between each of these indices is shown in Table 9. A number of differences are seen between each set of indices. In particular, the standardised TIB indices each display a considerably flatter trend over time than the TVH indices. Despite this, the peaks and troughs in each of the TIB and TVH indices generally coincide. For example, local maximum occur for the 2005, 2011 and 2016 seasons while local minimum occur for the 2006, 2009, 2015 and 2017 seasons. This similarity is also reflected in the relatively high correlation (ρ =0.8) between the TIB index (*Seller*) and the two TVH indices. As both the TIB and TVH fisheries are fishing the same resource, this result should not be unexpected. The reasons for the flatter trend in the TIB indices remain uncertain and warrants further investigation, but may be due to the nature of the data collected from this fishery, in particular the courser scale measure of effort collected from the TIB fishery (day) in comparison to that collected in the TVH fishery (hours). There is also a problem with the substantive amount of data which is not included in the analyses for the TIB fisher in some seasons, and its more limited spatial extent. Some form of hyper-stability in catch rates in the TIB-sector also cannot be ruled out.

Figure 8. Comparison of the selected TIB and TVH resource indices.

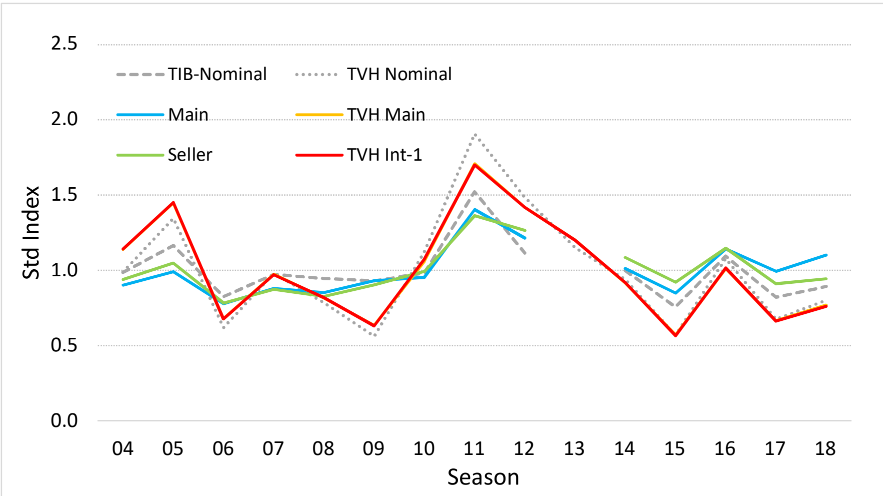


Table 9. Pearson correlation between the various TIB and TVH-based indices.

Model	TVH-Main	TVH-Int1
Main	0.71	0.70
Main+A	0.54	0.53
Seller	0.80	0.80
Seller+A	0.80	0.80

7. Concluding Remarks

For the Torres Strait rock lobster fishery there are currently two sources of catch and effort data, those for the TVH and TIB sectors. The TRL04 Logbook data from the TVH sector is believed to provide a relatively complete and good source of catch and effort data for this sector (e.g. Campbell eta al, 2018). Improvements in compliance to ensure that all fields in the Logbook are completed (e.g. area fished and hours fished) would improve the utility of these data. Also, a better recording of the locations of the fishing effort (i.e. at the tender level) would also improve the accuracy of the data for standardising catch rates. On the other hand, the data for the TIB sector is less complete and the measure of effort (days fished) is less accurate and incomplete in many instances. However, given the potential for this sector to grow in importance in future years there is a need to assess the utility of these data to provide a useful index of resource abundance.

The results presented above indicate that while the TIB-based indices have the potential to capture the major trends stock abundance, they likely lack the detail required to track finer inter-annual trends in abundance. There are several reasons for this outcome. In particular, the measures of catch and effort in the TIB data are coarser (trip-based) compared to the tender-hours based data for the TVH data. Indeed, for the TIB data it remains unknown how many hours per trip fishing actually occurred and whether there are differences between the different sellers and trends over the years. Also of concern is the likely lack of accuracy of the data related to the Area fished being recorded in the docket books, as this is likely to be highly influential variable in helping to account for the annual variability in catch rates across the fishery.

Finally, it has been noted that either the Docket-Book or many of the fields in the Docket-Book were not completed in recent seasons, though there were improvements in 2017 and 2018. With the introduction of the new Torres Strait Catch Disposal Record (TDB02, shown in Appendix A) it is hoped that the improvements seen in data recording will continue. While the recording of several data fields (e.g. Fisher Name, Fisher Type, Boat Symbol, and catch details) will be mandatory in the new form, it is also essential that the other fields in the voluntary sector of the form (e.g. detailing fishing effort and methods) are completed if the required information is to be available for standardising the TIB catch and effort data. As with the TVH data, continued effort needs to be placed on ensuring the completeness and accuracy of these data if they are to be used on a continuing basis.

References

Campbell, R.A., 2016a. Data issues pertaining to the Torres Strait rock lobster fishery – discussions with AFMA. Information paper presented to the 18th meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 2-3 August 2016, Thursday Island.

Campbell, R.A., 2016b. Separating TIB, TVH and Processor catch records from Docket-Book Data. Report to AFMA.

Campbell, R.A, Dennis, D., Plaganyi, E., Deng, R., 2017. Use of TIB Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2017 Update. Information paper presented to the 21st meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12-13 December 2017, Cairns.

Campbell, R.A., Pease, D. 2017. Separating TIB, TVH and Processor catch records from Docket-Book Data. Report to AFMA – 2017 Update. Information paper to be presented to the 21st meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12-13 December 2017, Cairns.

Campbell, R.A, Plaganyi, E., Deng, R., 2018. Use of TVH Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2018 Update. Information paper to be presented to the 24th meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 18-19 October 2018, Cairns.

Appendix A (i). The old Buyers and Processors Docket Book (TDB01) used in the TIB sector of the Torres Strait rock lobster fishery.

Torres Strait Seafood Buyers and Processors Docket Book

RECIPIENT CREATED TAX INVOICE

FOR Name:..

Address:..

....

A.B.N.:....................................Lic. No. ....

Seller:				**Book No.**	**Page No.**
Seller's ABN:		Seller's Licence No.			
Seller's Address:			Date:		

Fishing effort and boat details – Traditional Inhabitant Boat (TIB) only

Boat symbol:		No. of divers/fishers:	
Days fishing:		Area fished: From map (write no. of area most fished)	

Methods used: (tick box, use more than one if needed)
- ☐ Hookah (MDH)
- ☐ Free dive (MDF)
- ☐ Lamp fishing (MLF)
- ☐ Handline (LHL)
- ☐ Rod and reel (LRR)
- ☐ Troll (LTL)
- ☐ Drop line (LDR)
- ☐ Other– specify

Non Traditional Inhabitant Boat (TIB) fishers & buyers of PNG & east coast product only

Region Fished: (tick box) ☐ Torres Strait ☐ East Coast Queensland ☐ Papua New Guinea

Has the seller recorded their catches elsewhere?: (tick box) ☐ YES (please indicate) → ☐ TRL04 Logbook ☐ TSF01 Logbook ☐ Other → ☐ No

Details of catch being sold

Species	Processing Code	Grade	Kg	$/Kg	$/Kg	Amount
				SEEN BY AFMA (OPTIONAL)	NOT SEEN BY AFMA	NOT SEEN BY AFMA
Completed by:					Subtotal	
Signature:					GST	
Payment received:					**TOTAL**	

Australian Fisheries Management Authority PO Box 376 Thursday Island QLD 4875	**For assistance** Phone: (07) 4069 1990 Fax: (07) 4069 1277	WHITE COPY: **Fisher** (seller) YELLOW COPY: **AFMA** PINK COPY: **Buyer** (you)

Appendix A (ii). The new Torres Strait Catch Disposal Record (TDB02) to be used in the TIB sector of the Torres Strait rock lobster fishery.

Australian Fisheries
Management Authority
Box 7051
Canberra Mail Centre ACT
2610

CDR No.	40	Page No.	34

Torres Strait Catch Disposal Record TDB02

PART A - MANDATORY

Receiver Details					
Fish Receiver Name		Fish Receiver Licence No.		Date	
Fish Receiver Address					

Fisher Details			
Fisher Name		Fishing Licence Number	
Fisher Type (Circle One)	TIB TVH Sunset	Boat Symbol	

Logbook Number and Page Numbers this catch relates to	Logbook Number	&	Page Number(s)	

Details of Catch					
Part or Whole of Catch? (Circle One)			Part Whole		
Species	Processing Code	Grade	Weight	$/kg	$ Total
				Not Entered In Database	Not Entered In Database
TOTAL (Optional)					

Signature of Receiver		Received by (Name)	

PART B - VOLUNTARY/OPTIONAL

Fishing Effort and Area (Voluntary)			
Number of Fishers		Number of Days	
Area Fished		Start and End Dates	

Fishing Method (Voluntary)					
Hookah (MDH)		Handline (LHL)		Drop Line (LDL)	
Free Dive (MDF)		Rod and Reel (LRR)		Other	
Lamp Fishing (MLF)		Troll (LTL)		(Specify)	

Tax Receipt Details (Optional)			
Fisher ABN		Fisher Address	
Receiver ABN		Receiver Address	
Invoice Total ($)		GST ($)	
Signature of Fisher		Date	

White Copy Must go to AFMA within 3 days of unload
Pink Copy Fisher to Retain
Green Copy Remains in this logbook (Receiver copy)

For assistance please contact AFMA Direct 1300 723 621

Appendix B (i). Number of GLM data records, total number of days fished, total catch weight, and associated CPUE in each Season*Area strata. Note, strata with less than 10 records are shaded (dark shading where number is zero) and nominal CPUE is only shown for strata where the number of the days fished is 5 or greater.

(a) Number of TIB RECORDS

		Season															
Area	Area	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
Northern	6	36	40	60	54	12	7	4	14	7		53	24	1	6	3	321
Mabuiag	7	502	1107	430	482	272	102	15	409	141		799	252	24	9	85	4629
Badu	8	342	1063	583	703	429	26	49	356	174		246	370	218	191	218	4968
Thurs Is	9	1384	1583	761	2025	2254	2373	2180	722	535		58	703	853	2066	917	18414
Central	10	39	131	85	134	39	16	8	26	27		26	11	1	67	15	625
Warrior	11	15	751	341	459	335	193	17	5	0		0	22	46	12	231	2427
Warraber	12	192	200	372	595	452	244	154	92	49		260	302	253	28	137	3330
Adolphus	13	95	72	112	112	52	9	43	51	4		7	6	3	3	13	582
Great NE	14	135	138	188	126	186	212	106	86	21		15	10	89	47	235	1594
GBR	15	10	40	29	98	35	29	3	1	0		0	2	1	0	1	249
Darnley	16	77	245	127	263	121	0	45	30	10		0	3	3	11	39	974
Cumber	17	23	116	162	259	128	0	1	0	0		1	0	0	2	32	724
Total		2850	5486	3250	5310	4315	3211	2625	1792	968	0	1465	1705	1492	2442	1926	38837

(b) Total Number of DAYS_FISHED

AREA	AREA	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
Northern	6	74	53	77	87	27	10	6	16	9		91	51	1	12	5	519
Mabuiag	7	552	1735	700	666	318	334	41	552	387		972	316	27	29	216	6845
Badu	8	378	1103	615	749	471	31	65	565	464		707	1011	648	288	313	7408
Thurs Is	9	1545	1719	802	2311	2364	2452	2296	730	554		59	711	859	2093	1086	19581
Central	10	76	159	115	141	57	16	10	31	34		53	33	2	89	21	837
Warrior	11	36	758	394	560	424	263	22	7	0		0	66	51	35	435	3051
Warraber	12	507	456	728	822	783	472	308	103	51		520	583	471	35	199	6038
Adolphus	13	183	143	161	155	92	13	99	58	6		7	7	3	5	16	948
Great NE	14	349	288	246	170	252	629	205	95	28		18	16	200	80	392	2968
GBR	15	23	73	46	139	69	33	5	1	0		0	5	1	0	4	399
Darnley	16	93	293	141	266	123	0	49	30	15		0	3	3	12	47	1075
Cumber	17	37	180	229	352	207	0	1	0	0		1	0	0	2	79	1088
Total		3853	6960	4254	6418	5187	4253	3107	2188	1548	0	2428	2802	2266	2680	2813	50757

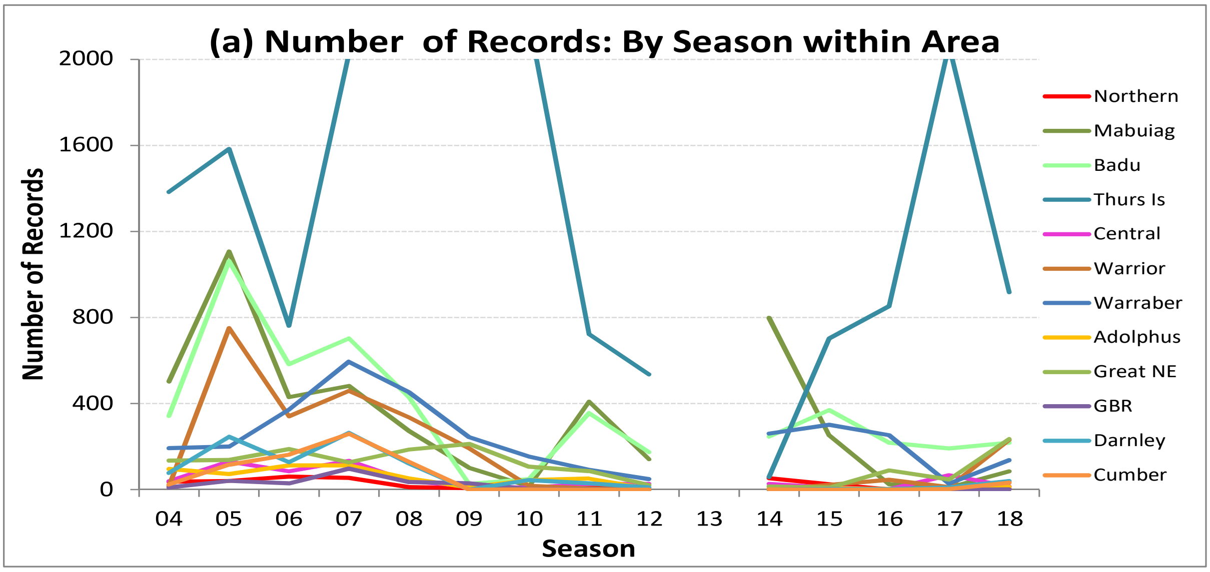
(c) Total CATCH_WEIGHT

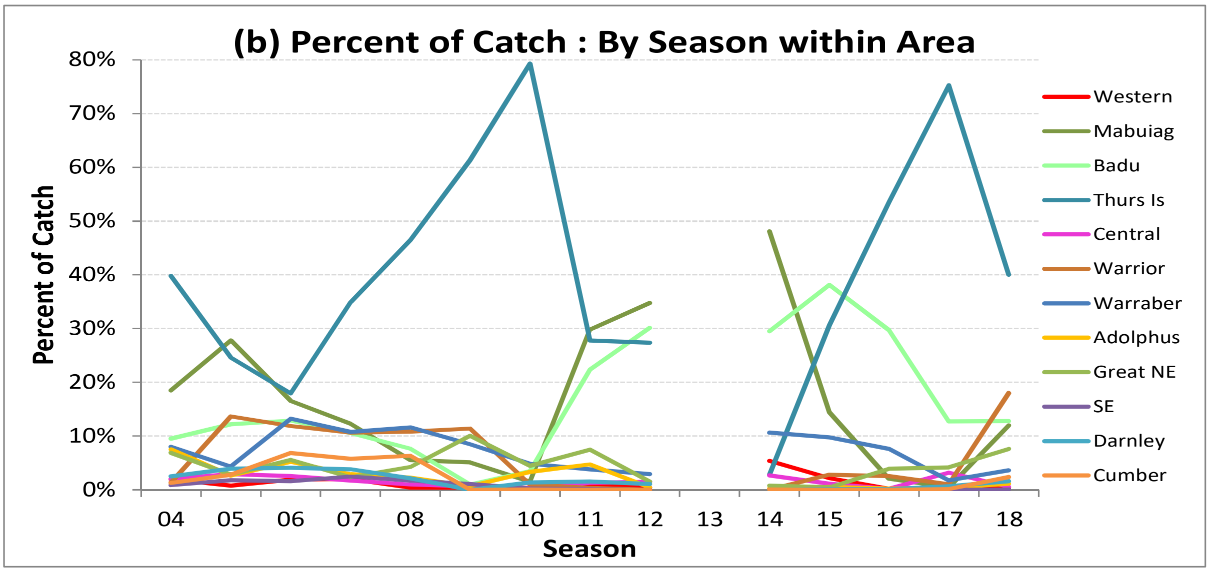
AREA	AREA	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
Northern	6	2303	1982	2043	3920	553	503	333	915	237		3941	1353	99	323	247	18752
Mabuiag	7	21999	71500	17896	24174	8498	6001	1371	30682	20259		35484	9102	1385	306	9215	257872
Badu	8	11334	31390	13922	20703	11831	1138	3224	23002	17574		21767	24121	20364	8840	9839	219050
Thurs Is	9	47450	63302	19376	68655	71844	72268	74548	28615	15954		2076	19339	36708	52464	30858	603456
Central	10	2370	7465	2733	3415	1465	735	282	1336	847		1976	696	98	2201	409	26027
Warrior	11	1548	35041	12813	20843	16736	13395	916	352	0		0	1769	1739	708	13884	119745
Warraber	12	9483	11071	14282	21084	17940	9924	4531	3892	1698		7833	6163	5214	1191	2773	117077
Adolphus	13	8934	6690	5609	5624	3465	777	3118	4867	238		187	333	126	248	880	41096
Great NE	14	8208	7153	6008	4574	6577	11798	4175	7680	885		558	275	2675	2904	5848	69319
GBR	15	990	4502	1717	4814	2577	1256	196	135	0		0	27	54	0	50	16317
Darnley	16	2985	10061	4391	7506	3273	0	1271	1552	601		0	72	89	436	1221	33457
Cumber	17	1525	7140	7406	11364	9747	0	31	0	0		20	0	0	77	1833	39143
Total		119129	257297	108196	196676	154506	117795	93996	103028	58293	0	73842	63250	68551	69698	77057	1561311

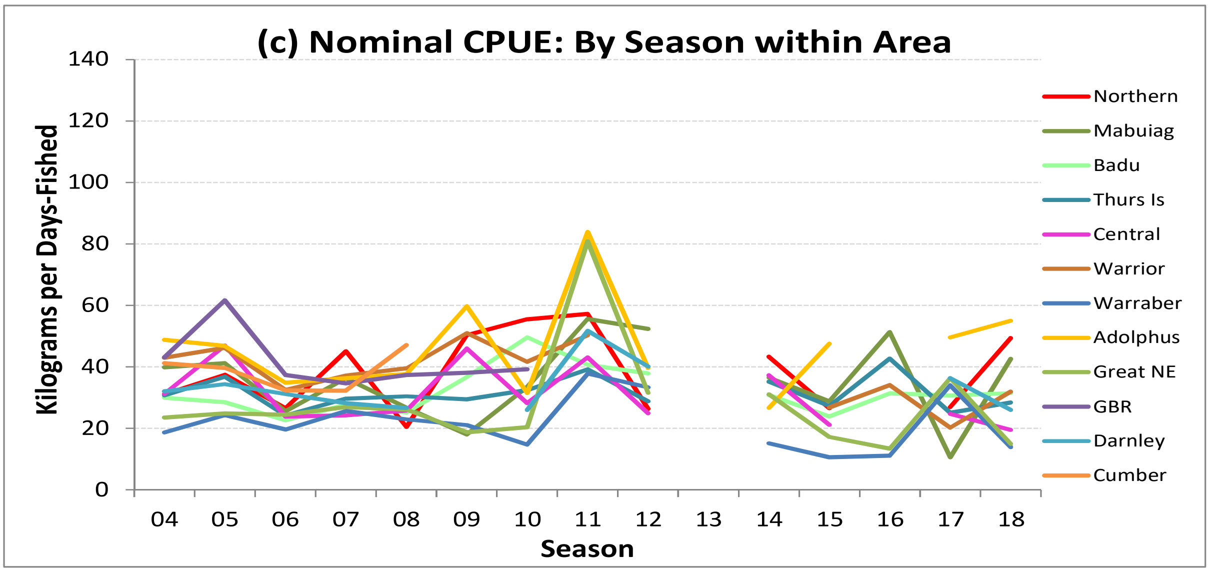
(d) Nominal CPUE

AREA	AREA	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
Northern	6	31.1	37.4	26.5	45.1	20.5	50.3	55.5	57.2	26.3		43.3	26.5		26.9	49.4	36.1
Mabuiag	7	39.9	41.2	25.6	36.3	26.7	18.0	33.4	55.6	52.3		36.5	28.8	51.3	10.6	42.7	37.7
Badu	8	30.0	28.5	22.6	27.6	25.1	36.7	49.6	40.7	37.9		30.8	23.9	31.4	30.7	31.4	29.6
Thurs Is	9	30.7	36.8	24.2	29.7	30.4	29.5	32.5	39.2	28.8		35.2	27.2	42.7	25.1	28.4	30.8
Central	10	31.2	46.9	23.8	24.2	25.7	45.9	28.2	43.1	24.9		37.3	21.1		24.7	19.5	31.1
Warrior	11	43.0	46.2	32.5	37.2	39.5	50.9	41.6	50.3				26.8	34.1	20.2	31.9	39.2
Warraber	12	18.7	24.3	19.6	25.6	22.9	21.0	14.7	37.8	33.3		15.1	10.6	11.1	34.0	13.9	19.4
Adolphus	13	48.8	46.8	34.8	36.3	37.7	59.8	31.5	83.9	39.7		26.7	47.6		49.6	55.0	43.4
Great NE	14	23.5	24.8	24.4	26.9	26.1	18.8	20.4	80.8	31.6		31.0	17.2	13.4	36.3	14.9	23.4
GBR	15	43.0	61.7	37.3	34.6	37.3	38.1	39.2					5.4				40.9
Darnley	16	32.1	34.3	31.1	28.2	26.6		25.9	51.7	40.1					36.3	26.0	31.1
Cumber	17	41.2	39.7	32.3	32.3	47.1										23.2	36.0
Total		30.9	37.0	25.4	30.6	29.8	27.7	30.3	47.1	37.7		30.4	22.6	30.3	26.0	27.4	30.8

Appendix B (i). Number of GLM data records, percent of catch, and associated CPUE in each Season*Area strata. Note, nominal CPUE is only shown for strata where the number of the days fished is 5 or greater.







Appendix B (ii). Number of GLM data records, total number of days fished, total catch weight, and associated CPUE in each Season*Month strata. Note, strata with less than 10 records are shaded (dark shading where number is zero) and nominal CPUE is only shown for strata where the number of the days fished is 5 or greater.

(a) Number of TIB RECORDS

		Season															
Month	Month	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
Dec	12	0	447	274	401	282	229	217	146	196		74	271	76	51	243	2907
Jan	1	289	321	250	576	351	331	204	237	230		128	130	70	184	212	3513
Feb	2	339	574	595	571	657	417	450	408	117		152	286	260	371	339	5536
Mar	3	447	659	658	1040	919	547	410	291	140		172	192	192	376	272	6315
Apr	4	227	649	443	564	611	409	330	114	65		153	192	152	263	285	4457
May	5	356	755	437	675	357	315	234	154	53		126	153	147	293	179	4234
Jun	6	347	726	214	509	325	310	266	156	75		139	158	147	244	168	3784
Jul	7	397	587	224	401	443	299	189	163	39		153	127	184	254	228	3688
Aug	8	283	414	96	312	208	201	219	81	35		204	109	167	260	0	2589
Sep	9	165	354	59	261	162	153	106	42	18		164	87	97	146	0	1814
Total		2850	5486	3250	5310	4315	3211	2625	1792	968	0	1465	1705	1492	2442	1926	38837

(b) Total Number of DAYS_FISHED

Month	Month	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
Dec	12		532	342	488	327	265	266	154	212		122	390	142	54	390	3684
Jan	1	322	380	323	730	417	426	250	245	284		184	183	131	194	352	4421
Feb	2	394	703	685	652	739	550	477	413	238		264	451	378	426	406	6776
Mar	3	500	897	821	1249	1011	654	441	294	288		364	329	374	417	393	8032
Apr	4	300	854	613	647	715	525	376	157	125		314	311	237	283	410	5867
May	5	584	927	608	805	425	365	270	291	118		260	278	229	311	281	5752
Jun	6	513	896	346	644	431	433	321	240	144		228	289	199	271	268	5223
Jul	7	567	755	270	539	604	451	251	243	84		250	238	238	269	313	5072
Aug	8	452	579	158	360	323	362	289	109	37		261	185	219	288	0	3622
Sep	9	221	437	88	304	195	222	166	42	18		181	148	119	167	0	2308
Total		3853	6960	4254	6418	5187	4253	3107	2188	1548	0	2428	2802	2266	2680	2813	50757

(c) Total CATCH_WEIGHT

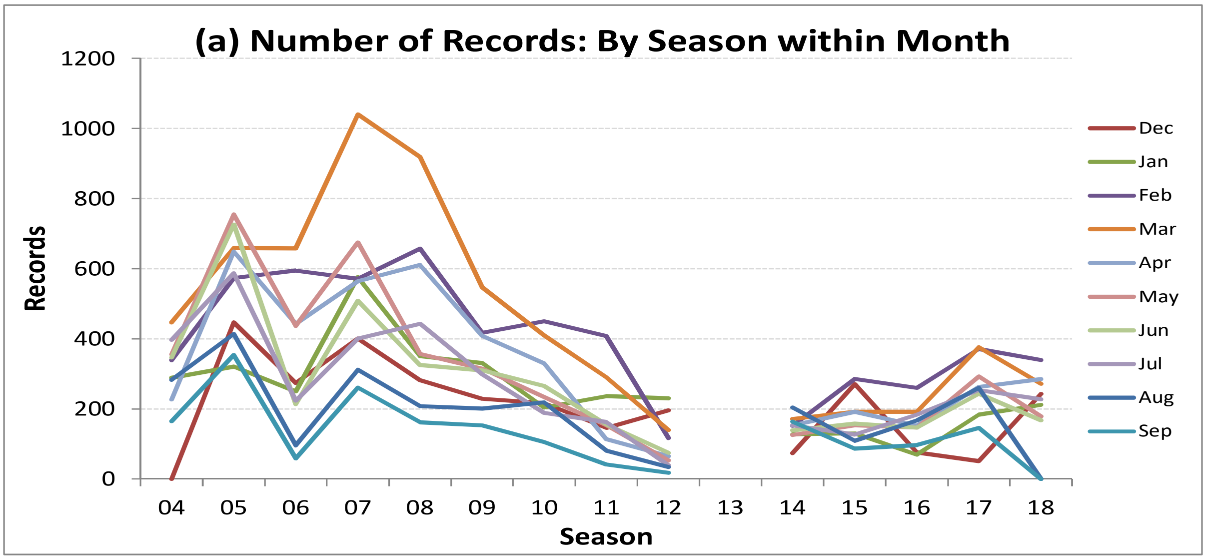
Month	Month	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
Dec	12		14348	8792	13095	9198	7607	5128	5742	5634		4438	7251	2851	1198	9246	94528
Jan	1	9619	10498	7195	18559	11385	11833	4847	12306	7398		5640	3632	2906	4545	6782	117146
Feb	2	14636	29970	18553	19205	24185	16595	18247	20415	9490		8399	11035	12530	11280	11024	225565
Mar	3	18196	35730	21822	42928	30872	20555	13935	17776	14318		11665	6813	11018	11174	10489	267293
Apr	4	9737	35605	15571	22240	21233	17615	12849	8175	5012		10323	9126	7333	7872	11985	194677
May	5	17958	39627	14676	24832	13835	12130	9208	12881	4731		7145	5722	7881	8514	7942	187081
Jun	6	15533	33197	8111	21095	12190	10868	9962	9257	5766		6506	6631	6872	6589	8182	160760
Jul	7	14330	27713	7026	14964	19342	9980	6725	10645	3399		6693	6023	7019	7845	11409	153111
Aug	8	12929	18362	4271	11446	7152	6518	8470	4095	1550		7874	4306	7329	7579	0	101880
Sep	9	6191	12245	2179	8310	5112	4092	4625	1737	995		5159	2712	2811	3101	0	59269
Total		119129	257295	108196	196674	154504	117793	93996	103029	58293	0	73842	63251	68550	69697	77059	1561310

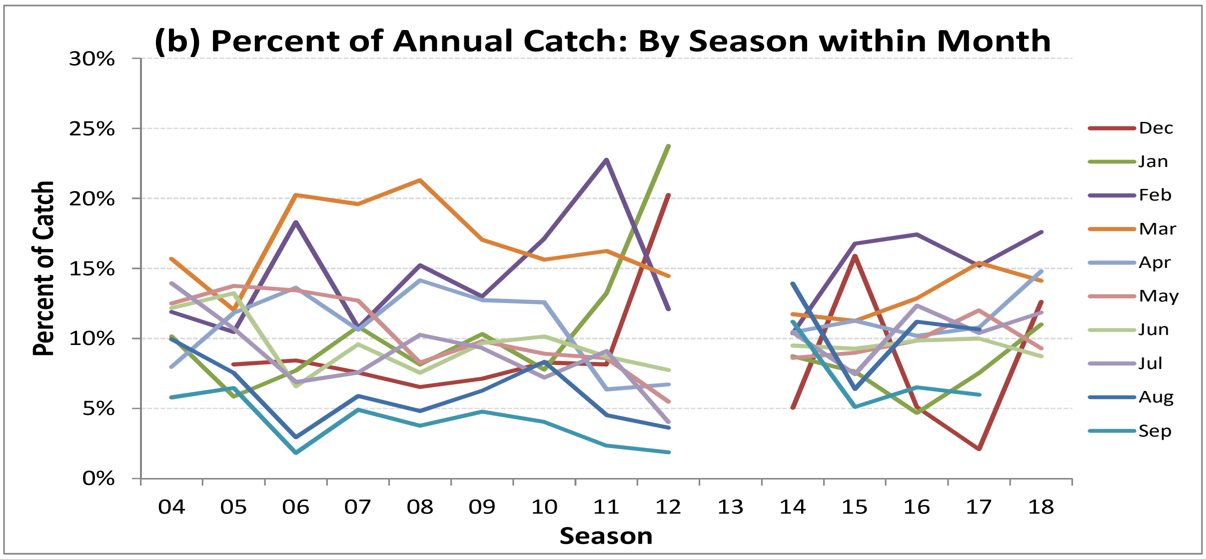
5

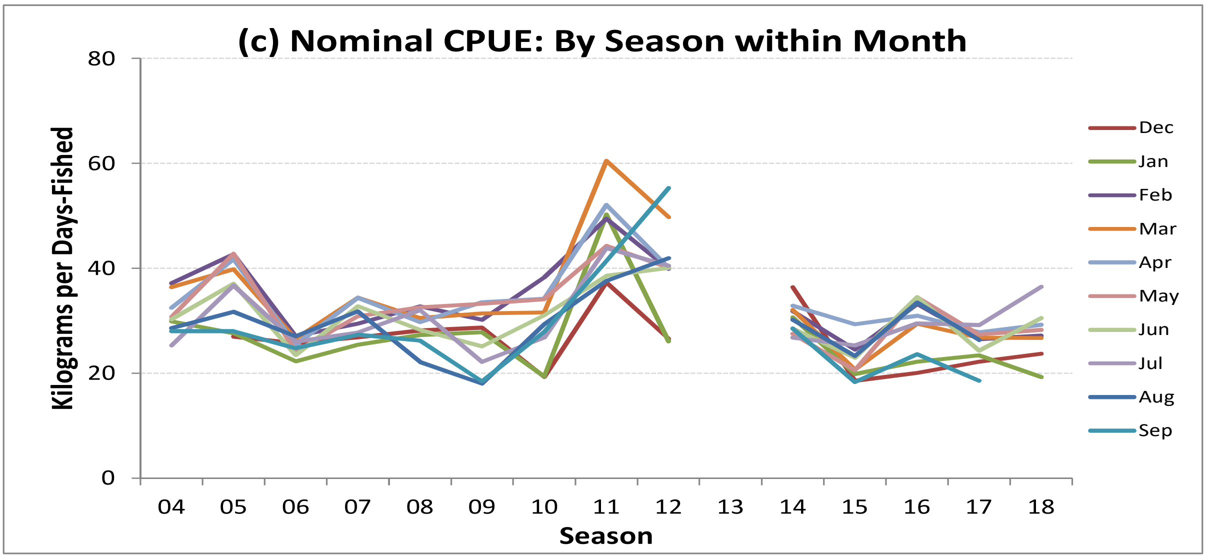
(d) Nominal CPUE (where Days-Fished > 4 days)

Month	Month	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
Dec	12		27.0	25.7	26.8	28.1	28.7	19.3	37.3	26.6		36.4	18.6	20.1	22.2	23.7	25.7
Jan	1	29.9	27.6	22.3	25.4	27.3	27.8	19.4	50.2	26.0		30.7	19.8	22.2	23.4	19.3	26.5
Feb	2	37.1	42.6	27.1	29.5	32.7	30.2	38.3	49.4	39.9		31.8	24.5	33.1	26.5	27.2	33.3
Mar	3	36.4	39.8	26.6	34.4	30.5	31.4	31.6	60.5	49.7		32.0	20.7	29.5	26.8	26.7	
Apr	4	32.5	41.7	25.4	34.4	29.7	33.6	34.2	52.1	40.1		32.9	29.3	30.9	27.8	29.2	
May	5	30.8	42.7	24.1	30.8	32.6	33.2	34.1	44.3	40.1		27.5	20.6	34.4	27.4	28.3	
Jun	6	30.3	37.1	23.4	32.8	28.3	25.1	31.0	38.6	40.0		28.5	22.9	34.5	24.3	30.5	
Jul	7	25.3	36.7	26.0	27.8	32.0	22.1	26.8	43.8	40.5		26.8	25.3	29.5	29.2	36.5	
Aug	8	28.6	31.7	27.0	31.8	22.1	18.0	29.3	37.6	41.9		30.2	23.3	33.5	26.3		28.1
Sep	9	28.0	28.0	24.8	27.3	26.2	18.4	27.9	41.4	55.3		28.5	18.3	23.6	18.6		25.7
Total		30.9	37.0	25.4	30.6	29.8	27.7	30.3	47.1	37.7		30.4	22.6	30.3	26.0	27.4	30.8

Appendix B (ii). Number of GLM data records, percent of catch, and associated nominal CPUE in each Season*Month strata. Note, nominal CPUE is only shown for strata where the number of the days fished is 5 or greater.







Appendix B (iii). Number of GLM data records, total number of days fished, total catch weight, and associated CPUE in each Area*Month strata. Note, strata with less than 10 records are shaded (dark shading where number is zero) and nominal CPUE is only shown for strata where the number of the days fished is 5 or greater.

(a) Number of TIB RECORDS

	AREA	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Northern	6	17	35	47	45	56	26	27	40	18	10	321
Mabuiag	7	365	482	725	840	431	368	415	415	285	303	4629
Badu	8	303	410	874	930	618	567	454	430	224	158	4968
Thurs Is	9	1202	1575	2738	2972	2135	2074	1785	1763	1276	894	18414
Central	10	79	89	99	121	59	51	34	34	34	25	625
Warrior	11	363	250	327	352	299	224	197	189	146	80	2427
Warraber	12	295	302	325	495	394	397	375	380	281	86	3330
Adolphus	13	33	46	86	54	69	75	78	61	54	26	582
Great NE	14	87	116	124	216	173	224	219	199	143	93	1594
GBR	15	12	29	32	34	26	20	40	27	12	17	249
Darnley	16	112	119	115	132	107	112	72	53	70	82	974
Cumber	17	39	60	44	124	90	96	88	97	46	40	724
	Total	2907	3513	5536	6315	4457	4234	3784	3688	2589	1814	38837

(b) Total Number of DAYS_FISHED

	AREA	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Northern	6	29	63	76	85	79	33	41	71	29	13	519
Mabuiag	7	429	609	1049	1218	734	627	655	653	449	422	6845
Badu	8	447	562	1173	1379	941	944	717	666	340	239	7408
Thurs Is	9	1339	1776	2836	3105	2230	2223	1903	1883	1361	925	19581
Central	10	99	111	106	170	83	61	53	76	51	27	837
Warrior	11	498	309	414	420	351	287	269	233	176	94	3051
Warraber	12	434	496	558	848	755	758	724	769	556	140	6038
Adolphus	13	56	54	116	71	113	132	132	83	130	61	948
Great NE	14	153	196	212	366	295	402	440	352	354	198	2968
GBR	15	19	44	45	50	32	35	60	59	20	35	399
Darnley	16	131	132	121	145	117	124	75	61	79	90	1075
Cumber	17	50	69	70	175	137	126	154	166	77	64	1088
	Total	3684	4421	6776	8032	5867	5752	5223	5072	3622	2308	50757

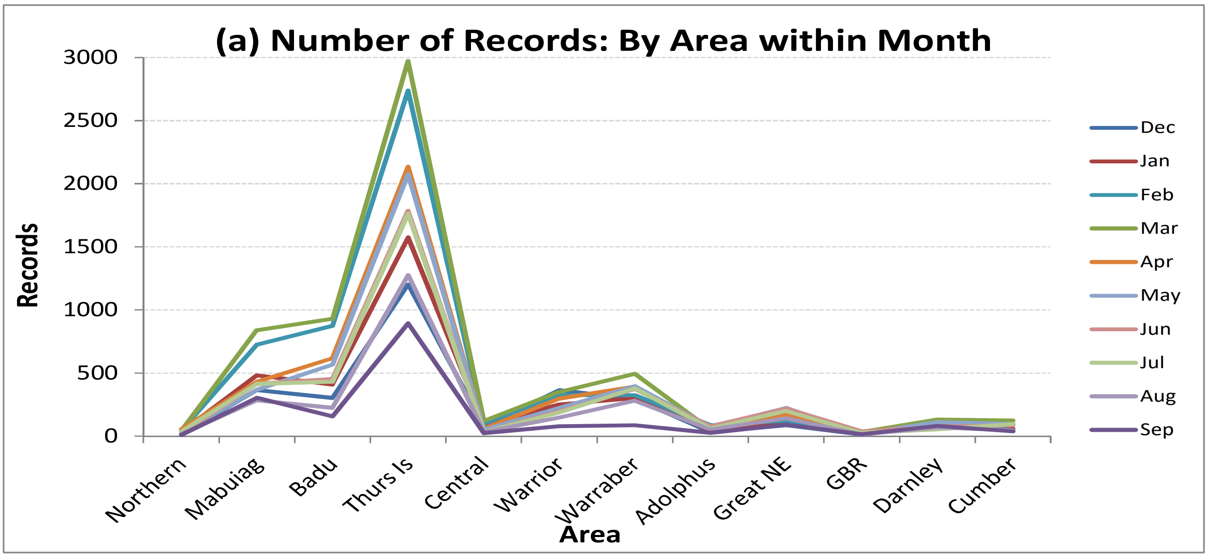
(c) Total CATCH_WEIGHT

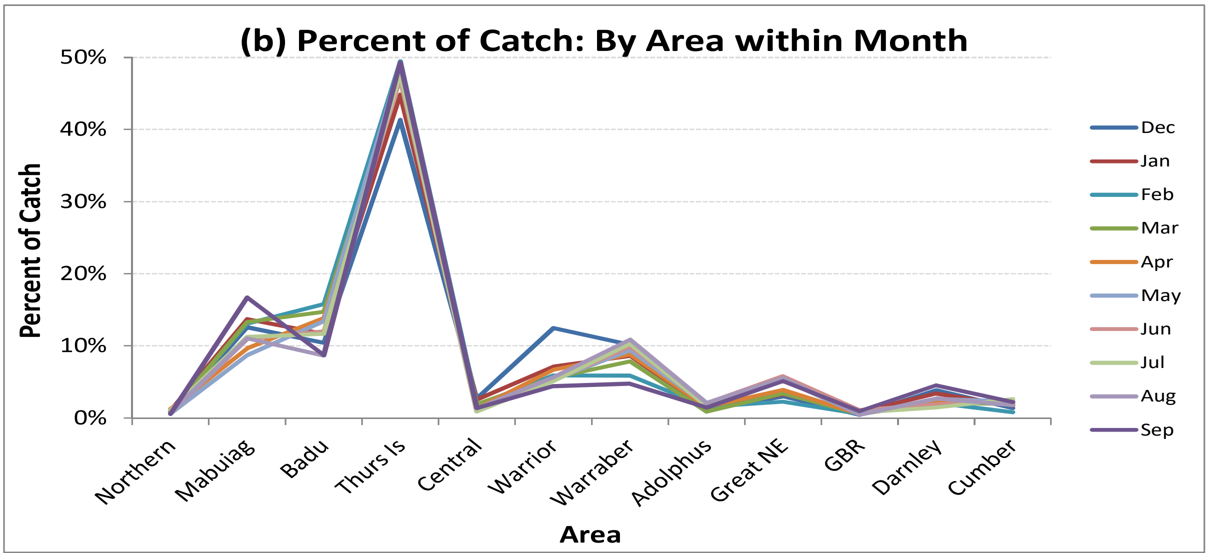
	AREA	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Northern	6	954	2190	3382	2833	3462	1581	1364	1634	832	519	18752
Mabuiag	7	13635	23181	45964	52315	27820	24793	23528	21418	14431	10787	257872
Badu	8	11613	16323	36543	43815	29128	27750	20123	17763	10234	5758	219050
Thurs Is	9	29604	40133	95983	105041	76683	72506	61557	57910	39654	24385	603456
Central	10	2699	2868	3152	5186	3004	2194	2203	2014	1656	1050	26027
Warrior	11	16942	10903	14665	14348	15365	13772	12100	11586	7044	3020	119745
Warraber	12	7932	9690	10802	17736	13929	15218	14019	15269	10327	2157	117077
Adolphus	13	1526	1782	4074	3395	6732	7334	5490	4214	4545	2003	41096
Great NE	14	3112	3624	3855	10525	7703	10811	9483	9002	7289	3914	69319
GBR	15	540	1275	1541	2622	1913	1960	2346	2616	677	827	16317
Darnley	16	4186	3505	3788	4219	4335	3857	2218	2093	2347	2910	33457
Cumber	17	1784	1672	1816	5260	4602	5307	6329	7591	2844	1938	39143
	Total	94527	117146	225565	267295	194676	187083	160760	153110	101880	59268	1561311

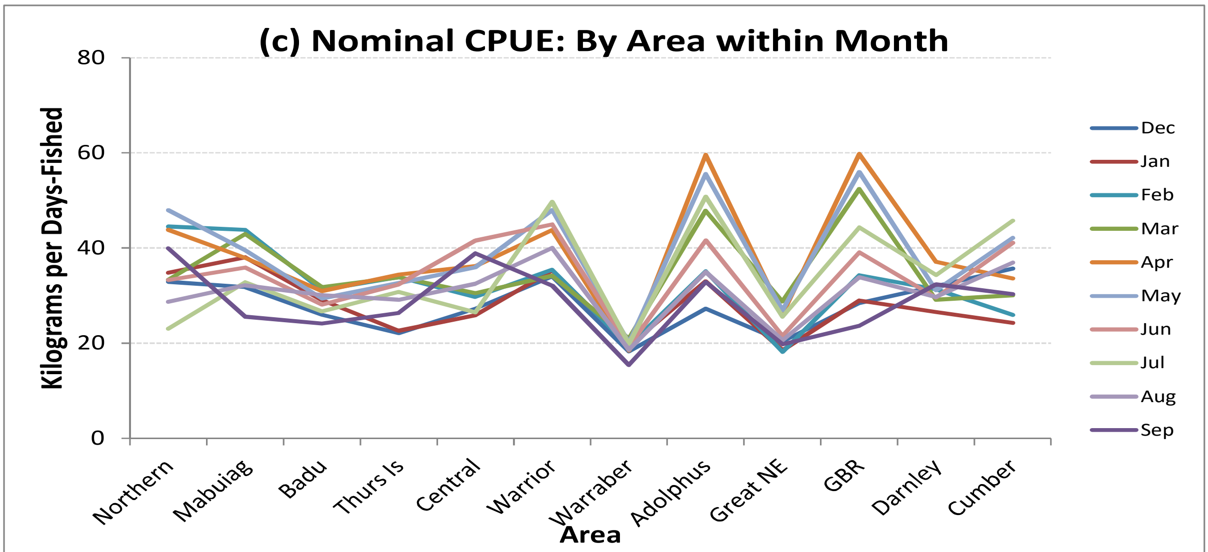
(d) Nominal CPUE

	AREA	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Northern	6	32.9	34.8	44.5	33.3	43.8	47.9	33.3	23.0	28.7	39.9	36.1
Mabuiag	7	31.8	38.1	43.8	43.0	37.9	39.5	35.9	32.8	32.1	25.6	37.7
Badu	8	26.0	29.0	31.2	31.8	31.0	29.4	28.1	26.7	30.1	24.1	29.6
Thurs Is	9	22.1	22.6	33.8	33.8	34.4	32.6	32.3	30.8	29.1	26.4	30.8
Central	10	27.3	25.8	29.7	30.5	36.2	36.0	41.6	26.5	32.5	38.9	31.1
Warrior	11	34.0	35.3	35.4	34.2	43.8	48.0	45.0	49.7	40.0	32.1	39.2
Warraber	12	18.3	19.5	19.4	20.9	18.4	20.1	19.4	19.9	18.6	15.4	19.4
Adolphus	13	27.3	33.0	35.1	47.8	59.6	55.6	41.6	50.8	35.0	32.8	43.4
Great NE	14	20.3	18.5	18.2	28.8	26.1	26.9	21.6	25.6	20.6	19.8	23.4
GBR	15	28.4	29.0	34.2	52.4	59.8	56.0	39.1	44.3	33.9	23.6	40.9
Darnley	16	32.0	26.6	31.3	29.1	37.1	31.1	29.6	34.3	29.7	32.3	31.1
Cumber	17	35.7	24.2	25.9	30.1	33.6	42.1	41.1	45.7	36.9	30.3	36.0
	Total	25.7	26.5	33.3	33.3	33.2	32.5	30.8	30.2	28.1	25.7	30.8

Appendix B (iii). Number of GLM data records, percent of catch, and associated CPUE in each Area*Month strata. Note, nominal CPUE is only shown for strata where the number of the days fished is 5 or greater.







TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	MEETING 24 18-19 October 2018
RESULTS OF THE 2018 MID-YEAR SURVEY	**Agenda Item 5** **For Discussion and Advice**

RECOMMENDATIONS

1. That the RAG **DISCUSS** and **PROVIDE ADVICE** on the results of the 2018 mid-year survey (**Attachments 5a and 5b**) (Attachment 5b pending).

KEY ISSUES

2. The TRL Fishery 2017/18 fishing season was managed in line with a historically low recommended biological catch (RBC). Historically, existing management arrangements for the TRL Fishery have been largely sufficient to keep catch levels below the Australian catch share of the RBC without the need for additional management controls. However, during the 2017/18 fishing season, catches were tracking to reach the Australian catch share of the RBC prior to the end of the season on 30 September 2018.
3. In response, changes were made to management arrangements within the fishing season for the purpose of prolonging the opportunity for the TIB sector to fish for the duration of the season and ensure the Australian catch share of the RBC was not exceeded. These changes were largely in the form of input controls (e.g. restrictions on the use of hookah gear) which had impacts on both fishers and the fishery-dependant data available to support future stock assessments.
4. In light of this, a TRLRAG meeting was held on 15 May 2018 (TRLRAG23), to consider these impacts and survey options to support future stock assessments and management of the TRL Fishery. The RAG recommended that a mid-season survey be conducted – further details on reasons provided in Background to this paper.
5. Members also discussed at what point the mid-season survey results may trigger a review of the recommended biological catch (RBC) for the TRL Fishery. Members recommended a review of the RBC be undertaken if the results of the 2018 mid-season survey 2+ survey index falls outside the 95% confidence interval associated with the model forward prediction based on the November 2017 pre-season survey 1+ index, in relation to directly comparable sites (e.g. sites sampled in both surveys only).
6. Following TRLRAG23, a mid-year survey was conducted between 28 June and 9 July 2018. Results from the survey were provided to the RAG out-of-session on 20 July 2018. This meeting has been convened to consider these results further. CSIRO's analyses of the survey data is attached for RAG discussion and advice. This will be presented further at the meeting:
   a. *Torres Strait TRL 2018 Midyear Survey Summary Report* (**Attachment 5a**);
   b. Pending (**Attachment 5b**).

BACKGROUND

2. At TRLRAG23, members recommended that a mid-season survey be conducted as soon as practically possible, to be facilitated by industry and PZJA agencies, for the purposes of:
   a. providing further data on the abundance and spatial distribution of all age classes in the current season to input to the 2018/19 stock assessment, noting that CPUE data

for the current season is now biased by management changes and may be unusable should the Fishery close early this season;

b. providing further data to validate the 0+ and 1+ indexes of abundance from the November 2017 pre-season survey, noting the 0+ index may not have been reliably estimated from the November 2017 pre-season survey and the model was unable to satisfactorily fit this index;

c. providing an 2+ index of abundance to more accurately inform on stock status and for comparison with CPUE data;

d. provide a preliminary prediction of the expected 1+ lobster recruitment for the 2018/19 season (0+ lobsters in November 2017 pre-season survey) to provide forewarning on the likelihood of another low RBC for the 2018/19 season.

3. The survey will consist of 77 pre-determined sites expressly selected to provide for comparison with previous mid-season surveys. The RAG further recommended that CSIRO work with industry to ensure areas fished in the current season are adequately represented in the sites sampled in the mid-season and future pre-season surveys.

4. A mid-year survey was conducted between 28 June and 9 July 2018. A total of 78 sites were surveyed by divers and each site was re-located accurately using portable GPS. 73 sites corresponded to the November 2017 pre-season survey, whereas 5 additional sites that were surveyed corresponded to the hotspot area fishers have focussed on during 2018. The selection of the 5 additional sites was circulated to RAG members and fishers for comment prior to the survey with agreement from those that responded that these sites were representative of the hotspot area for the 2018 season.

Torres Strait TRL 2018 Midyear Survey Summary Report

Éva Plagányi, Mark Tonks, Robert Campbell, Nicole Murphy, Frank Coman, Kinam Salee, Judy Upston, Roy Deng

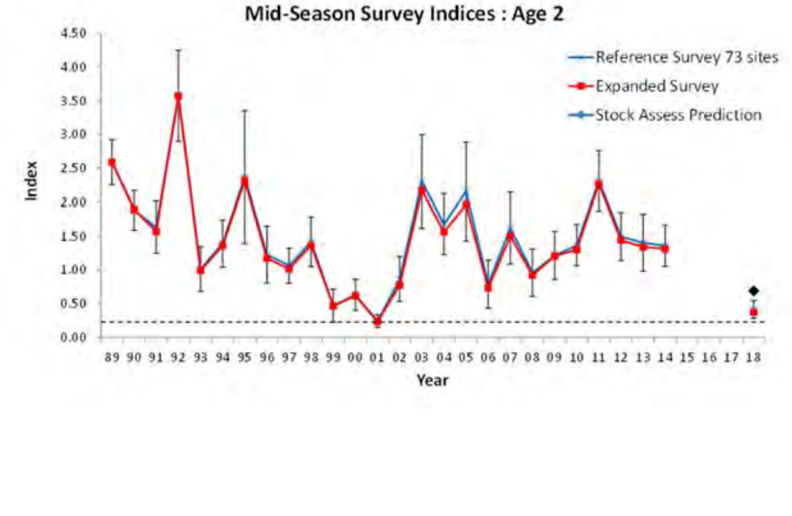
CSIRO Oceans and Atmosphere

Abstract

The 2018 Midyear survey of the Torres Strait lobster population was conducted between 28th June - 9th July 2018 using the mothership Wild Blue (Gladstone) and CSIRO tender. The survey has shown convincingly that the original scientific results and recommendations hold, i.e. the observed 2018 2+ survey index is NOT significantly different to the stock assessment model-predicted value. The survey results therefore recommend no increase in this year's RBC based on the process agreed at the May 2018 TRLRAG: "*The RAG recommended a review of the RBC be undertaken if the results of the 2018 mid-season survey 2+ survey index falls outside the 95% confidence interval associated with the model forward prediction based on the November 2017 pre-season survey 1+ index, in relation to directly comparable sites (e.g. sites sampled in both surveys only).*" The survey result suggests that the 2+ stock abundance (being the cohort that will contribute to spawning) is lower than predicted based on forward projections (it's the 2nd lowest index after the 2001 minimum value), and hence that a low precautionary RBC is warranted.

The survey suggested that the incoming 1+ recruiting cohort is slightly above average and hence preliminarily suggests that next year will be a much better year. The 1+ index is higher than would have been predicted by the Preseason 0+ index. However previous analyses acknowledged that the 0+ index was negatively biased and the stock assessment model downweighted it based on the high associated standard deviation. This year's November 2018 Preseason survey will be able to corroborate the Midyear 1+ index, which is a key input for computing next year's RBC. Previous analyses showed that the relationship between recruiting (1+) lobster indices recorded from mid-year and pre-season surveys in the same years was highly significant (R^2=0.97), which isn't too surprising given that the surveys were conducted only four months apart (June and November).

The midyear survey index has provided a valuable basis for calibrating this year's CPUE, but we won't be able to start those analyses until we have the entire year's CPUE data analysed. The full report containing the detailed analyses of the survey data will be circulated before the next TRLRAG meeting.



Key summary figure showing July 2018 Midyear standardised survey index relative to historical values and compared with the stock assessment prediction (based on the 2017 Preseason survey).

1. Introduction

The May 2018 TRLRAG recommended the following: "*that a mid-season survey be conducted as soon as practically possible, to be facilitated by industry and PZJA agencies, for the purposes of:*

- *providing further data on the abundance and spatial distribution of all age classes in the current season to input to the 2018/19 stock assessment, noting that CPUE data for the current season is now biased by management changes and may be unusable should the Fishery close early this season;*
- *providing further data to validate the 0+ and 1+ indices of abundance from the November 2017 pre-season survey, noting the 0+ index may not have been reliably estimated from the November 2017 pre-season survey and the model was unable to satisfactorily fit this index;*
- *providing a 2+ index of abundance to more accurately inform on stock status and for comparison with CPUE data;*
- *provide a preliminary prediction of the expected 1+ lobster recruitment for the 2018/19 season (0+ lobsters in November 2017 pre-season survey) to provide forewarning on the likelihood of another low RBC for the 2018/19 season.*

The survey will consist of 77 pre-determined sites expressly selected to provide for comparison with previous mid-season surveys.

The RAG further recommended that CSIRO work with industry to ensure areas fished in the current season are adequately represented in the sites sampled in the mid-season and future pre-season surveys."

Annual fishery-independent monitoring of the Torres Strait ornate rock lobster *Panulirus ornatus* population has been carried out between 1989 and 2018. Midyear surveys were conducted for all years 1989-2014, with the 2018 survey extending this series. Pre-season surveys have been conducted for years 2005-2008 and 2014-2017. These surveys provide the only long-term information on the relative abundance of recruiting (1+) and fished (2+) lobsters, since there was no comprehensive monitoring of commercial catch and effort prior to 2003. The survey sites are distributed throughout the majority of the fished area to provide representative abundance estimates. The relative abundance indices and age composition data are used in the TRL fishery model for assessments of the status of the stock, and to inform management regulations.

The 2018 Midyear survey of the Torres Strait lobster population was conducted between 28th June - 9th July 2018 using the mothership *Wild Blue* (Gladstone) and CSIRO tender (Figure 1). A total of 78 sites were surveyed by divers and each site was re-located accurately using portable GPS. Seventy-three sites corresponded to the 2017 Preseason survey, whereas 5 additional sites that were surveyed corresponded to the hotspot area fishers have focussed on during 2018 (Figure 2). The selection of the 5 additional sites was circulated to TRL RAG members and fishers for comment prior to the survey with agreement from those that responded that these sites were representative of the hotspot area for the 2018 season. The four scientific divers involved in the survey ranged in experience with two divers having more than 10 surveys experience while the other two had completed 2 or 3 TRL surveys. The two dive teams were split based on experience with a less experienced diver coupled with a more experienced diver. Measured belt transects (500 m by 4 m) were employed as the primary sampling unit, as they were found to give the greatest precision (p=SE/Mean) of lobster abundance. Transect distance was measured, to the nearest metre using a Chainman® device. At the completion of each transect divers recorded: the number of lobsters caught, the number and age-class of those observed but not caught, depth, visibility, distance swum, numbers of pearl oyster (*Pinctada maxima*), crown of thorns starfish and holothurian species observed, and percent covers of standard substratum and biota (including seagrass and algae species) categories. The sampled lobsters were measured (tail width in mm), sexed and moult staged to provide fishery-independent size-frequency data.

The only glitch was an early hydraulic pump breakdown on the vessel, but the experienced crew were very helpful and efficient and the boat was fast so the team caught up time. The weather and underwater conditions for the survey were generally good. There were some strong winds (20-25 knots) for the first 7-8 days, dropping to 15-20 knots over the last 3 days. The visibility was good, averaging 2.5-3m. The lowest recorded visibility was 1.5m.

As previously, diving operations were limited by a Marine Park Permit to take only 5 lobsters per site from 6 sites located within the Great Barrier Marine Park Zone in the SE region of the fishery. Restrictions included: collection of no more than 30 juvenile lobster (< 90mm carapace length) from the 6 sites per year and no more than 5 collected per site per year.

Figure 1. Vessels used for 2018 midyear survey: mothership Wild Blue and a 5m CSIRO naiad

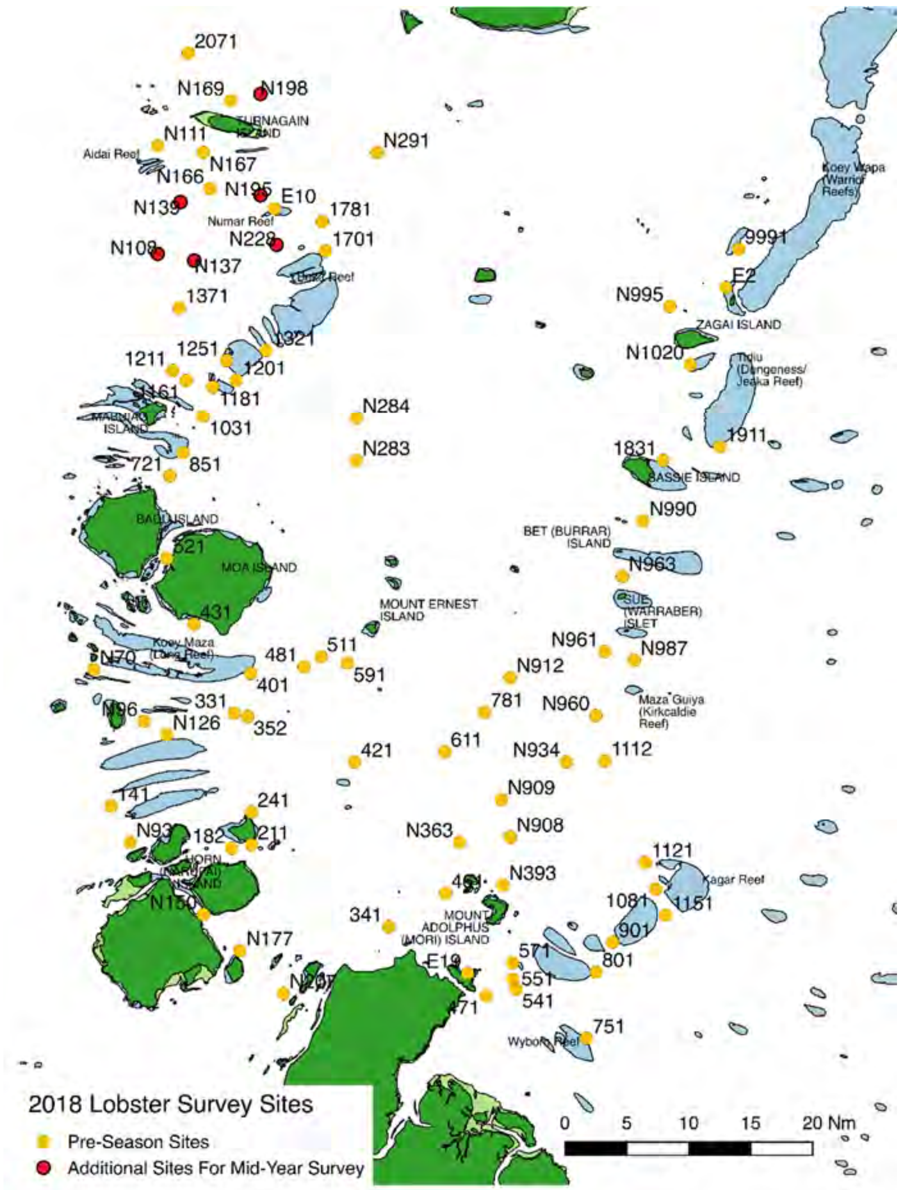


Figure 2. Map of western Torres Strait showing sites surveyed during the 2018 TRL midyear population survey. Sites marked in yellow are the same sites as surveyed in the 2017 Preseason survey whereas the red marks indicate additional sites added to the Midyear Survey.

Fishing Effort: Previous midyear surveys have been conducted during the fishing season. There was concern that the 2018 midyear survey might be positively biased due to reduced fishing effort this year as a result of a low RBC, plus concern that the fishery might close before the start of the survey if the RBC was reached, and because of a hookah ban implemented mid-season.

The 2017/18 total RBC is 299t. Following a recent agreement between Australia and PNG on the allocation of the 2017/18 recommended biological catch (RBC) for the Torres Strait Tropical Rock Lobster Fishery (TRL Fishery), there will be no cross endorsement and hence the final Australian catch share is 254.15 tonnes. This is an increase from 190.65 tonnes. The sustainable catch limit for the

Australian sector for the 2017/18 fishing season is thus 254.15 tonnes and the total reported catch as at 12 July 2018 was 228.12 tonnes, with 24 t taken from 1-12 July. Assuming that the PNG catch as at 12 July was 45t, this suggest the total catch up until the end of the midyear survey was approximately 273t.

Other fishery restrictions this year have included additional moon-tide closures and a hookah ban for a short time period. However, the use of hookah gear was again permitted from 2-9 July 2018, and hence it can be assumed that the total level of fishing effort preceding and during the time the midyear survey was conducted was not overly anomalous. However there are indications from the data and from anecdotal reports from fishers that the fishing effort has been fairly locally concentrated this year, and hence high fishing pressure in the Mabuiag stratum in particular could influence results.

2. Results

TRL distribution and abundance

The distribution of recruiting (1+) lobsters observed during the 2017 Preseason survey was compared with the 2+ lobster abundance (given they have grown into the next age class) during the 2018 Midyear survey (Fig. 3). Both survey indices suggested low abundance of the (1+) lobsters in November 2017 and the same cohort (2+) in June/ July 2018 across most strata. Buru stratum had one of the higher 2+ indices from the 2018 Midyear survey which contrasted with the very low 1+ abundance index observed for this stratum in the November 2017 preseason survey. The South East stratum which had an average 1+ index in November 2017, had a low Midyear 2+ index indicating the expected northward movement of lobsters as they grow and prepare for migration around September. In general, there were plenty of sites with empty dens where one might have expected 2+ animals if the abundance was high.

The 2018 recruiting class (1+) suggests a more even distribution of recruits than was the case last year (Fig. 3). The Midyear survey indicated that all strata had reasonable numbers of 1+ recruits however the north-western stratums (Buru and Mabuiag), and the South-East stratum had higher indices compared to the others.

Annual indices of abundance for 1+ and 2+ lobster

As the 2015, 2016 and 2017 pre-season surveys involved a reduced number of transects (77) from previous surveys (>130, e.g. 2014), a number of alternative methods have been used to calculate annual pre-season indices of abundance between 2005 and 2017. Previous analyses indicated that transitioning to smaller scale pre-season surveys would not interrupt the time series collected to date. Moreover, analyses were done to cross-check the reliability of using subsets of the survey data, such as selecting for analysis of the Preseason survey index, only those sites also common to the earlier Midyear surveys. As the Preseason survey becomes more extensive, more recent additions to the survey could be included in the standardised index. The 2018 Midyear survey used mostly the same reference sites (73) as per the 2017 Preseason survey but also included an additional 5 sites in the Mabuiag stratum where most fishery catches were being reported from. There were therefore 4 alternative methods (Table 1) used to analyse the 2018 Midyear survey index relative to previous years. The first involved using exactly the same method as was used to obtain the Reference Case Preseason 1+ index from the 2017 Preseason survey (using 68 common sites), being the series that was input to the stock assessment model. The second method involved using all 73 sites as used in the Preseason survey. The third method used all 78 sites, i.e. including the additional 5 sites. The fourth used only sites common to all years.

The 2018 midyear abundance index for 2+ lobsters is significantly lower than the previous 8 midyear survey indices and is the second lowest value on record (Fig. 4). The 2018 index is 26% of the average survey indices over the period 1989-2004 (Fig 4). The overall pattern of a low 2018 index is very similar across all methods examined.

The (1+) recruiting index is much more positive and is at approximately the average historical level, suggesting that the next fishing season will be improved relative to the current fishing season (Figure 4).

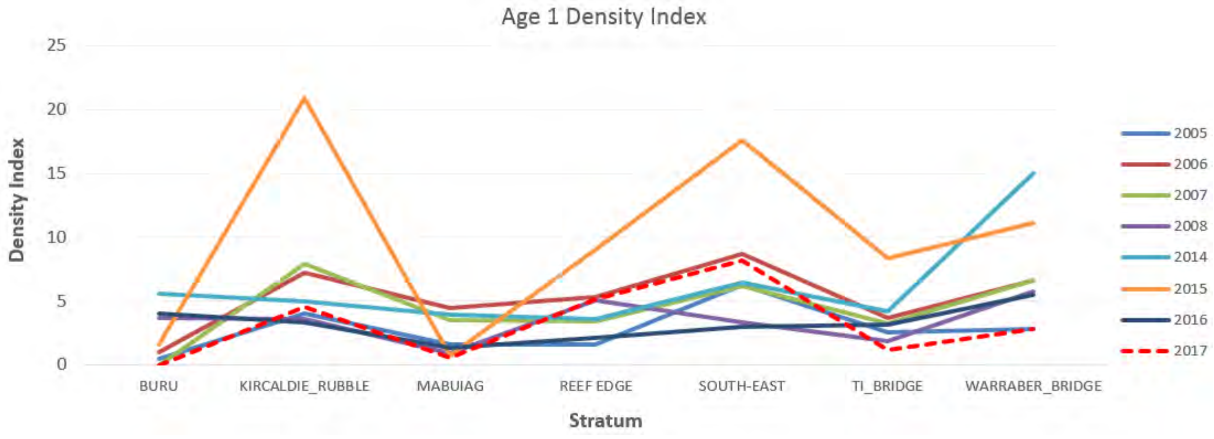
Figure 5 compares the standard errors (SE) of the alternative survey indices, highlighting the improvement (i.e. reduction in standard error) in the precision of surveys with substantially more sites (e.g. 34 vs 73 sites) but only a small change in precision associated with adding a few more sites. The 2018 coefficient of variation (SE/mean) for both the 2+ and 1+ indices was similar to the average of the historical series, supporting that the 2018 midyear survey was adequately precise.

Table 1. Description of the four options used to estimate ornate rock lobster (*Panulirus ornatus*) abundance indices from the 2018 Midyear population survey conducted in Torres Strait.

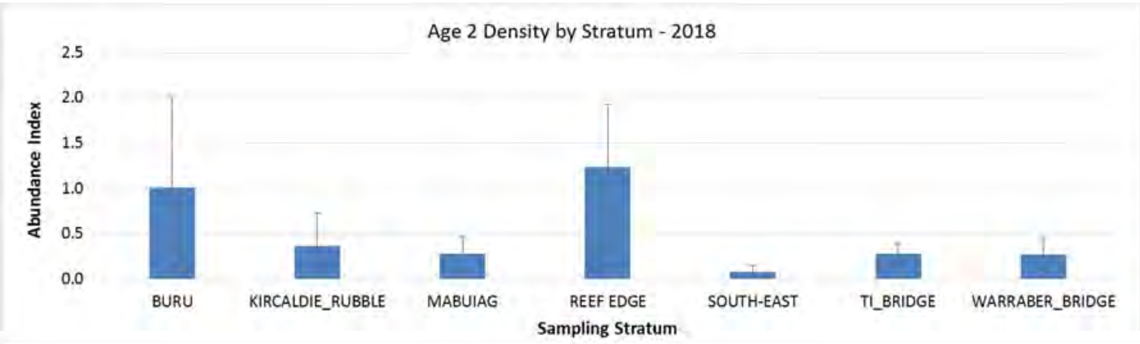
Midyr Index Option	**Number of Transects in 2018**	**Total Number of Transects in series**	**Description**
1. 73 Reference Sites	73	73#	The 73 Reference Sites used in the 2018 survey
2. Reference Index used in Stock Assessment Model	68	73#	Historically selected reference sites : Sites common to those in the 2002 and 2006 surveys
3. Expanded survey	78	83	Sites used in Option 2 plus the additional sites in the 2018 survey
4. MID_YEAR ONLY SITES- common across all years	34	34	Sites common to surveys across all years

Of the 73 sites included in options 1 and 2 above, 68 sites are common to both options while 5 sites are particular to each option.

November 2017 Preseason Survey



July 2018 Midyear survey



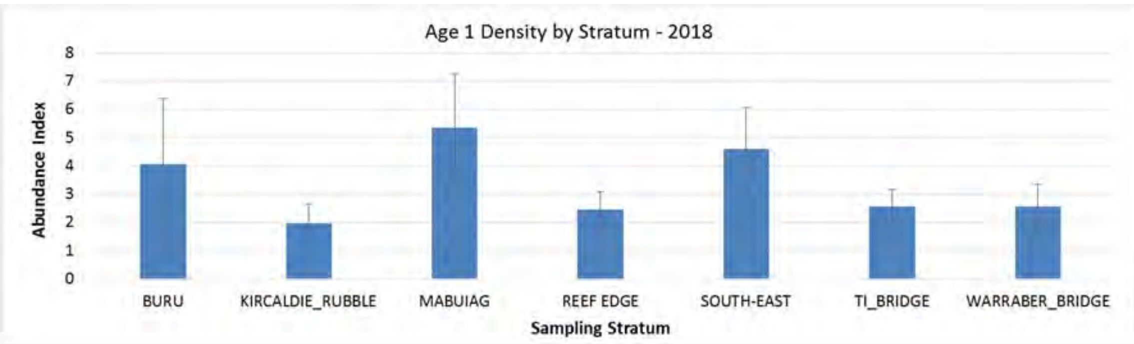
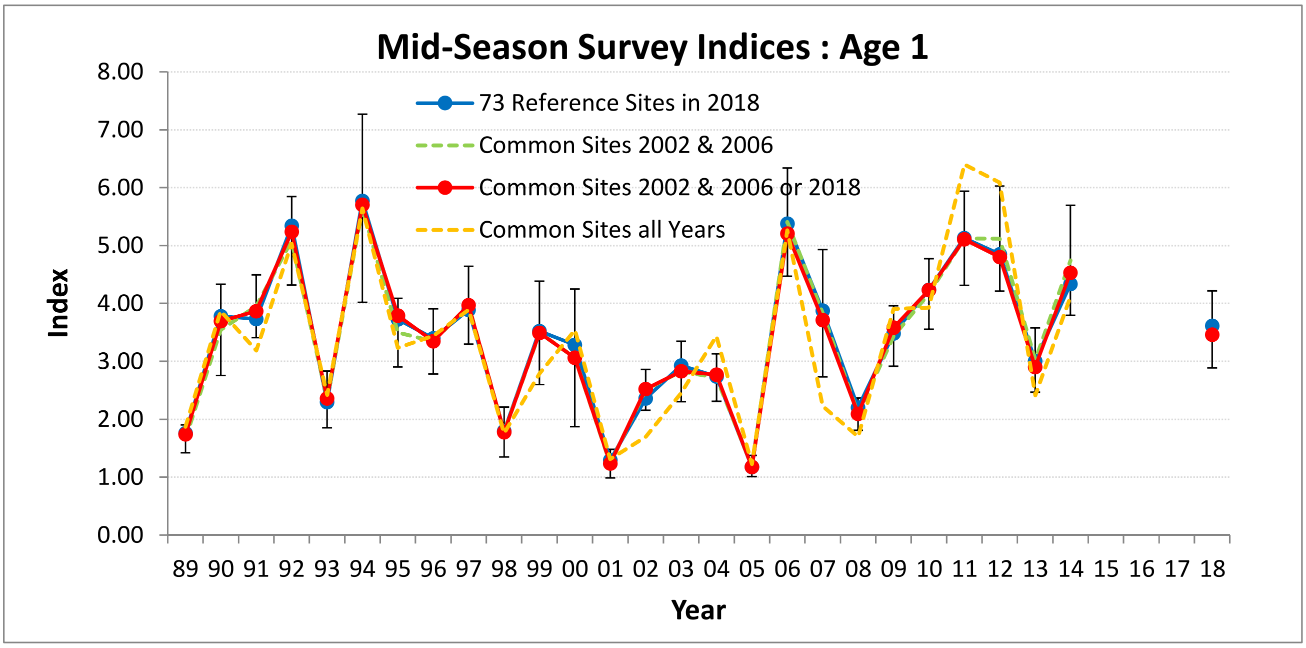


Figure 3. Comparative indices of abundance of recruiting (1+) ornate rock lobsters (*Panulirus ornatus*) recorded in each sampling stratum during pre-season surveys in Torres Strait between 2005 and 2017 (note surveys were not done during 2009-2013), compared with results (based on all 78 sites) obtained during the July 2018 Midyear survey



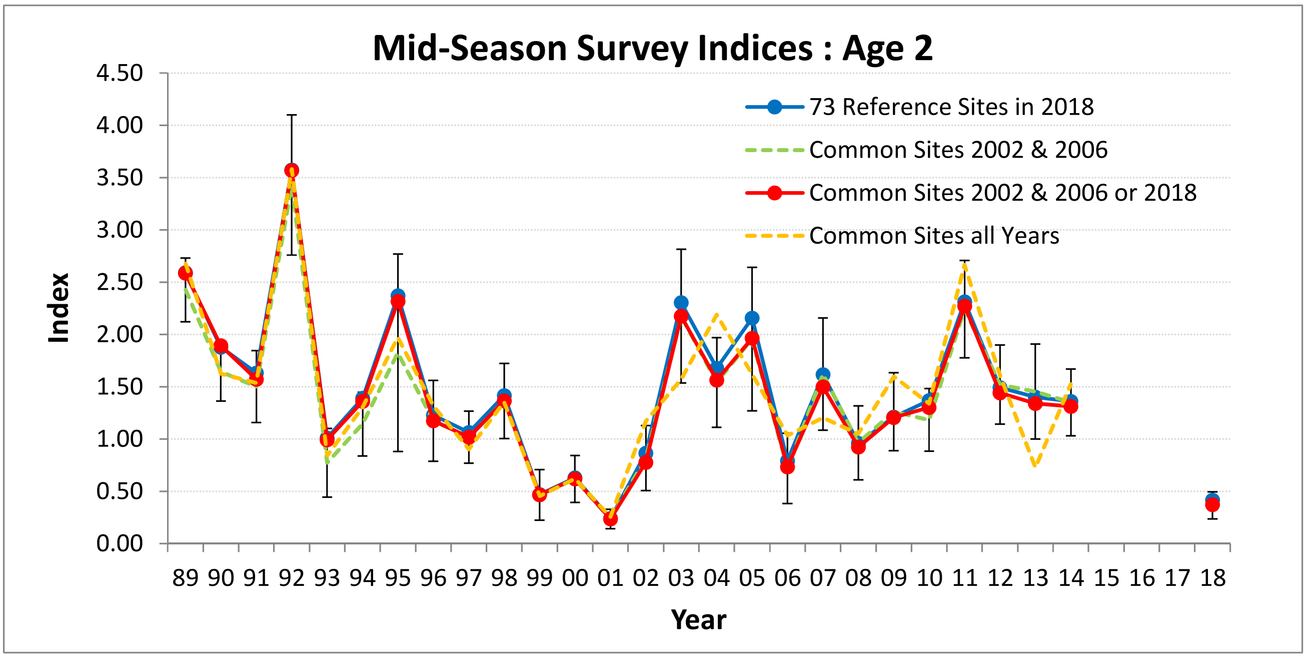
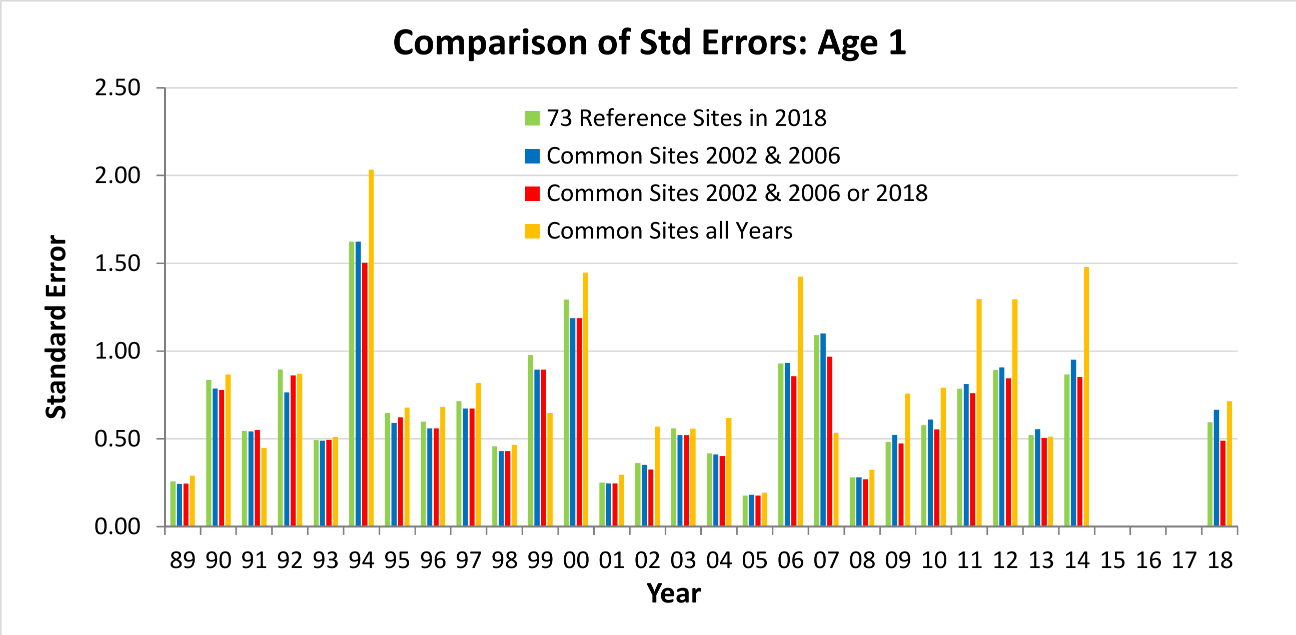


Figure 4. Four comparative indices of abundance of recruiting (1+) and fished (2+) ornate rock lobsters (*Panulirus ornatus*) recorded during midyear surveys in Torres Strait between 1989 and 2018 (note midyear surveys were not done during 2005-2017). Error bars of MYO indices represent standard errors.



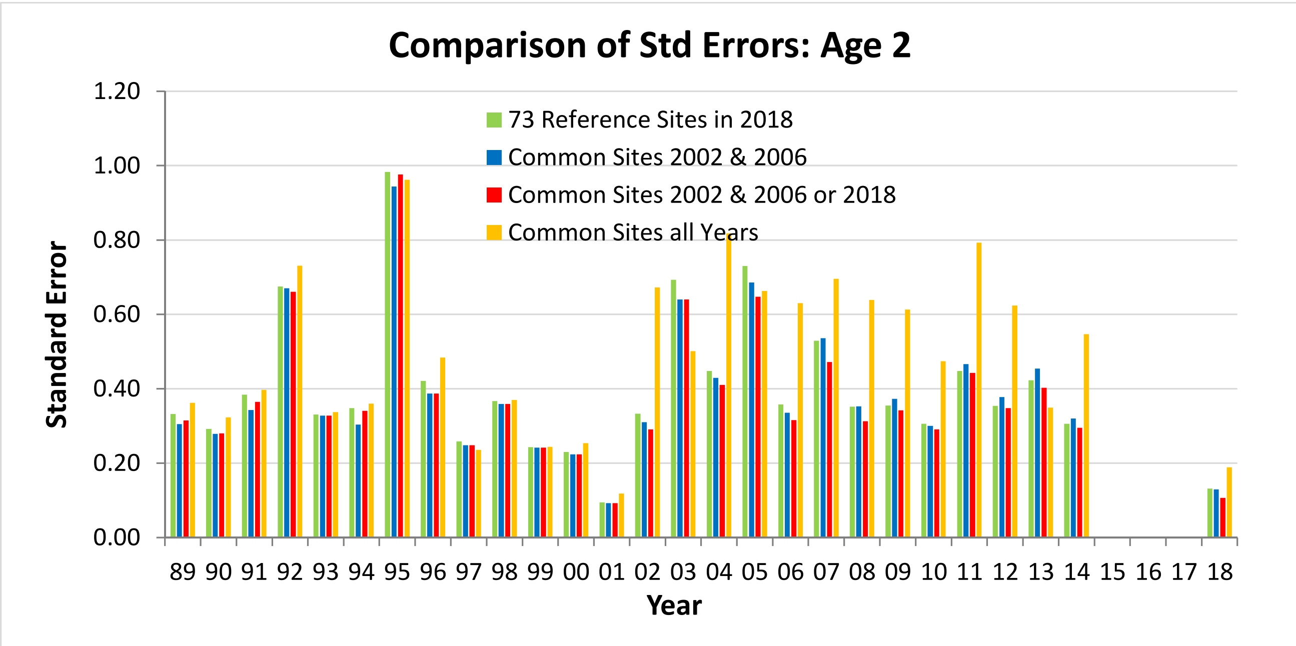


Figure 5. Comparative standard errors for four indices of abundance of recruiting (1+) and fished (2+) ornate rock lobsters (*Panulirus ornatus*) recorded during midyear surveys in Torres Strait between 1989 and 2018 (note midyear surveys were not done during 2005-2017).

Evaluating Results relative to predictions based on the 2017 Preseason survey and Stock Assessment Model Predictions

The TRLRAG May 2018 meeting noted the following with regard to at what point the mid-season survey may trigger a review of the RBC for the TRL Fishery: "*The AFMA member advised that there would need to be a significant variation between the results of the November 2017 pre-season survey and the 2018 mid-season survey to trigger a review. Such an "anomalous" result is considered unlikely at this point given indications from available data for the Fishery to date. The CSIRO scientific member supported this view and suggested an anomalous result be defined as a 2018 mid-season survey 2+ survey index that falls outside the 95% confidence interval associated with the model forward prediction based on the November 2017 pre-season survey 1+ index. This is given uncertainties in available data and the fact that a mid-season survey has not been conducted since 2014. The RAG noted that a 95% confidence interval sets a high bar, but agreed that this would be appropriate.*"

As shown in Table 2 and Figure 6, the midyear 2+ index falls within the confidence limits associated with the stock assessment model prediction, and is slightly lower than predicted. As per the agreed process for evaluating results, this therefore suggests that no increase in the RBC is warranted.

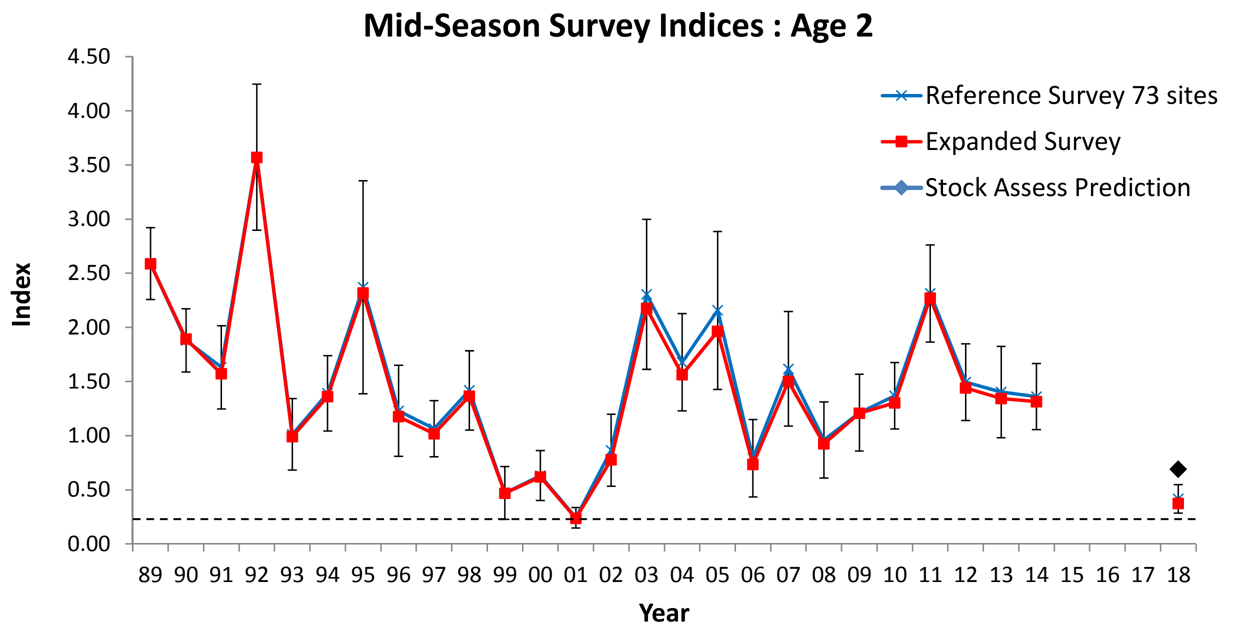
The midyear survey also provides an early indication of the recruiting (1+) age class, which is helpful given the 0+ index is considered unreliable. As evident from table 2 and Fig. 6, the 1+ index is slightly higher than the upper 95% limit associated with the model prediction, and is seen to be at approximately the average historical value, suggesting a more positive outlook for next year.

Table 2. Stock assessment model (Dec 2017 Reference Case version) prediction of 2018 Midyear survey expected relative numbers (i.e. equivalent to survey index) of 1+ and 2+, shown with lower and upper 75% and 95% confidence limits, compared with actual Observed values from 2018 Midyear survey.

	Observed	Predicted Value	lower95%	upper95%	lower75%	upper75%
1+	**3.56**	2.69	1.84	3.54	2.10	3.47
2+	**0.37**	0.69	0.34	1.04	0.44	0.93

Comparison with additional sites added to the index

The additional 5 sites were added to the Mabuiag stratum given information that the stock distribution has shifted this year and fishing has been concentrated in this stratum. It was therefore anticipated that the absence of these sites in the 2017 Preseason survey may have biased results negatively, and that the bias could be evaluated by comparing with results from an index including additional sites in the "hotspot" area. As shown in Fig. 8, a difference in the stratum-specific indices is therefore only expected for the Mabuiag stratum. However, in contrast to the expected results, the index for the Mabuiag stratum actually decreased slightly when adding the additional 5 sites. This could be partly because the lobsters are very spatially concentrated in this stratum and the survey has underestimated overall abundance because the survey is designed to provide a larger scale representative index. Alternatively, this suggests that the earlier "hotspot" concentrations of lobsters in this stratum have now been fished and the index is reflecting the fishing pressure that has been exerted in this area. In summary though, this suggests that there is no basis for concluding that lobster abundance is significantly higher than indicated by the survey and hence that the RBC should be increased.



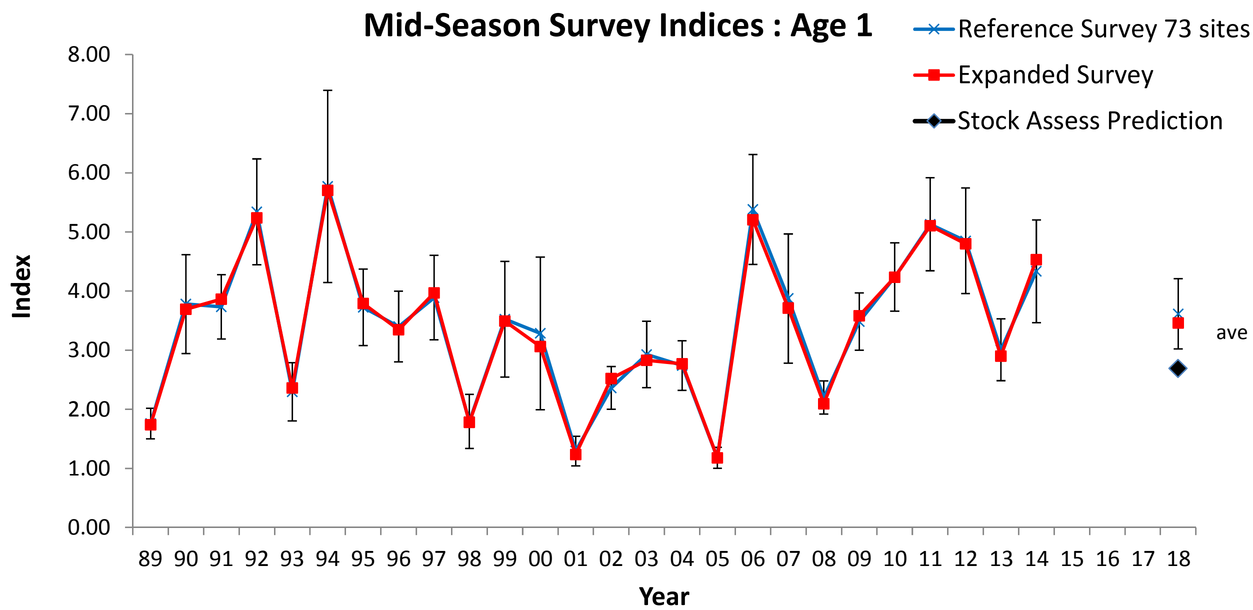


Figure 6. Comparison of the Reference and Expended Survey indices of abundance of recruiting (1+) and fished (2+) ornate rock lobsters (*Panulirus ornatus)* recorded during midyear surveys in Torres Strait between 1989 and 2018 (note midyear surveys were not done during 2005-2017), shown together with the stock assessment model-predicted values that were based on the model fitted to the Preseason 2017 survey data. Error bars represent standard errors.

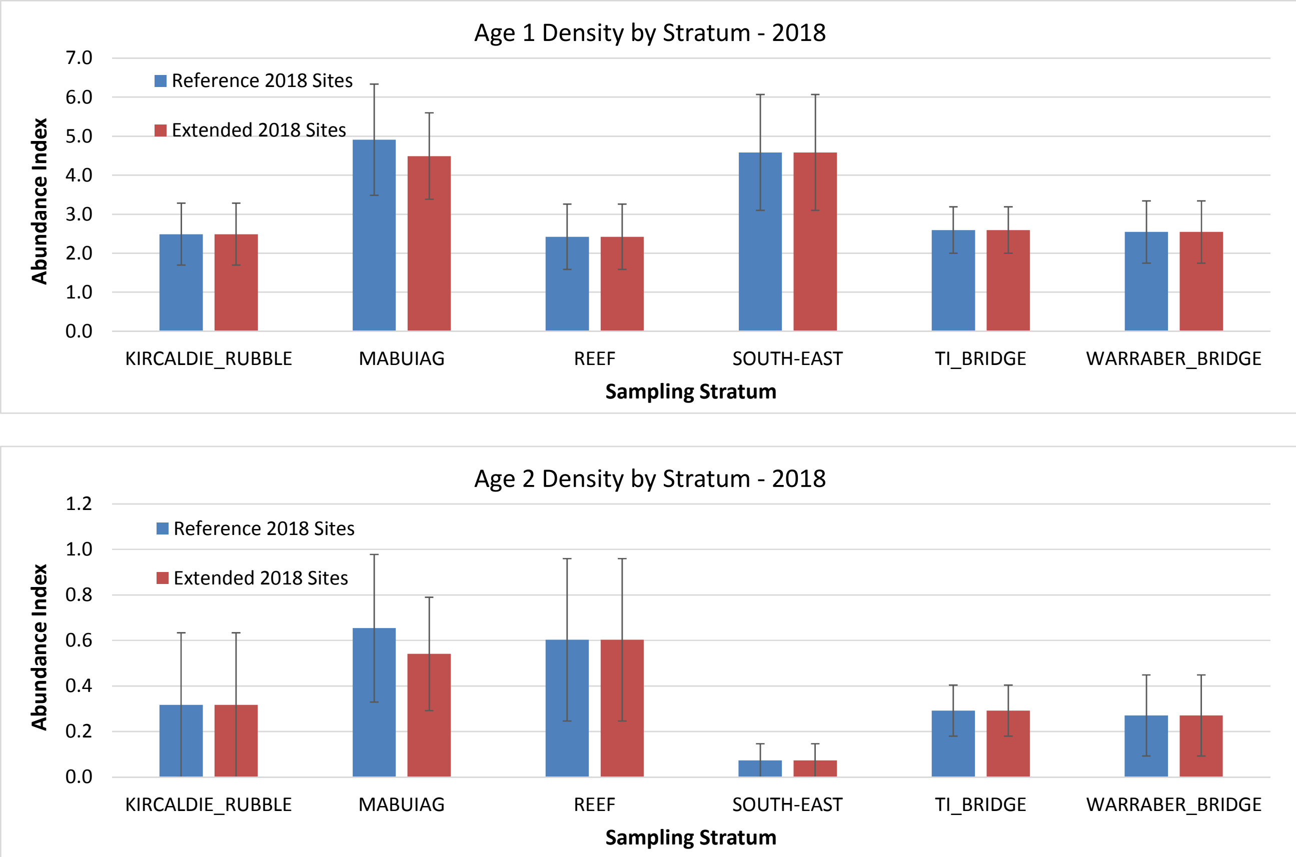


Figure 7. Comparison of 2018 Midyear survey results per stratum as shown.

The midyear survey index has provided a valuable basis for calibrating this year’s CPUE, but we won’t be able to start those analyses until we have the entire year’s CPUE data analysed. The full report containing the detailed analyses of the survey data, including length frequency information, will be circulated before the next TRLRAG meeting.

Acknowledgements

We wish to sincerely thank the master (Rob Benn) and crew (Joseph Harland) of the Wild Blue for excellent assistance in all aspects of the mid-year dive survey in Torres Strait, and in logistic support prior to and after the field survey. We also thank Tim Skewes for stepping in to assist with the diving and sharing his extensive experience from decades of involvement in TRL research. We are grateful to Darren Dennis for comments which helped improve the analyses. Finally we thank all TRL RAG members and observers for their constructive inputs. We gratefully acknowledge funding support for the survey from AFMA and CSIRO.

Torres Strait Tropical Rock Lobster Mid- and Pre-season surveys – Summary of observed and modelled size (tail width) distributions.

Judy Upston, Éva Plagányi, Mark Tonks, Tim Skewes, Kinam Salee, Frank Coman, Nicole Murphy, Rob Campbell, Mick Haywood, Roy Deng, Trevor Hutton

With thanks to Darren Dennis for valuable contributions to the TRL research

CSIRO Oceans and Atmosphere, Australia

Paper for TRL RAG, October 2018

Summary

This paper comprises a summary of observed and modelled size (tail width) distributions for Torres Strait tropical rock lobsters based on observations from independent research surveys during the Mid-Season (June/ July) and Pre-season (November/ December), with emphasis on 2018 and recent survey years. The paper provides a reference set of summary statistics and plots to support discussion by the TRL Research Advisory Group, as necessary.

Acknowledgements

Thank you to Rob Benn and Joseph Harland on the Wild Blue vessel for their contributions to successful field operations for the 2018 mid-year survey in Torres Strait. We also thank TRL RAG for their valuable discussions. Funding support for the 2018 survey was provided by AFMA and CSIRO.

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Figure D1. Diagnostic plot. Mid-Season Histogram (density distribution) of TS rock lobster TW by sex and areas (North and South), 2018 and recent years.
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Figure A2. Mid-Season Survey – Histogram (counts) of TS rock lobster TW by sex, years.
Figure A3. Pre- and Mid-Season Surveys – Histogram (counts) of TS rock lobster TW by sex, years surveyed (since 2013).
Figure A4. Diagnostic plot. Mid-Season Survey - Histogram (counts) of TS rock lobster tail width (TW) by sex and areas (North and South), 2018 and recent years surveyed.
Figure A5. Diagnostic plot. Mid-Season Survey 2018 - Histogram (counts) of TS rock lobster tail width (TW) by sex and zone). Zones: 1=North West, 2=South West, 3=Central, 4=South East.

1. Tables and Figures

Table 1. Number of TS rock lobsters (n_lob) observed and measured each Survey and Year, by area (n_lob_North,…South). The number of locations (sites) at which lobsters were observed and measured (loc_lob_obs) and total locations surveyed (loc_surveyed) are indicated.

Year	Survey	n_lob	Ratio_MF	n_lob_North	n_lob_South	loc_lob_obs	loc_surveyed
1989	Mid	816	0.99	125	691	73	542
1990	Mid	521	1.02	193	328	81	100
1991	Mid	655	0.89	248	407	84	100
1992	Mid	851	0.91	212	639	83	100
1993	Mid	334	1.06	77	257	67	100
1994	Mid	599	0.90	205	394	80	100
1995	Mid	458	0.97	165	293	69	100
1996	Mid	367	0.92	137	230	73	82
1997	Mid	457	1.18	227	230	67	82
1998	Mid	386	0.88	213	173	108	215
1999	Mid	375	0.88	132	243	56	82
2000	Mid	231	1.18	112	119	50	82
2001	Mid	148	0.97	28	120	48	82
2002	Mid	271	0.63	71	200	52	375
2003	Mid	499	0.88	286	213	94	158
2004	Mid	340	0.88	123	217	77	117
2005	Mid	232	0.86	72	160	54	86
2005	Pre	302	1.14	100	202	84	154
2006	Mid	303	1.16	68	235	56	80
2006	Pre	395	1.09	175	220	105	189
2007	Mid	339	0.97	130	209	78	106
2007	Pre	327	1.21	101	226	95	188
2008	Mid	207	0.95	59	148	56	103
2008	Pre	216	0.88	97	119	72	148
2009	Mid	238	0.92	114	124	56	74
2010	Mid	342	0.76	117	225	55	74
2011	Mid	380	0.90	109	271	61	73
2012	Mid	333	1.03	183	150	55	77
2013	Mid	173	1.16	73	100	41	74
2014	Mid	283	1.02	104	179	56	74
2014	Pre	436	1.12	146	290	92	130
2015	Pre	440	0.86	54	386	56	78
2016	Pre	130	0.69	52	78	49	77
2017	Pre	109	0.76	8	101	36	77
2018	Mid	178	1.14	74	104	52	78

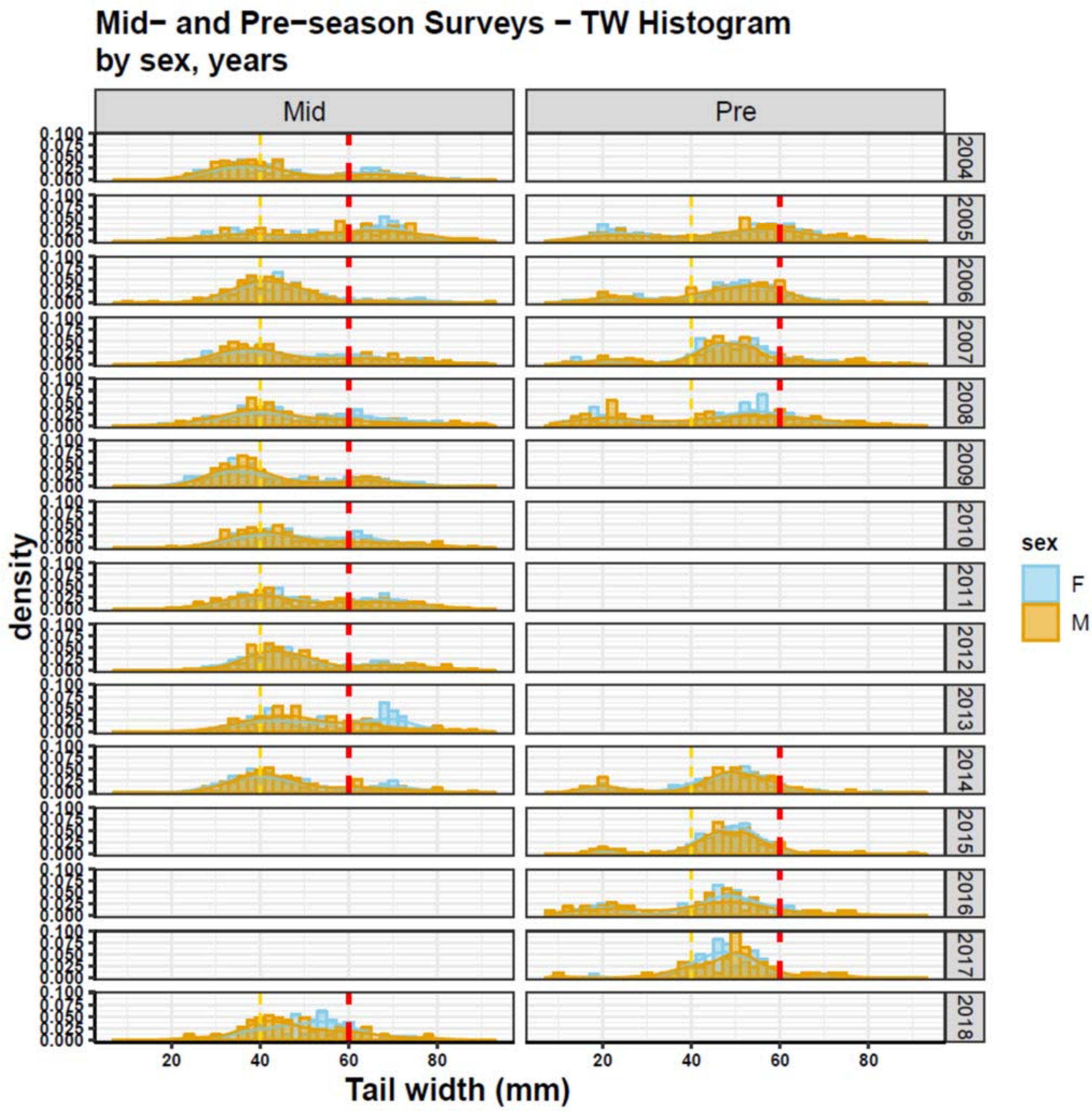


Figure 1. Mid- (Jun/ Jul) and Pre-Season (Nov/ Dec) Surveys – Histogram (density distribution) of TS rock lobster tail width (TW) by sex, years (since 2004). Minimum legal size (converted. Males 60 mm TW, combined sexes 62 mm TW) and nominal 40 mm TW (estimated mean TW for 1+ cohort in Mid-season) are indicated (red and yellow dashed lines).

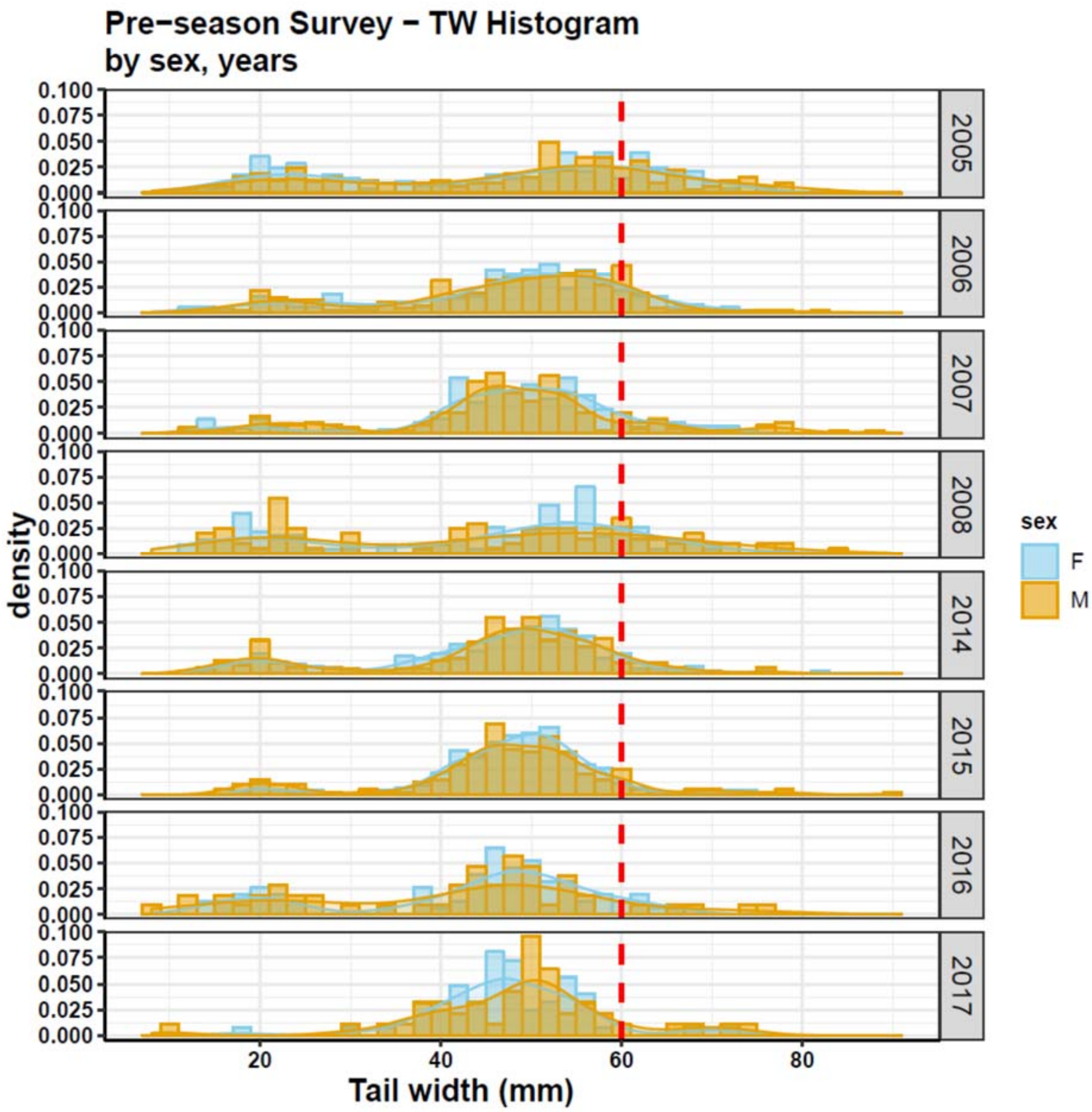


Figure 2. Pre-Season Survey – Histogram (density distribution) of TS rock lobster tail width (TW) by sex, years (2005 to 2008, 2014 to 2017). Minimum legal size (converted. Males 60 mm TW, combined sexes 62 mm TW) is indicated (red dashed line).

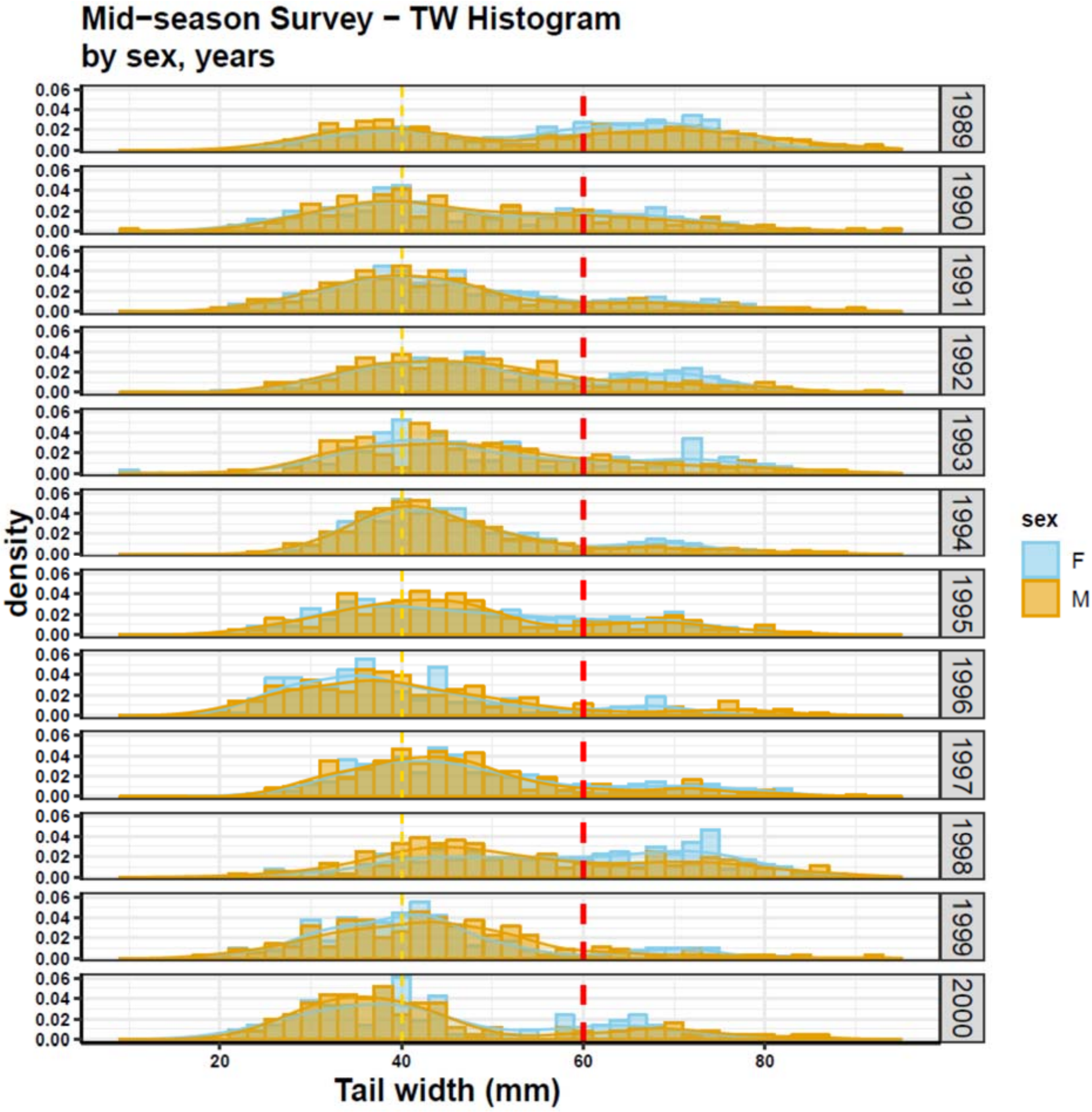


Figure 3. Mid-Season Survey - Histogram (density distribution) of TS rock lobster tail width (TW) by sex, years (1989 to 2000). Minimum legal size (converted. Males 60 mm TW, combined sexes 62 mm TW) and nominal 40 mm TW (estimated mean TW for 1+ cohort in Mid-season) are indicated (red and yellow dashed lines).

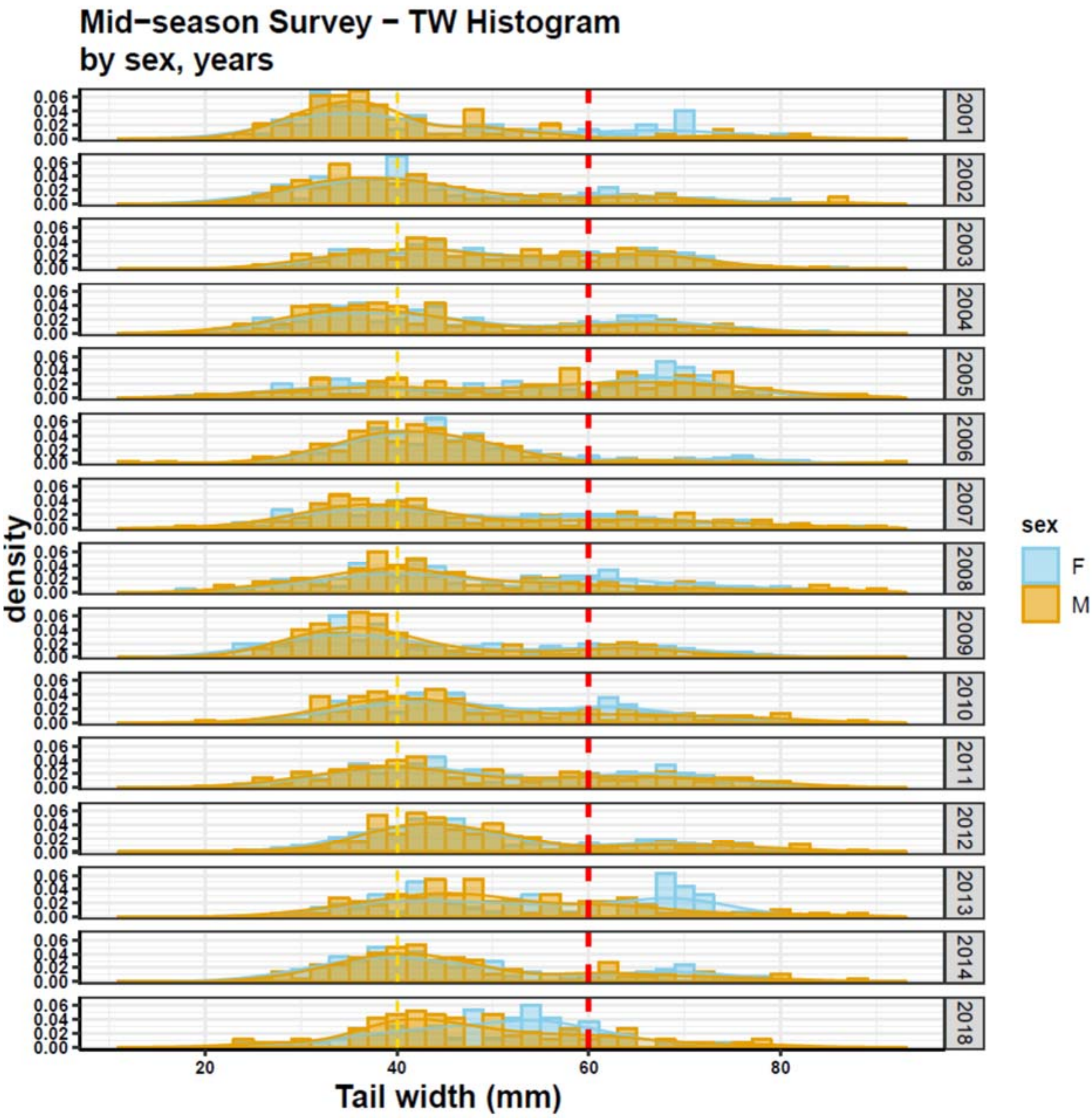


Figure 4. Mid-Season Survey - Histogram (density distribution) of TS rock lobster tail width (TW) by sex, years (2000 to 2014, 2018). Minimum legal size (converted. Males 60 mm TW, combined sexes 62 mm TW) and nominal 40 mm TW (estimated mean TW for 1+ cohort in Mid-season) are indicated (red and yellow dashed lines).

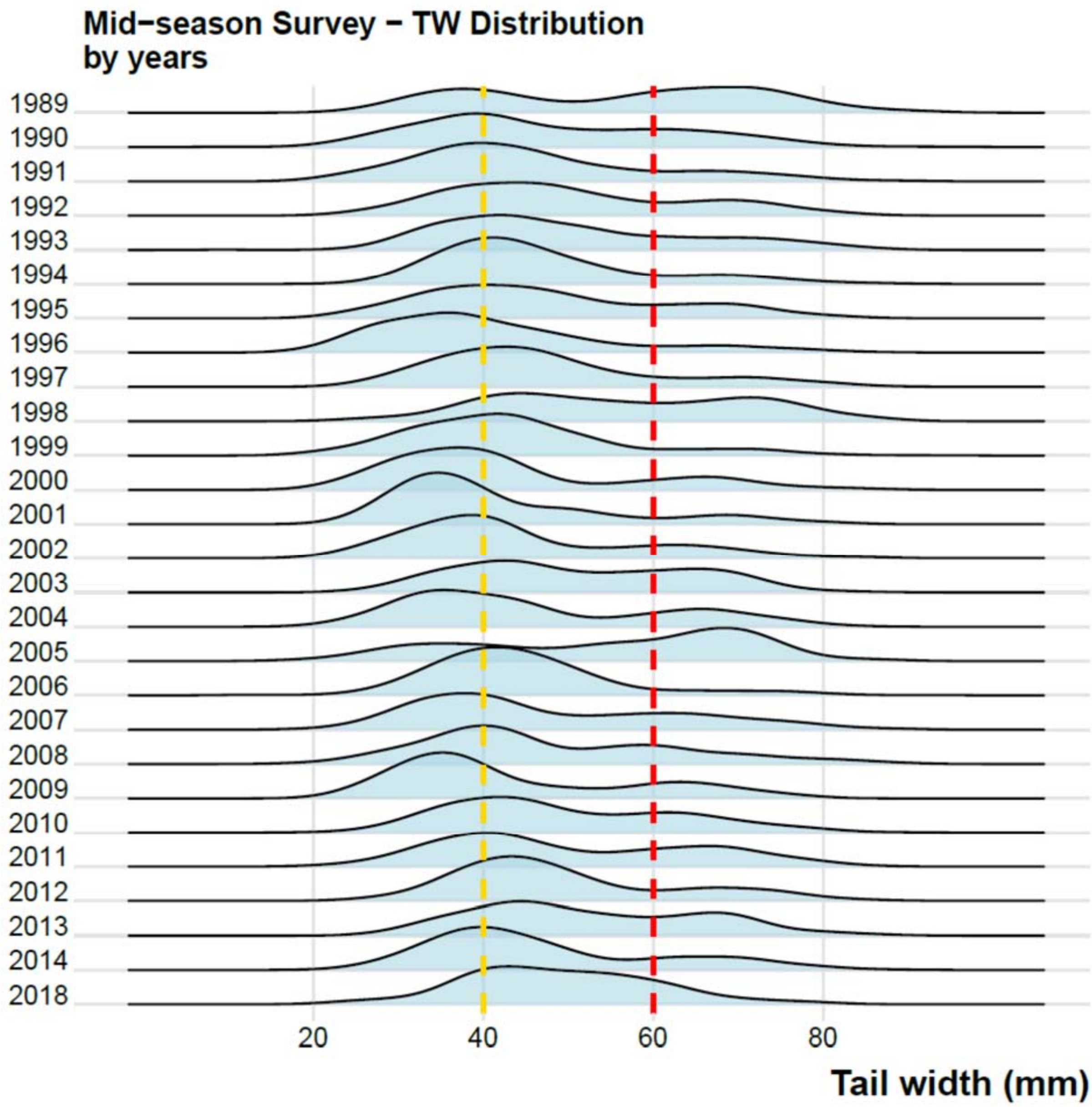
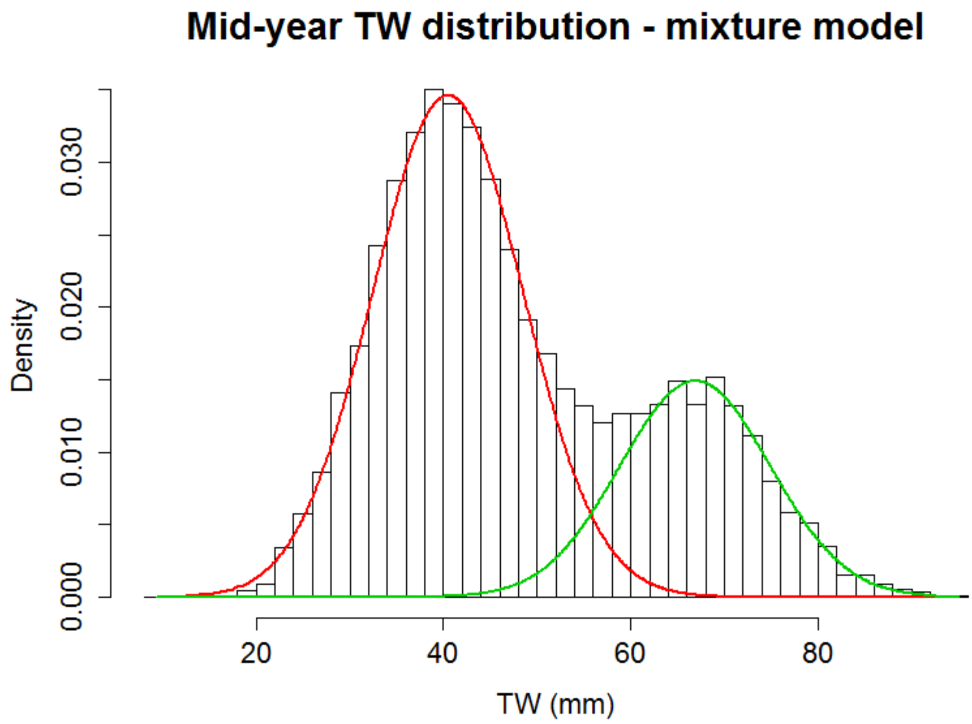


Figure 5. Mid-Season Survey – Ridge plot showing TS rock lobster tail width (TW) density distributions for combined sexes, each year surveyed (1989 to 2018). Minimum legal size (converted. Males 60 mm TW, combined sexes 62 mm TW) and nominal 40 mm TW (estimated mean TW for 1+ cohort in Mid-season) are indicated (red and yellow dashed lines).



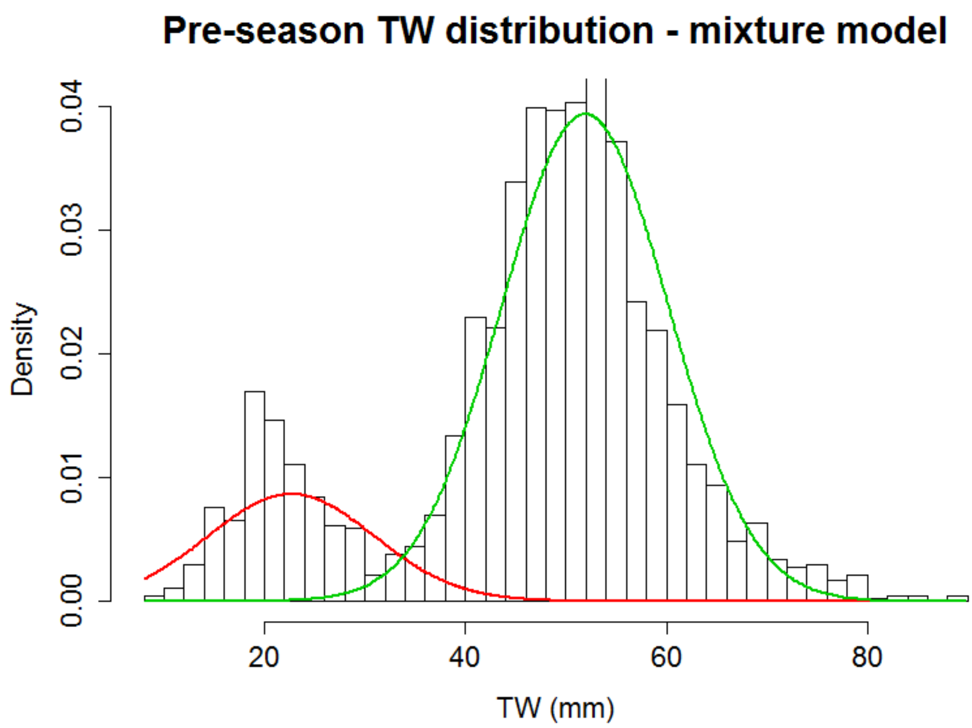


Figure 6. Histogram and fitted normal component density distributions of TW (cohorts on average across all survey years) for Mid-Season (Mid-year) Survey (top plot), and Pre-Season Survey (bottom plot).

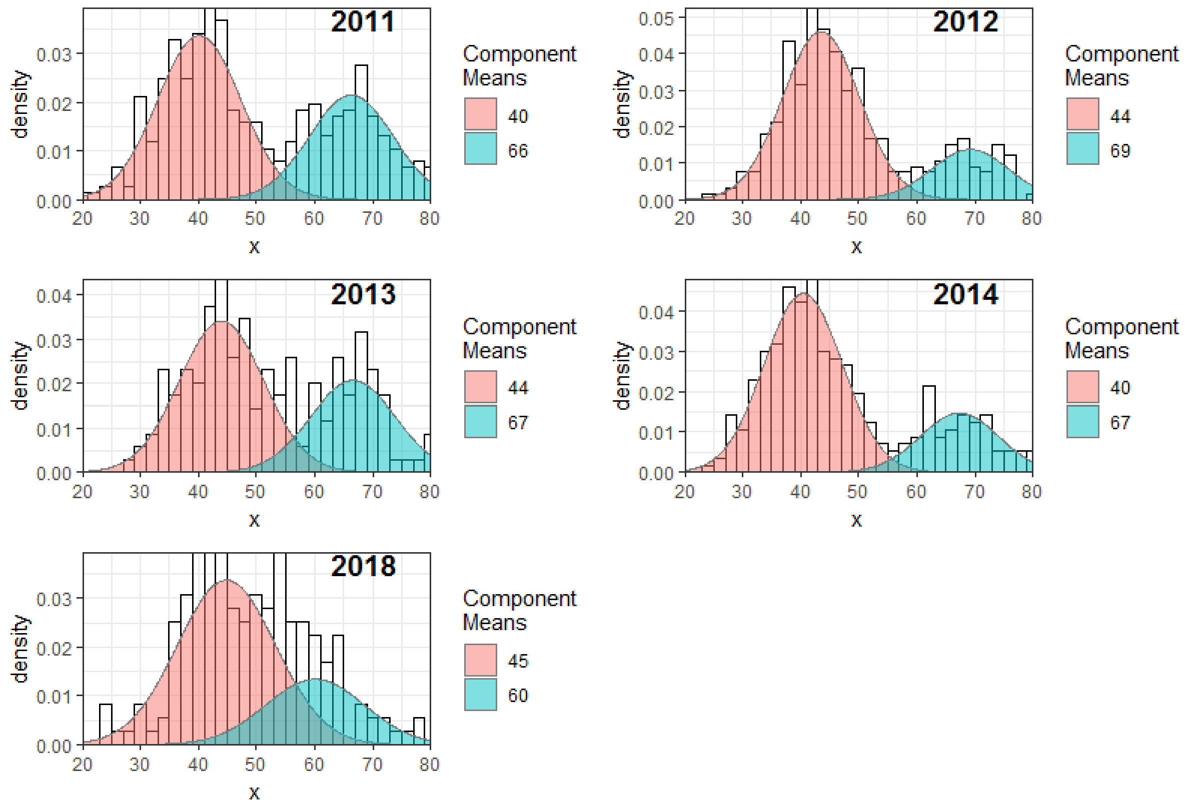


Figure 7a. Mid-Season Survey - Histogram and fitted normal component density distributions of TW and mean estimates for recent years. x-axis: tail width (mm).

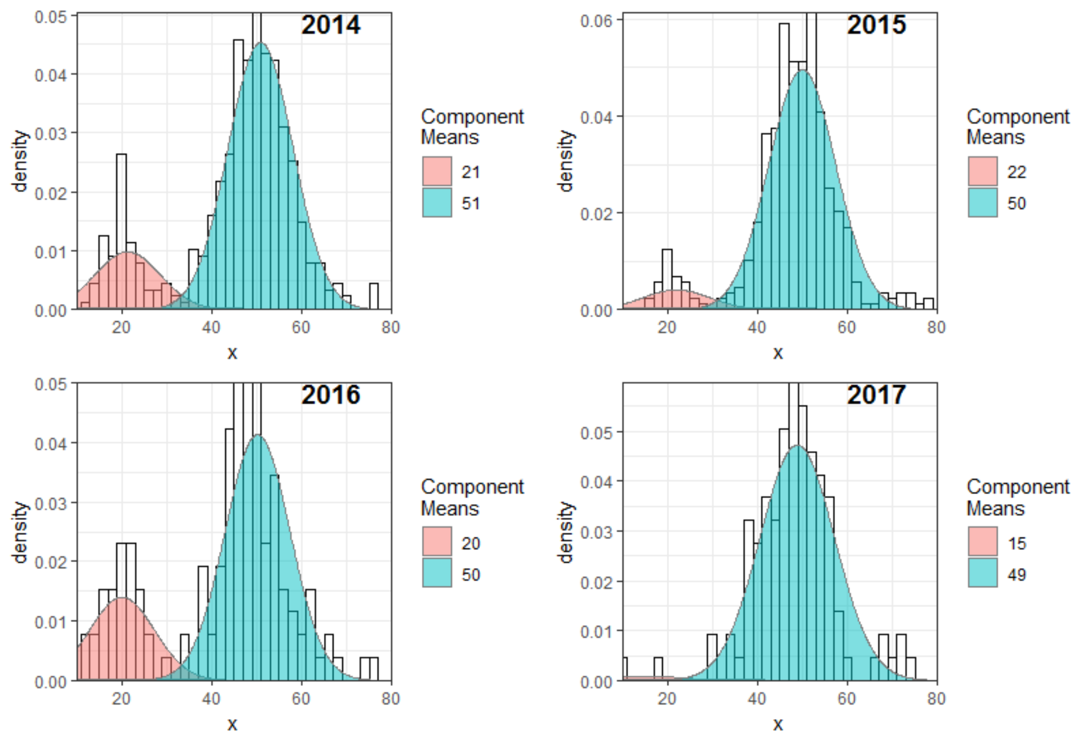


Figure 7b. Pre-Season Survey - Histogram and fitted normal component density distributions of TW and mean estimates for recent years. x-axis: tail width (mm).

2. Diagnostic plots

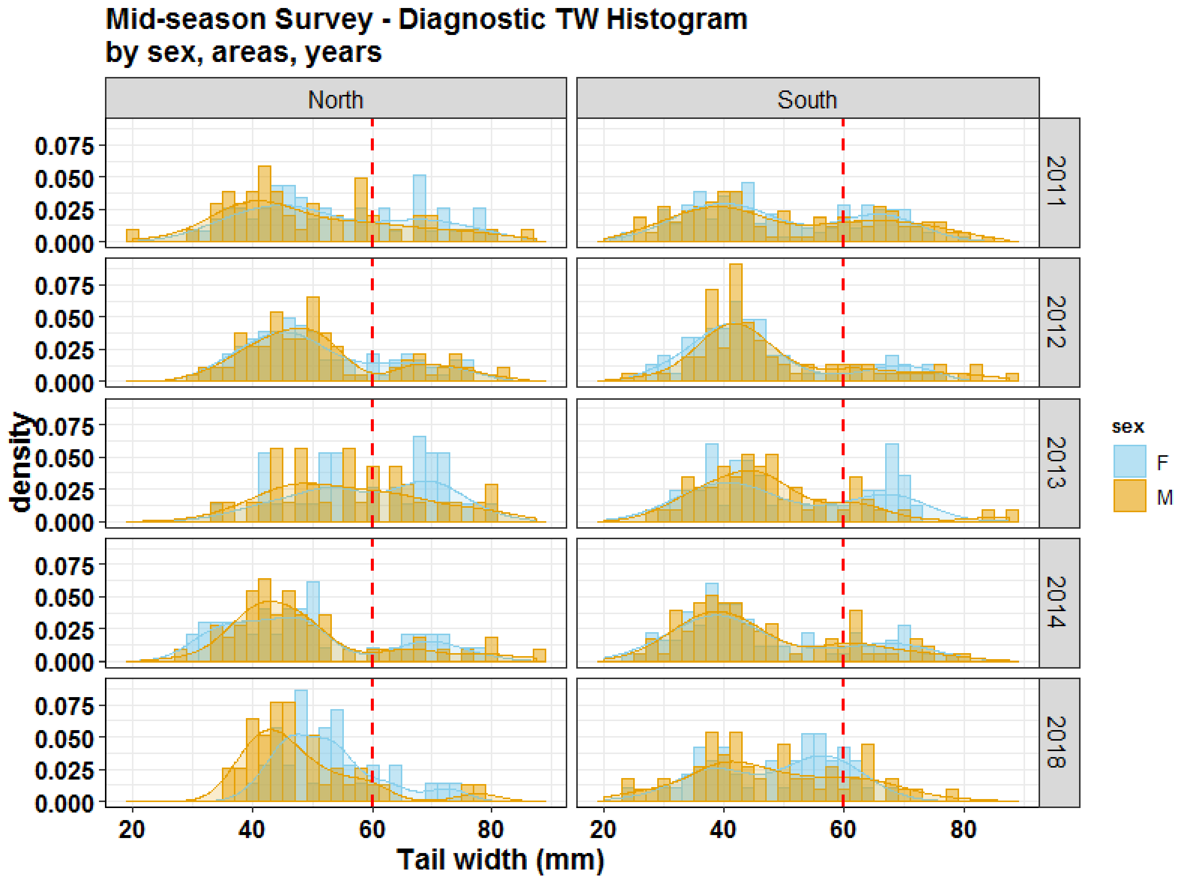


Figure D1. Mid-Season Survey - Histogram (density distribution) of TS rock lobster tail width (TW) by sex and areas (North and South), 2018 and recent years surveyed.

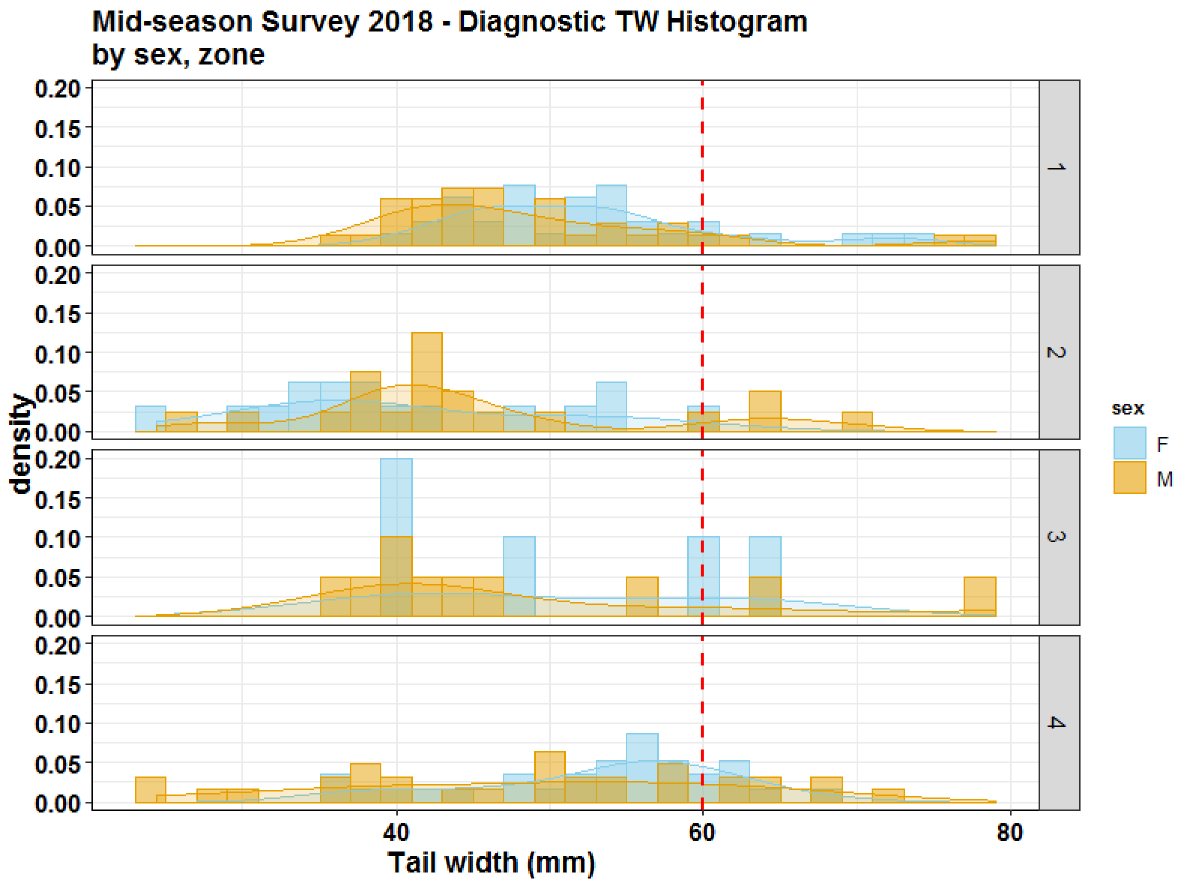


Figure D2. Mid-Season Survey 2018 - Histogram (density distribution) of TS rock lobster tail width (TW) by sex and zone). Zones: 1=North West, 2=South West, 3=Central, 4=South East.

3. Appendix

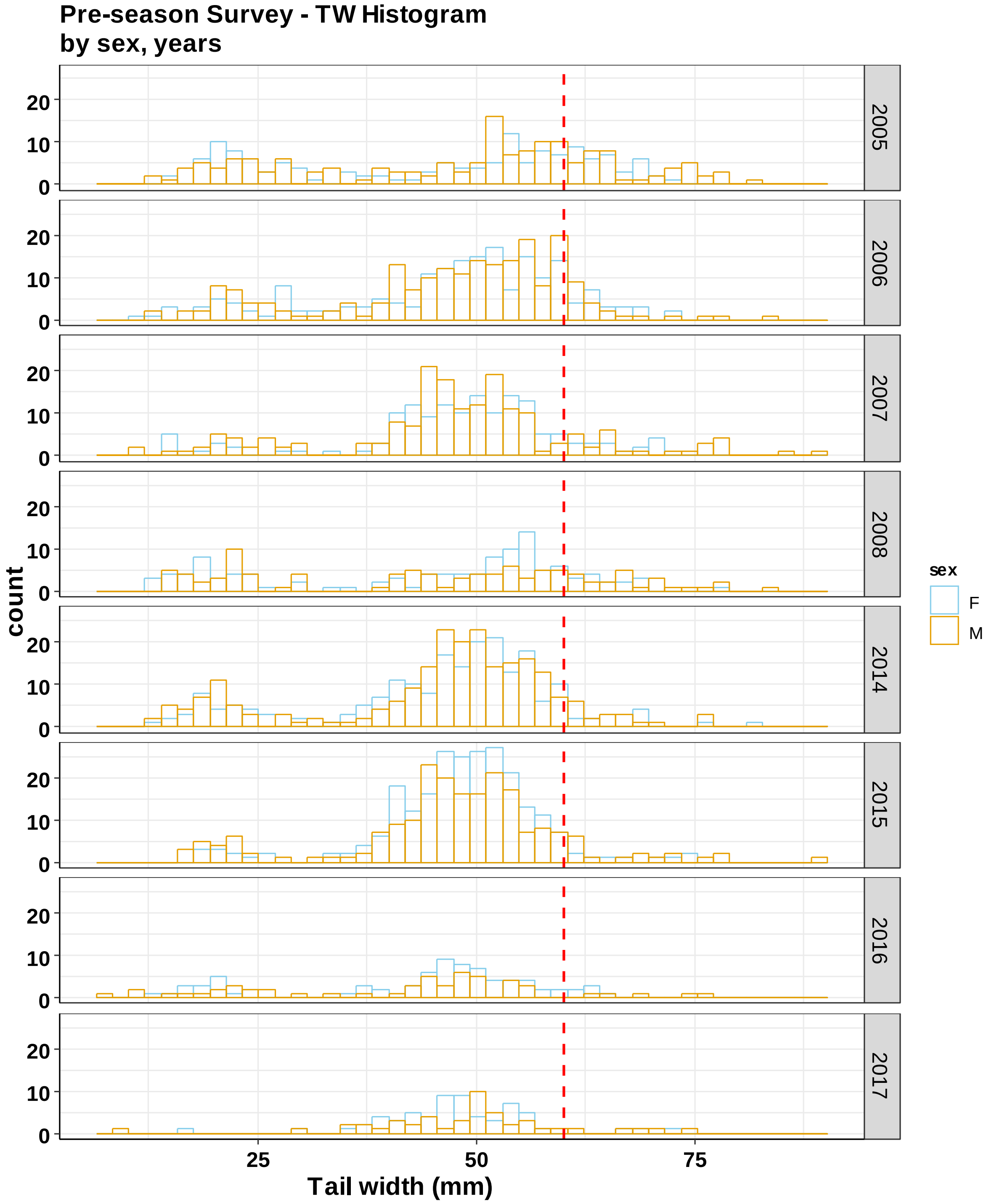


Figure A1. Pre-Season Survey – Histogram (counts) of TS rock lobster TW by sex, years (2005 to 2008, 2014 to 2017).

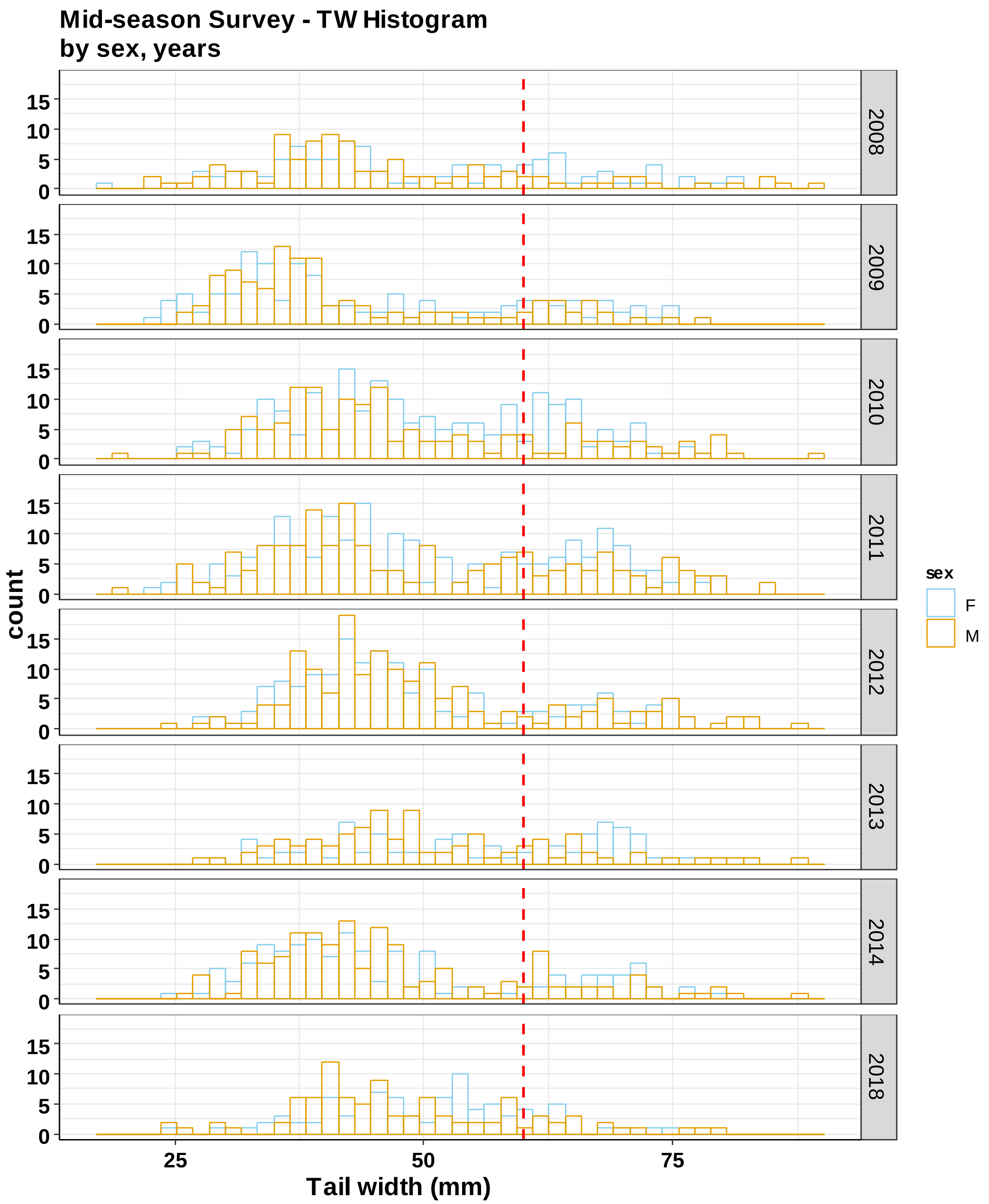


Figure A2. Mid-Season Survey – Histogram (counts) of TS rock lobster TW by sex, years (2008 to 2014, 2018).

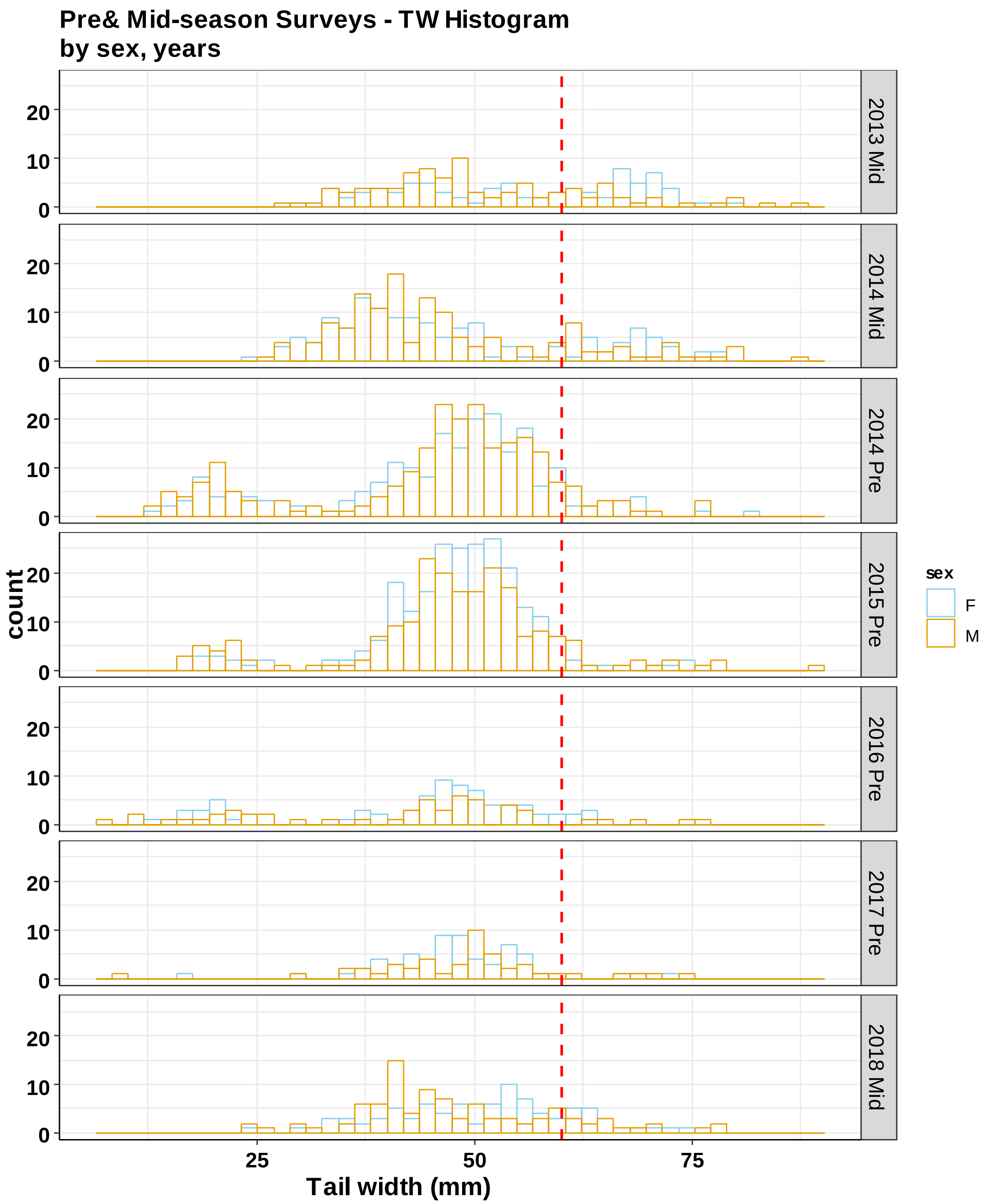


Figure A3. Pre- and Mid-Season Surveys – Histogram (counts) of TS rock lobster TW by sex, years surveyed (since 2013).

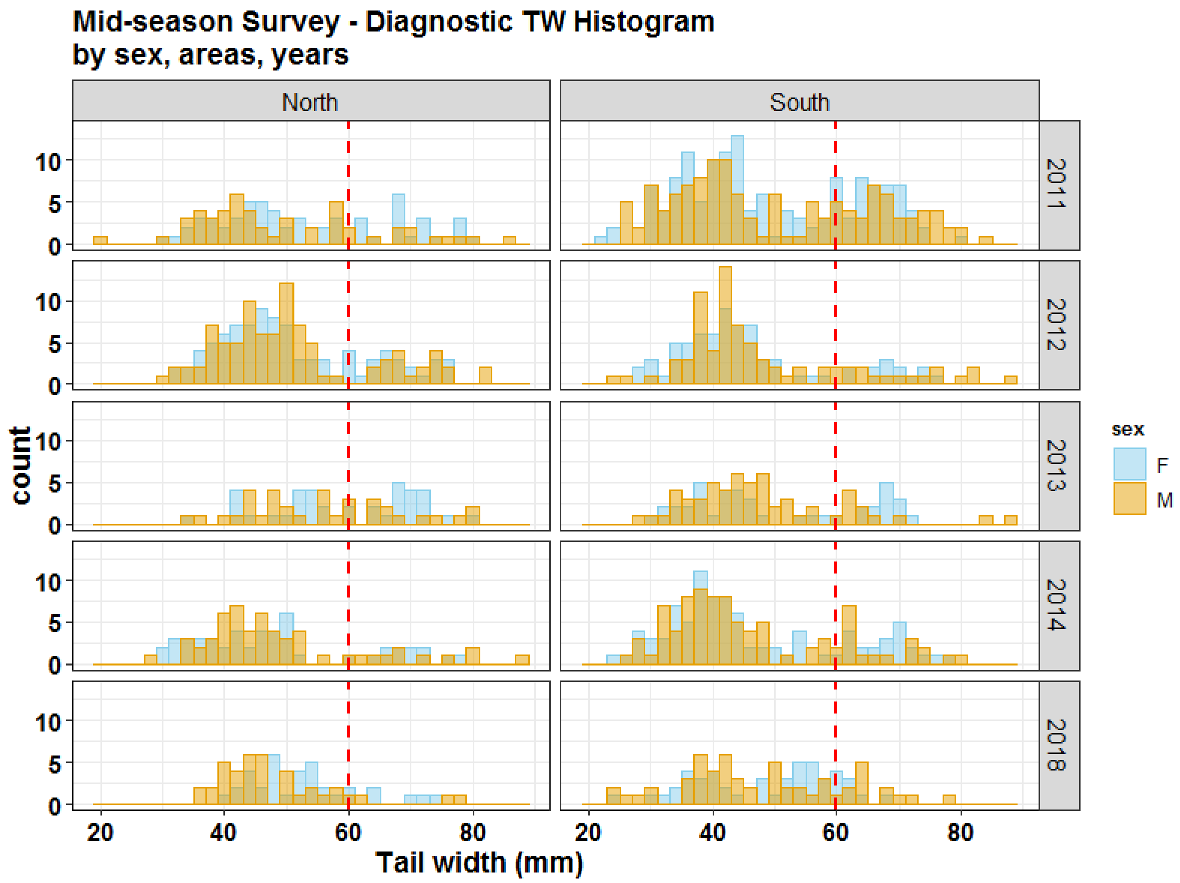


Figure A4. Mid-Season Survey - Histogram (counts) of TS rock lobster tail width (TW) by sex and areas (North and South), 2018 and recent years surveyed.

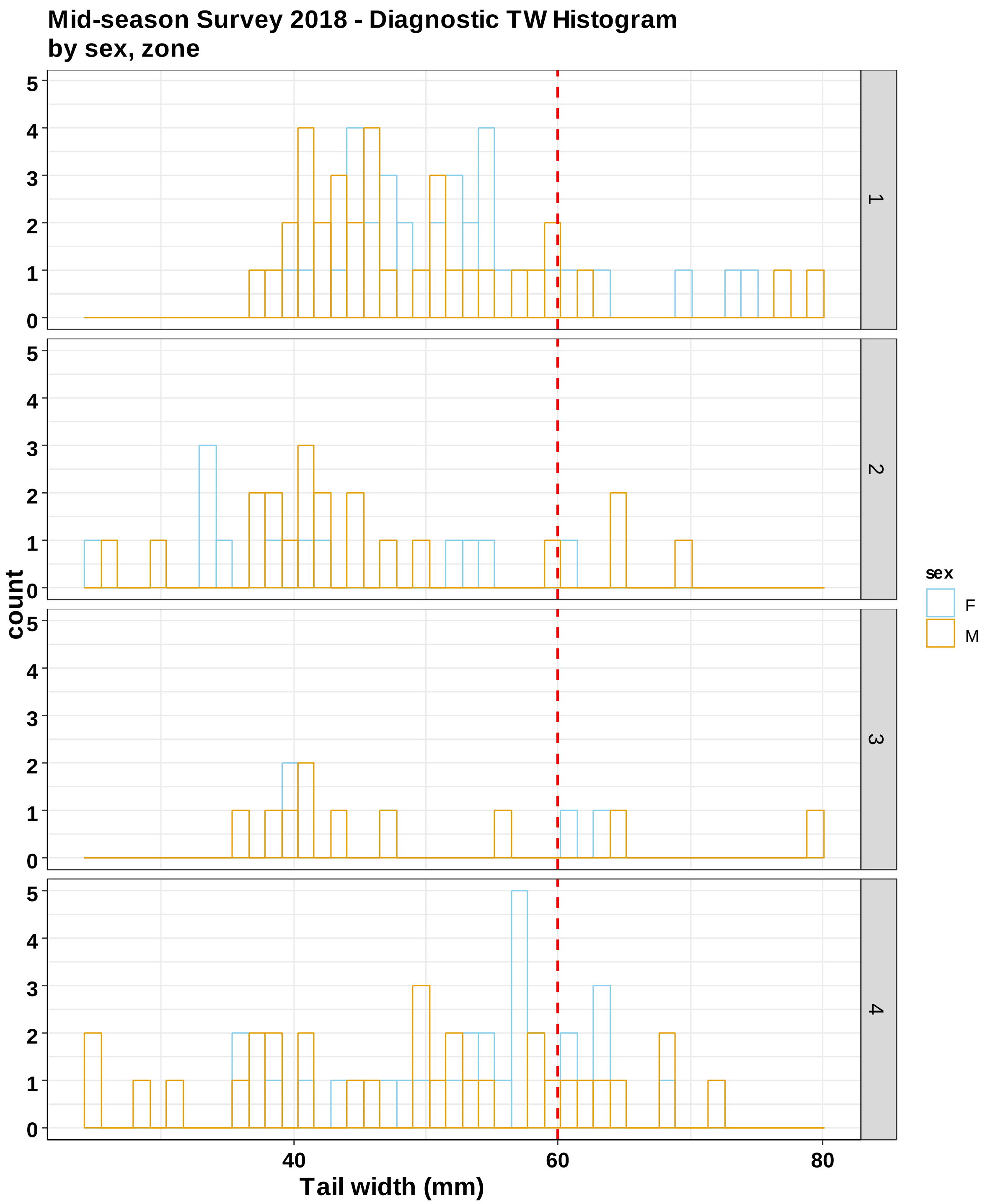


Figure A5. Mid-Season Survey 2018 - Histogram (counts) of TS rock lobster tail width (TW) by sex and zone). Zones: 1=North West, 2=South West, 3=Central, 4=South East.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
COMPARISON OF CPUE ANALYSES AGAINST RESULTS OF THE 2017 PRE-SEASON AND 2018 MID-YEAR SURVEYS	**Agenda Item 6** **For Discussion and Advice**

RECOMMENDATIONS

1. That the RAG, noting the comparison of commercial CPUE data analysis against results of the pre-season and mid-year surveys presented under Agenda Items 4 and 5, **DISCUSS** and **PROVIDE ADVICE** on the implications of these results for:
   a. logbook data and how we interpret CPUE data, including:
      i. how to best progress improvements to catch and effort data for the TRL Fishery, including discussions needed regarding historical fishing power changes (e.g. workshop with industry, or through other methods) (**Attachment 6a**);
   b. future survey design, including:
      i. any changes to be included in call for research for 2019/20-2021/22 survey and stock assessment project;
      ii. the use of industry vessels to conduct future surveys (**Attachment 6b**);
   c. the draft Harvest Strategy.
2. That the RAG **DISCUSS** and **PROVIDE ADVICE** on the costs/benefits of an independent review of the survey design, stock assessment and draft Harvest Strategy (**Attachments 6c and 6d**).

KEY ISSUES

3. On 20 August 2018, the TRLRAG Chair proposed an agenda to support a comprehensive discussion at this meeting on the survey and CPUE data and their use in stock assessments and harvest strategies (**Attachment 6e**). This is in response to both the impact that management of the fishery during the 2017/18 fishing season had on many stakeholders and concerns from some that the pre-season survey did not accurately reflect biomass this season.
4. The purpose of this agenda item is to inform the RAG discussion as suggested by the RAG Chair.

Implications for logbook data and how we interpret CPUE data

5. Noting the analyses and results presented under Agenda Items 4 and 5, members are invited to consider the implications of these results for logbook data and how CPUE data is interpreted. At the TRLRAG meeting held on 15 May 2018 (TRLRAG23), members discussed key areas for improvements to catch and effort data for the TRL Fishery.
6. The RAG recommended that the accuracy of catch and effort data for the TRL Fishery be improved as a matter of priority, with a particular focus on:
   a. improving the accuracy of the spatial information on catch and effort data (e.g. point of capture as opposed to point of anchoring or landing) and providing further guidance to fishers on how this data should be recorded;

b. developing a finer scale measure of effort for the TDB02 catch disposal record (CDR) (e.g. 'hours fished' as opposed to 'days fished') and providing further guidance to all fishers on how effort should be recorded in both the TDB02 CDR and TRL04 logbook (e.g. to include time spent travelling, searching and actively fishing);

c. developing a better understanding on changes in fishing behaviour and power over time (e.g. changes to the size of engines, use of GPS, gear, areas fished, time fished, experience of divers), to inform the standardisation of CPUE data. This should be done through close consultation with industry;

d. in the longer term, consider the inclusion of travelling time, searching time and fishing time as separate effort fields in the logbooks.

7. With regards to how to best progress these improvements, members are asked to advise the best means to do so e.g. workshop with industry, or through other methods. Further information is provided in (**Attachment 6a**).

Implications for future survey design (including potential use of industry vessels)

8. Noting the analyses and results presented under Agenda Items 4 and 5, members are invited to consider the implications of these results for the design of future surveys. For example, the mid-year survey included additional survey sites to reflect the recommendation from the RAG to ensure areas fished during the season were adequately represented in the sites sampled in the mid-year and future pre-season surveys.

9. The RAG is also invited to consider the use of industry vessels to conduct future surveys and advise of any considerations or issues that need to be addressed before this option is explored further (e.g. technical/scientific risks arising from the use of industry vessels).

10. Industry participation in research has many benefits, including the potential for improved management. Industry has shown interest in taking a greater role in the science underpinning the management of the TRL Fishery. At the same time exploring options for delivering cost-effective research has become increasingly important with changes to research funding levels and increasing research priorities of other Torres Strait fisheries.

11. At the TRLRAG meeting held on 15 May 2018 (TRLRAG23), members noted that industry could contribute to a mid-season survey and the broader science underpinning the management of the TRL Fishery in a number of ways. This could be through a commitment of funding, an in-kind contribution of vessels to support the conduct of surveys or the voluntary provision of additional data on catch and effort to support analyses on the dynamics of the stock and Fishery performance.

12. Further information on CSIRO requirements for vessels used to conduct TRL surveys is provided at **Attachment 6b** to assist industry in understanding what commitment is required.

13. The RAG (TRLRAG20) and TRL Working Group (TRLWG4) has previously considered how industry can contribute to the conduct of TRL Fishery surveys. Options explored have included:
    a. industry divers to participate in CSIRO run fishery-independent surveys on CSIRO chartered vessels - workplace insurance requirements make this option unviable at this time.
    b. CSIRO to sub-contract industry divers to complete certain survey components (e.g. select survey transects) – sub-contracting not permitted under current AFMA contracts with CSIRO.
    c. third party to run a dive survey independently from CSIRO – would require CSIRO to provide training and to audit this training to maintain a level of scientific integrity.

Implications for the draft Harvest Strategy

14. Noting the analyses and results presented under Agenda Items 4 and 5, members are invited to consider the implications of these results for the draft Harvest Strategy.

15. Decision rules are a component of harvest strategies. The draft Harvest Strategy for the TRL Fishery has decision rules designed to maintain the stock at (on average), or return to a target biomass reference point, maintain the stock above a limit biomass reference point and implement rebuilding strategies if the stock falls below the limit in two successive years.

16. There are a number of decision rule scenarios. Scenario 3 is when the eHCR assesses the stock to be below the limit, the eHCR is reviewed by stock assessment and determines the limit has not been breached. The eHCR limit is triggered if the pre-season survey 1+ abundance indices is 1.25 or lower (average number of 1+ age lobsters per survey transect). Under this scenario, the draft Harvest Strategy decision rule requires, among other actions, discussions to be held on preventative measures to reduce the risk of Fishery closure. Fishery closure relates to closing the Fishery to commercial fishing if the limit biomass reference point is breached in two successive years. The 2017 pre-season survey 1+ abundance indices was well above the 1.25 trigger (1.78).

17. If the Fishery is closed to commercial fishing (Scenario 4), the draft Harvest Strategy decision rule is for the Fishery to remain closed until an assessment update confirms that the stock has recovered to above the limit. Discussions are to be held on future management arrangements, fishery independent surveys (both mid-year and pre-season) are required on an annual basis and the eHCR must be revised.

Independent review

18. Peer review, both that done by RAGs and externally, is an essential element in the fisheries management process. It is necessary to ensure rigour in the methodology applied to stock assessments and to other research and scientific information to engender confidence in the subsequent management decisions. RAGs should view external, independent peer review as a facility available to them for validating the science.

19. Peer review may cover the range and quality of data collected; the methodology of analysis and modelling; and the conclusions drawn and reported. The most appropriate form of review should be chosen to be cost-effective and appropriate to the information under review. Further information on different options for peer review and consideration for the design and conduct is provided at **Attachment 6c**.

20. This is drawn from detailed guidance for conducting effective peer review processes provided in *Guidelines for quality assurance of Australian fisheries research and science information* (the Guidelines) provided at **Attachment 6d**. Drawing on these Guidelines, AFMA is developing a policy to ensure the quality and integrity of research and scientific information used to inform AFMA’s fisheries management and policy decision making processes.

Key areas for improvements to catch and effort data for the TRL Fishery - identified at TRLRAG23

Issue	TRLRAG23 discussion and advice	Possible action
Spatial structure	At TRLRAG23, industry members advised that catches attributed to the Badu and Thursday Island areas are likely to be overstated, as fishers are reluctant to disclose the areas in which they have fished and may instead nominate the area the lobsters are being landed - catches are more likely coming from the Mabuiag and Northern areas. Dr Campbell agreed that this is a credible conclusion given anecdotal reports do not appear to align spatially with the catch and effort data. With regards to the TVH sector, the TRL04 logbook limits the reporting of catch and effort to a single location. Given this, the location the primary boat is anchored is generally recorded, not the location where tenders are actually fishing (which can range as far as 20 nm from the primary boat).	Amend the TDB02 CDR and TRL04 logbook to prvide for the point of capture to be recorded as opposed to the point of anchoring or landing. Provide further guidance to fishers on how this data should be recorded in the TDB02 CDR and TRL04 logbook. Deploy observers/VMS on all boats.
Measure of effort	At TRLRAG23, members agreed that the 'days fished' measure used in the TDB02 CDR is a crude measure of effort and may not include travel or searching time nor indicate what portion of the day was spent actively fishing. Industry members advised it is common practice for fishers to round-up to whole days. Further, the 'hours fished' measure used in the TRL04 logbook is being reported inconsistently across fishers (e.g. hours the tender spends away from the	Consider benefits of a finer scale measure of effort for the TDB02 CDR (e.g. 'hours fished' as opposed to 'days fished') and amend the TDB02 CDR as appropriate. In the longer term, consider the inclusion of travelling time, searching time and fishing time as separate effort fields in the TDB02 CDR and TRL04 logbook. Provide further guidance to all fishers on how effort should be recorded in both the TDB02 CDR and TRL04 logbook (e.g. to include time

	boat, hours divers are in the water).	spent travelling, searching and actively fishing).
CPUE	At TRLRAG23, members agreed that there is a need to better standardise the CPUE data. Standardisation of CPUE data involves making adjustments to the data to take into account factors other than stock abundance that may influence catch rates. An important one of these factors is changes in fishing behaviour and fishing power over time. These changes can otherwise confound results by overestimating CPUE and by inference stock abundance. This "effort creep" includes changes to the size of engines, use of GPS, gear, areas fished, time fished and experience of divers. Current CPUE data may also be confounded by a hyperstability effect, seen when fishers remain on fishing "hotspots" or move from one hotspot to another – thereby maintaining high catch rates that don't represent the population size of the entire stock. Industry members and observers acknowledged the best way to understand effort creep is to talk to the fishers themselves.	Through discussions with industry, possibly a workshop, develop a better understanding on changes in fishing behaviour and power over time (e.g. changes to the size of engines, use of GPS, gear, areas fished, time fished, experience of divers), to inform the standardisation of CPUE data.
Voluntary fields	At TRLRAG23, members noted that given constraints under the *Torres Strait Fisheries Act 1984* (the Act), some data fields on the TDB02 CDR are voluntary and as such often left uncompleted. This creates problems in providing a complete analysis of the data for the TIB sector and it is recommended that all fields be made mandatory. The AFMA member advised that amendments to the Act are being progressed to provide	Amend the Act to provide the capacity to require all licence holders to complete TRL04 logbooks.

	the capacity to require all licence holders to complete logbooks, but that this process is lengthy one and these amendments are a number of years off.	
Length frequency	At TRLRAG23, members noted that the length frequency data is currently provided by MG Kailis. The RAG agreed this data is of high value and has been particularly useful this season in informing analyses on the performance of the Fishery. However, there is a longer term need to collect representative length frequency data from across the Fishery.	To be discussed.

CSIRO requirements for vessels used to conduct TRL surveys

Vessel availability
- Vessel must be available for the dates specified for the pre-season survey - Vessel availability must be confirmed by mid-September to provide for arrangement of logistics
Role of the vessel and crew
- To transport the CSIRO dive team, comprising four persons, to approximately 80 dive sites in the Torres Strait - To accommodate and feed the CSIRO dive team, comprising four persons, for the survey period - To assist the CSIRO dive team, comprising four persons, with transfer to and from CSIRO dive tender and primary vessel - To assist with the refuelling of the CSIRO dive tender and hookah compressor - To fill dive tanks when required - To administer oxygen therapy if required
Vessel certification
- Compliance with NSCV Standards and have Certificate of Operation
Vessel capacity
- Capacity to stow away approximately 2 cubic meters of survey equipment (wt 300kg) - Capacity to stow on board the CSIRO 5m Airib inflatable (wt 450kg)
Vessel inclusions
- Mobilisation/demobilisation to and from Horn Island, Torres Strait - Master and Deckhand/Cook, all meals, linen for CSIRO dive team, comprising four persons - Unleaded fuel (400L of fuel - 340L for CSIRO dive tender outboard and 60L for hookah compressor) and 10L 2 stroke outboard oil - Dive compressor with recent air test certificate (within 3 months) - 4 dive tanks with A-clamp fittings in test - 20 dive weights - F size Oxygen tank for therapy in case of medical emergency

Options for peer review and considerations for design and conduct

1. The following is drawn from detailed guidance for conducting effective peer review processes provided in *Guidelines for quality assurance of Australian fisheries research and science information* (the Guidelines) provided at **Attachment 6d**.

2. As defined in the Guidelines, peer review is a process of evaluation of research or scientific information by one or more experts in the appropriate field, either with similar competence or in the same occupation, profession or industry to the producers of the work. Peer review methods are employed to ensure that the work meets appropriate or applicable standards of quality. Peer review usually emphasises the importance of independence of the reviewers in order to obtain an unbiased evaluation, recognising that a larger and more diverse group of people will usually find more weaknesses and errors in research, and will make a more impartial evaluation of it, than the person or group responsible for that research. There are many options for conducting effective peer review, depending on the novelty and complexity of information.

Options for peer review

3. Peer review may be conducted in a range of ways and at different stages. Forms of peer review include:

    a. Scientific Working Groups – this form of peer review is most suited for where there is a requirement for regular and timely review and provision of scientific advice. It is a role of the PZJA RAGs to peer review stock assessments and other research and scientific information. On occasion, AFMA has also formed Scientific Panels, the main function of which is to peer review scientific and economic data and information for a specific stock/fishery.

    b. Review by individual scientist(s) - if a research project is relatively uncomplicated or simply an update of previous work, or has already been peer reviewed elsewhere, peer review of the final research report by one or more qualified scientists with the appropriate expertise may be adequate.

    c. Specialist Technical Review Workshops – are more appropriate where the questions to be addressed, and the information to be reviewed, relate less to providing immediate science advice for fisheries management decisions, and more to reviewing novel, complex, or contentious research approaches in order to provide technical guidance to future peer review processes.

    d. Independent Expert Peer Review – may be required where the research is novel, complex, or contentious; when there are strong conflicts of interest relating to potential impacts of fisheries management decisions on organisations, industries or groups with whom some participants in regular peer review processes are affiliated; or where attempts at peer review using existing committees or panels have resulted in adversarial debate and irreconcilable opposing views.

Considerations for design and conduct

4. The Guidelines provide that peer review should be designed and conducted to meet the following criteria described below:

    a. Independence and Expertise - peer reviews should be conducted by experts who: were not responsible for conducting the research and analyses under review; have the appropriate expertise and experience to review the research and scientific information and analyses concerned; and are able to provide an impartial and objective review.

    b. Balance of Expertise - where peer review is to be conducted by a panel, committee or advisory group, these groups should incorporate an appropriate range and variety of scientific expertise relevant to review of the information concerned.

c. Inclusiveness – where relevant and useful to the interpretation and objective evaluation of the information under review, seafood industry and other stakeholders with knowledge and experience can be included in peer review processes, provided potential conflicts of interest are identified and managed.

d. Transparency and Openness – To facilitate trust and credibility of research and scientific information, science processes should be transparent and open to public scrutiny.

e. Timeliness

f. Impartiality and Management of Conflicts of Interest – Actual or potential conflicts of interest must be identified and actively managed so that the impartiality of the peer review processes is not called into question.

g. Reporting of Uncertainty and Risk – Research reports should identify and explain known or likely sources of uncertainty, evaluate levels of uncertainty in results, and assess the relevant risks that arise as a result of those uncertainties.

5. The degree to which each criterion can be met will differ for alternative forms of peer review. Trade-offs may be required, for example, between the independence of peer reviewers and the inclusiveness of stakeholder representatives with expert knowledge; or between the need for timely research and scientific information and the time required to conduct additional independent expert peer review.

Research and Science Information Guidelines for Australian Fisheries

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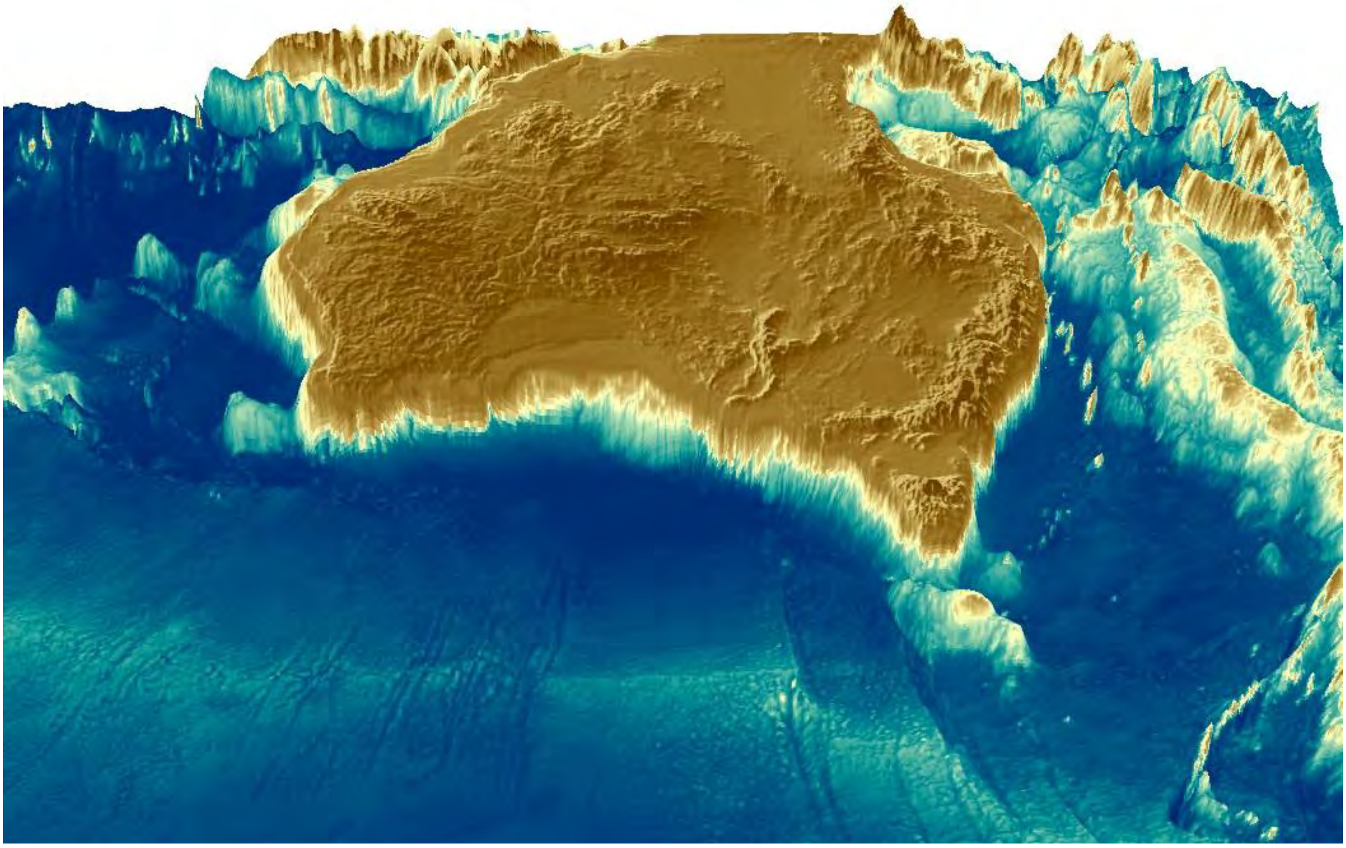

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In submitting this report, the researcher has agreed to FRDC publishing this material in its edited form.

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Figure 2. Decision tree to guide decisions regarding the stages and forms of peer review that should be applied to scientific research of increasing complexity and expected influence. 11

1. Research and Science Information Guidelines for Australian Fisheries

1.1. Purpose

Fisheries research and scientific information is used to inform and underpin fisheries management decisions and the formulation of fisheries and fisheries-related environmental policy.[1] Government Ministers and decision-makers, stakeholders and the public need to have confidence and trust in the research and scientific information used to inform fisheries management decisions. To help achieve this, key principles for ensuring quality of science need to be adhered to, and effective science quality assurance processes need to be put in place, to:

- ensure the quality and integrity of research and scientific information, irrespective of the source of that information;
- require research providers, relevant advisory committees and advisory processes to meet sufficient Guidelines for ensuring the quality of scientific information; and
- ensure that peer review processes, the primary mechanism for ensuring the quality of scientific information, are cost-effective and efficient.

These Guidelines provide guidance as to what constitutes high quality and reliable scientific information, and on best practice in relation to the quality assurance of research and scientific information intended or likely to inform management decisions for wild capture fisheries, regardless of the source of that information. The Guidelines set out key principles for research and scientific information quality, identify key responsibilities, and describe requirements for peer review processes, evaluation of scientific information quality, storage and management of data and documentation and communication of science results. The footnotes and the definitions of terms contained in Appendix A are an integral part of these Guidelines and must be read in conjunction with the Guidelines. The components and inter-relationships of the Guidelines are shown in Figure 1.

1.1.1. Scope

These Guidelines are intended to apply to all research and scientific information intended or likely to inform management decisions relating to wild capture fisheries and their impact on the marine environment. Scientific methods strive to produce objective and reliable information, and document how that information has been derived, such that the results can be validated and checked for reproducibility.

Scientific methods and quality assurance processes can be applied to any research project. Much of the research and scientific information used to inform fisheries management decisions relates to fisheries characterisations, biological studies, stock assessments, resource abundance surveys and evaluations of fishery impacts on associated or dependent species. Other disciplines using scientific methods also produce information that is used in fisheries management decisions, including broader ecosystem, social science and economic studies. The principles and quality assurance processes in these Guidelines can be applied to any such information, if derived using scientific methods.

[1] Scientific information: means any knowledge, facts or data that have been generated, tested and verified using scientific methods. Scientific information includes, but is not limited to, factual input, data, models, analyses, technical information, or scientific assessments, whether conveyed through data compiled directly from surveys or sampling programmes, or through statistical analyses and models that are mathematical representations of reality constructed using primary data. In the context of these Guidelines, relevant fields of research and science include, but are not limited to biology, ecology, oceanography, economics and sociology.

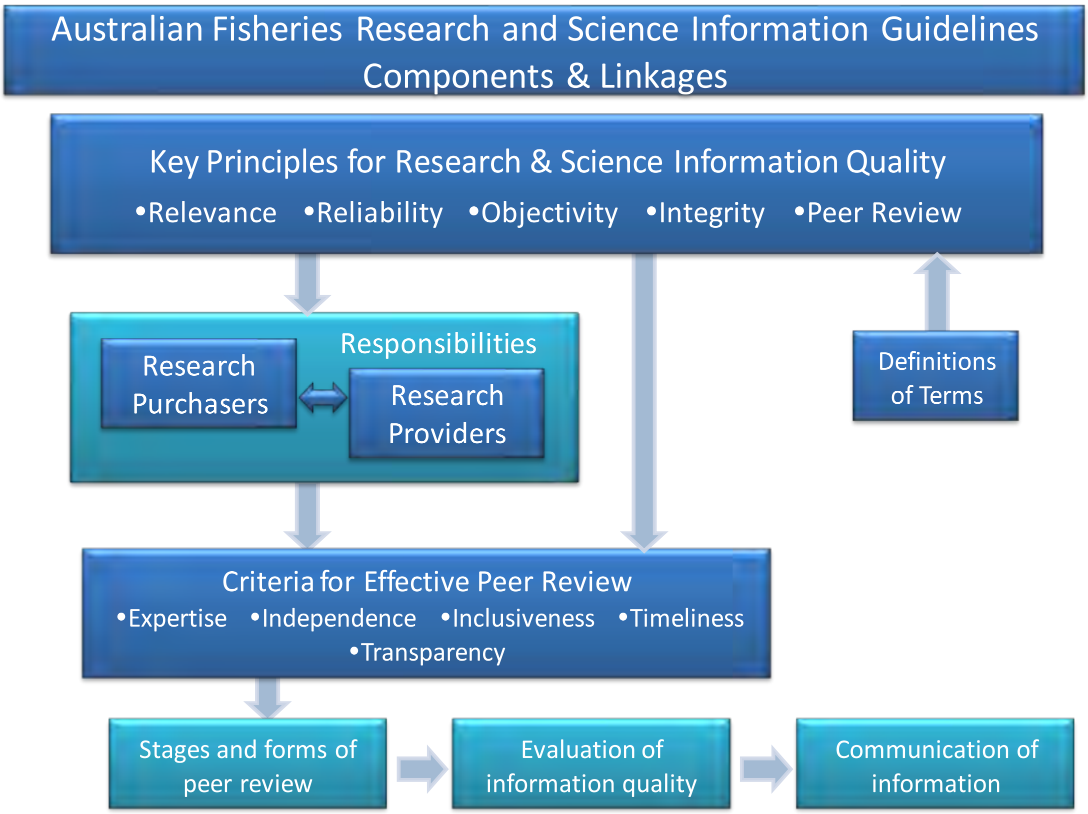

Figure 1. Components of the *Research and Science Information Guidelines for Australian Fisheries* showing linkages between components.

The provisions of these Guidelines are intended to be applicable to:

- Fisheries research projects contracted or conducted by research purchasers and/or providers such as the Fisheries Research and Development Corporation (FRDC), Australian Fisheries Management Authority (AFMA) and Commonwealth or State government departments purchasing or providing research intended or likely to inform fisheries management decisions relating to wild capture fisheries and their impact on the marine environment.
- Fisheries research projects conducted or contracted by the seafood industry or other stakeholder organisations as part of established research programmes intended to inform fisheries management decisions relating to wild capture fisheries and their impact on the marine environment.
- Any other research conducted or contracted by other organisations, if that research is intended or likely to inform fisheries management decisions relating to wild capture fisheries and their impact on the marine environment.

1.1.2. Application

The provisions of these Guidelines are intended to apply to all stages of the research process, including aspects of research planning processes related to evaluating the relevance of proposed research and the appropriateness of proposed methodology, to ensure the reliability and objectivity of resulting scientific information. Processes related to how research and scientific information is subsequently combined at policy or management level with other sources of information to inform fisheries management decisions, are not within scope of these Guidelines.

The Guidelines are not intended to apply to subjective information such as anecdotal information, opinions and impressions of individuals, or observations for which there are no quantifiable data or verifiable evidence beyond their testimony. Such information does not meet the definition of scientific information and cannot be objectively evaluated against the principles in these Guidelines. Decision-makers may nonetheless take such information into account, and it may provide important context against which to review the potential impact of alternative fisheries management decisions.

Depending on the extent to which research projects fall directly or indirectly under the control of the FRDC or government departments, different classes of research projects may be subject to the provisions of these Guidelines in different ways:

i. There will be an expectation that all relevant research provided to the FRDC will meet the requirements of these Guidelines. Such requirements will be incorporated into research contracts issued by the FRDC.

ii. For other research projects conducted under fisheries research programmes and intended to inform fisheries management decisions, research purchasers and/or providers should ensure that the Guidelines are applied.

iii. For research projects not covered by the above two categories, and that have not been subject to the requirements of these Guidelines during the research process, research purchasers and users should determine how to assess their quality on a case-by-case basis. Such research may include:
    - Research emanating from other government agencies or other organisations such as regional fisheries management organisations;
    - Industry-purchased research conducted outside of established research programmes; or
    - Other research including academic studies not originally intended to inform fisheries management decisions, but which is subsequently considered to be useful for that purpose.

There are several reasons why information might not be required to undergo further quality assurance and peer review before being used in fisheries management decisions:

- The information may already have been subjected to adequate peer review considered to be compatible with the provisions of these Guidelines. This may include peer review associated with publication in scientific journals or other formal scientific publications. It must nonetheless be determined that that such peer review meets the requirements of these Guidelines for scientific information intended to inform fisheries management decisions.
- The information may not be particularly influential on the fisheries management decision concerned, or it may be supported by other reliable information, such that the time and cost of further peer review is not justified.
- The information may emanate from a usually reliable source, or already been subject to some degree of peer review, and time constraints may require the information to be used to inform an important fisheries management decision before further peer review can be conducted. Under such circumstances, the risks associated with using such information without further peer review should be acknowledged and communicated.

Where there is uncertainty regarding the adequacy of previous peer review processes, or uncertainty as to the quality of the information, such that the information is determined to require further peer review, research purchasers or users should specify and arrange for the necessary additional peer review. Where such information has been subjected to comparable quality assurance processes outside of these Guidelines, the information may be determined by scientific reviewers, scientific working groups, peer review panels or other appropriate peer review processes as meeting the quality requirements for research and scientific information under these Guidelines, as a result of such previous review.

1.2. Key Principles for Scientific Information Quality

The quality of research and scientific information relates primarily to relevance, reliability, objectivity and integrity. The primary, internationally-accepted mechanism for evaluating the quality of research and scientific information is peer review. These key principles should underpin all quality assurance processes for research and scientific information.

Relevance – research and scientific information must be relevant to the fisheries management objectives and associated key questions for the fishery concerned, contributing directly to answering those questions and addressing management objectives for that fishery. Whether information is likely to be relevant to a fisheries management objective or question should be determined and documented as part of the peer review of research proposals.

Reliability – relates to the accuracy and reproducibility of information. Research and scientific information must be accurate, reflecting the true value of the results being reported, within an acceptable level of precision or uncertainty appropriate to the data and analytical methods used. Information should not be statistically biased or suffer from such a high level of imprecision that the results and conclusions are rendered unreliable. Methods and models used to produce scientific information must be verified and validated to the extent necessary to demonstrate that results may be reliably reproduced by an independent scientific expert using the same data and analytical methods.

Objectivity – refers to whether the information presented is impartial and free from personal bias. Objective interpretations or conclusions do not depend upon the personal assumptions, prejudices, viewpoints or values of the person presenting or reviewing the information.

Integrity – refers to the security of information, and to the protection of information from inappropriate alteration, selective interpretation or selective presentation, including with regard to uncertainty in that information. Scientific information should remain complete throughout the science-to-decision process. It must be ensured that the information and associated uncertainty is not selectively reported in a way that introduces bias into the interpretation of such information. Where such information is required to be summarised for the purposes of reporting, such summary should not be biased with respect to the complete information.

Peer Review - is a process of evaluation of research or scientific information by one or more experts in the appropriate field, either with similar competence or in the same occupation, profession or industry to the producers of the work. Peer review methods are employed to ensure that the work meets appropriate or applicable standards of quality. Peer review usually emphasises the importance of independence of the reviewers in order to obtain an unbiased evaluation, recognising that a larger and more diverse group of people will usually find more weaknesses and errors in research, and will make a more impartial evaluation of it, than the person or group responsible for that research. There are many options for conducting effective peer review, depending on the novelty and complexity of information.

1.3. Responsibilities for Scientific Quality Assurance

Implementation of scientific quality assurance practices to meet the requirements of these Guidelines will primarily be the responsibility of those who contract, purchase or otherwise require research to be conducted ('Research Purchasers'), and those who subsequently conduct and supply the contracted research ('Research Providers'). These roles may resort under a single organisation or entity that both contracts and conducts research, or may resort under separate research contracting and research conducting organisations. The responsibilities outlined below relate to the respective components of the process, irrespective of whether these resort under single or multiple organisations.

1.3.1. Responsibilities: Research Purchasers

All purchasers of research and scientific information that is intended or likely to inform management decisions for wild capture fisheries and their impact on the marine environment should implement processes and procedures to ensure that the provisions and requirements of these Guidelines are implemented and adhered to. Research purchasers should:

- Establish, maintain or support appropriate quality assurance and peer review processes, and ensure that research and scientific information is subjected to effective peer review against the provisions of these Guidelines.
- Ensure that research proposals are evaluated against the requirements for research and scientific information quality established by these Guidelines relating to relevance, project design and proposed methodology.
- Where necessary to ensure the quality of scientific information produced by substantial or complex projects, provide for staged technical guidance or peer review at appropriate stages in the project, ensuring that such peer review is appropriate to the cost, novelty, complexity, or contentiousness of research and scientific information.
- Ensure that research providers comply with relevant provisions of these Guidelines, including requirements relating to scientific expertise, data management procedures, project management and research quality assurance systems.
- Establish, maintain or support, or require research providers to establish, maintain or support, databases to manage and securely store any required raw data sets and relevant final data sets, analyses and research reports emanating from relevant research projects, to enable subsequent verification of the repeatability and reliability of the results.
- Ensure that the quality of research and scientific information provided to decision-makers is evaluated against the key principles for scientific quality in these Guidelines, and that the integrity of research and scientific information provided to decision-makers is protected.

1.3.2. Responsibilities: Research Providers

Research providers providing research and scientific information intended or likely to inform management decisions for wild capture fisheries and their impact on the marine environment should meet requirements relating to the following aspects of the research process:

Qualifications and Capabilities

- Research should be conducted by reputable research providers and designed, overseen and conducted by research staff with appropriate science qualifications and expertise.

Project Management and Quality Management

- Research providers should demonstrate that they implement and maintain effective in-house project management, research quality assurance and data management systems. Research project leaders are to be designated to be responsible for project management and quality assurance.

Data Management and Provision

- Research providers are to establish and routinely follow effective data management and data processing procedures, to ensure the accuracy and integrity of research data. Such systems should include processes for error checking, data validation, data-filtering and error correction. Research data are to be stored in appropriately designed databases with adequate cataloguing, documentation and metadata. Data backup and disaster recovery systems are to be implemented and maintained.
- Subject to any applicable confidentiality and privacy requirements, relevant datasets and analyses associated with research and scientific information intended or likely to inform management decisions for wild capture fisheries and their impact on the marine environment should be made available, if required, for independent peer review and possible validation or re-analysis. Where relevant, the computer code developed to analyse data should also be made available.

Certification of Laboratories and Equipment

Where research will involve laboratory analyses or the use of equipment that requires calibration or operation in accordance with applicable technical protocols, research providers will be required to:

- Demonstrate that laboratories meet any applicable certification requirements, where required.
- Demonstrate that all equipment has been calibrated and certified in accordance with applicable technical protocols for the equipment concerned.
- Maintain the equipment according to manufacturer's instructions or specifications.

Data Collection

- Data should be collected according to documented procedures and in a manner that reflects Guidelines or best practices generally accepted by the relevant science and technical communities. Data and information sources should be identified.
- Data collection methods, systems, instruments and statistical sampling designs must meet the requirements and objectives of the research projects concerned, and should be validated before use. Instruments used to collect data should be calibrated using applicable standards or fundamental engineering and scientific methods.
- Data should undergo quality assurance and any necessary data filtering and error correction prior to being used. Data filtering and error correction processes should be documented and the error-corrected data should be securely stored in a database.

Data Analysis and Synthesis

- Routine data analyses should be conducted using methods that are documented in published methods manuals or agreed technical protocols, or methods otherwise published and generally accepted by the relevant science and technical communities.
- Routine analytical methods, including statistical procedures, models and other analytical tools and resulting analyses, should be periodically reviewed by suitably qualified internal and/or external experts to ensure their validity.
- Analyses that are novel, complex or contentious should be submitted for appropriate peer review, and reviewed by appropriately qualified independent experts.
- Analytical methods used should be documented, particularly where new methods are developed, and information on methods used should be included when analyses are disseminated. Details of analytical methods used should be included in final research reports.
- Data requirements and assumptions associated with any statistical or analytical model used should be appropriate to the resolution and accuracy of the available primary data.

Experimental Studies

- The theory and details of experimental designs and methods should be documented, including details of assumptions made, hypotheses established or tested, experimental design, experimental data and results, analytical methods and the statistical procedures employed.
- Novel, complex or contentious experimental studies should be peer reviewed by appropriate independent experts. For such experimental studies, results of any initial experimental trials conducted should be subject to staged technical guidance prior to conducting subsequent stages in the study.
- Where it is intended that new experimental methods and approaches should move towards regular or production use, such approaches should be subjected to rigorous scientific peer review before being transferred into general research use.

Technical Protocols

- Research provider organisations should implement and follow any established or adopted technical protocols and established best practices relevant to the research field(s) concerned.
- Where research tools, techniques, methods or processes represent a significant development, advance, innovation or improvement in the research approach used, technical protocols should be drawn up that describe the tools, techniques and processes used. Such protocols should be subjected to independent scientific peer review.

Internal and External Peer Review

- Research providers should implement appropriate internal or external quality assurance and peer review processes relevant to each of the above requirements, including the production of final research reports.
- Research providers may also be required to submit data, analyses, results, conclusions and reports intended or likely to inform fisheries management decisions to external peer review processes specified by research purchasers, as or when requested to do so. Depending on the cost, size and complexity of the research project, this may require submission of project proposals, initial data, interim analyses and results, and final results and conclusions to several stages of technical guidance and peer review.

Research Reports

- All research projects should be written up in a format appropriate to the intended use of such information. Subject to applicable confidentiality arrangements, such reports should be made publically available. Where the research represents a significant advance in the research field concerned, research providers are encouraged to write up and submit the results to an appropriate peer reviewed science journal.

1.4. Criteria for Effective Peer Review

Peer review is the accepted and most reliable process for assessment of the quality of research and scientific information. Peer review processes designed to ensure that research and scientific information meets the key principles for scientific information quality specified in these Guidelines should be established and implemented for all research and scientific information that is intended or likely to inform management decisions for wild capture fisheries and their impact on the marine environment. Peer review may be conducted using a range of alternative processes, and at various stages, depending on the complexity, novelty, contentiousness or likely influence of the scientific information.

1.4.1. Peer Review Criteria

Irrespective of the chosen process, peer review should be designed and conducted to meet the criteria described below, as appropriate to the relevance and expected influence of the research and scientific information concerned. The degree to which each criterion can be met will differ for alternative forms of peer review. Trade-offs may be required, for example, between the independence of peer reviewers and the inclusiveness of stakeholder representatives with expert knowledge; or between the need for timely research and scientific information and the time required to conduct additional independent expert peer review.

Independence and Expertise – One of the prerequisites for trust and credibility of research and scientific information is that it must be seen as being provided by impartial processes that operate independently of politics, financial interests and advocacy. Peer reviews should be conducted by science experts who:

- were not responsible for conducting the research and analyses under review;

  - have the appropriate expertise and experience to review the research and scientific information and analyses concerned; and
  - are able to provide an impartial and objective review.

- Peer reviewers should primarily be selected on the basis of scientific expertise and experience relevant to the disciplines and subject matter to be reviewed.
- Participants in peer review processes are expected to act in an independent and expert manner during peer review processes. They should not act as advocates for any interest group, and are expected to step aside from their sector affiliations and participate as expert individuals primarily interested in producing objective, unbiased science.
- For peer review of research projects that are novel, complex, or contentious, a greater degree of independence may be necessary to ensure objectivity and credibility of the peer review process. In such cases, reviewers should not be affiliated or associated with affected stakeholder groups, or with the research providers involved in the research under review.
- Peer review processes should be designed and conducted in ways that are not adversarial, but participants should be prepared to have their contributions challenged in constructive ways.
- Intentional involvement of interested stakeholders with relevant knowledge or experience can be beneficial to increasing trust and acceptance of research results. In this case, potential conflicts of interest must be identified and managed during peer review processes to ensure that they do not result in bias in the information and conclusions.

<u>Balance of Expertise</u> – Where peer review is to be conducted by a panel, committee or advisory group, these groups should incorporate an appropriate range and variety of scientific expertise relevant to review of the information concerned.

- Selection of scientific experts should match the nature of the information under review and the level of technical expertise required, be sufficiently diverse to represent the range of scientific and technical fields of knowledge under review, and be sufficiently balanced to reflect the potential diversity of opinion amongst experts.
- In the context of peer review participation, the term ‘balance’ does not refer to balancing of stakeholder or political interests, but rather to diverse representation of alternative scientific perspectives and intellectual views.

<u>Inclusiveness</u> – Where relevant and useful to the interpretation and objective evaluation of the information under review, seafood industry and other stakeholders with knowledge and experience can be included in peer review processes.

- Provided potential conflicts of interest are identified and managed, the presence of stakeholder representatives at peer review meetings can facilitate transparency and openness without compromising objectivity. Constraints on stakeholder representatives or observers may include not participating in the scientific evaluation of information, analyses and conclusions, or not contributing to the achievement of consensus regarding scientific conclusions.
- The knowledge and expertise of representatives from the different stakeholder or interest groups that is used to inform the scientific debate should be identified as such when reflected in the scientific reports and advice provided.

<u>Transparency and Openness</u> – To facilitate trust and credibility of research and scientific information, science processes should be transparent and open to public scrutiny, particularly regarding the peer review processes followed, the results of peer review, and when reporting information.

- Subject to relevant confidentiality requirements and privacy legislation, the public should have access to all final research reports. results and conclusions.

- Such reports should provide adequate detail on data collection, analysis and modelling methods, results, conclusions and scientific advice, to facilitate understanding and trust in the scientific research being reported.
- The integrity of research and scientific information must be protected when making the information available to ensure that such information is not inappropriately altered, selectively presented or selectively interpreted.

Timeliness – Practical and efficient fisheries management decisions often require rapid review and provision of research and scientific information to fisheries managers.

- Science quality assurance processes need to be efficient, balancing the need to maximise the quality of research and scientific information with the requirement for cost-effectiveness and timely provision of information. Peer review processes should be appropriate to the requirements, particularly for research that follows established and well-tested methodology.
- The need for timeliness of research and scientific information can mean that preliminary results of scientific research or monitoring programmes may need to be presented before the study is complete, or before rigorous peer review can occur. Uncertainties and risks that arise from interim results, or from insufficient time to subject the information to independent peer review, should be acknowledged and communicated.

Impartiality and Management of Conflicts of Interest – Conflicts of interest arise when there is a divergence between the individual interests of a person and their role in a peer review process. Such conflicts can impair, or be perceived to impair, the participant's objectivity and impartiality in peer review processes, and contribute to bias in scientific conclusions or advice. Actual or potential conflicts of interest must be identified and actively managed so that the impartiality of the peer review processes is not called into question.

- Conflicts of interest may include, but are not limited to:
  - personal financial interests and investments;
  - employer affiliations;
  - consulting arrangements;
  - grants or contracts held by, or anticipated by, an individual or research provider; or
  - commercial or personal relationships with others who have material interests in related businesses or stakeholder organisations.
- Peer reviewers should not have conflicts of interest that may seriously constrain their ability to provide impartial, objective advice. In particular, Chairs of peer review working groups, workshops, or panels must be impartial, and should not have any direct affiliation with research providers whose research is being reviewed, or with seafood industry or other stakeholder groups that may be affected by management decisions based on the research and scientific information under review.
- While the existence of conflicts of interest need not preclude participation in peer review processes, all actual and potential conflicts of interest need to be identified and managed.
- Were peer review is to be conducted by a panel, management of conflicts of interest should primarily be the responsibility of the Chair of the peer review working group, workshop, or panel concerned. Procedural rules should be established for ensuring that conflicts of interest do not jeopardise the objectivity of the peer review process.
- Terms of Reference for peer review processes should include requirements for declaring and managing conflicts of interest. Participants should be required to:
  - declare all interests relating to any of the scientific research under review;
  - endeavour to provide their expert advice impartially, free from any undue influence by the seafood industry, fisheries managers, stakeholder organisations or other interest groups;
  - declare any actual or potential conflicts of interest that arise during discussion of the research, scientific information or resulting scientific advice; and

- work with the Chair of the peer review processes to manage any actual or potential conflicts of interest that arise.

Reporting of Uncertainty and Risk – Peer review processes must ensure that presentation of research and scientific information includes the appropriate evaluation and reporting of uncertainty and risk. Research reports should identify and explain known or likely sources of uncertainty, evaluate levels of uncertainty in results, and assess the relevant risks that arise as a result of those uncertainties.

- Stock assessments, environmental assessments, risk assessments and other research and scientific information products should describe data collection methods, state major assumptions, report sources and ranges of uncertainty or statistical error of analytical models, evaluate data limitations and, where appropriate, identify studies or analyses that could assist in reducing those uncertainties.
- Scientific conclusions must be appropriate to the reported evaluation of uncertainty. Attention must be paid to not over-emphasising or under-emphasising uncertainties in the information or analyses presented.

Staged Technical Guidance – The more costly, novel, complex, or contentious that research and scientific information is, the more rigorous and robust the science quality assurance requirements need to be. Irrespective of the peer review process used, early engagement of peer reviewers in the research process will enable technical problems to be identified, prevent wastage of resources on invalid or suboptimal methods, and improve the quality and reliability of results. This is best achieved by staged technical guidance.

Particularly where research projects are costly, novel, complex, or contentious, peer review and technical guidance should be conducted at the following stages in the research process (Figure 2):

- Review of the research project design to evaluate whether the proposed research methods are appropriate, and whether key fisheries management questions will be answered and research objectives will be met;
- Evaluation of the quality, representativeness and adequacy of data generated by the project, and consideration of the most appropriate analytical methods to use for those data;
- Review of the analyses, results, conclusions, summary documents and final research reports, including evaluation of the uncertainties of the research results and the associated risks for fisheries management.

1.4.2. Stages and Forms of Peer Review

There are many options for conducting effective peer review and the most appropriate form of review should be chosen to be cost-effective and appropriate to the information under review. The choice depends on factors such as: the need for timeliness; preferences for inclusiveness to facilitate buy-in and mitigate later objections to scientific results and advice; the novelty, complexity or contentiousness of the research and scientific information under review; and other relevant circumstances, requirements or limitations relating to the review process.

A variety of peer review processes may be undertaken by research purchasers and/or research providers. Research purchasers should primarily be responsible for specifying the preferred or most appropriate form of peer review, and the membership and terms of reference for peer review working groups, workshops or panels, following consultation with relevant stakeholders, and for ensuring that criteria for effective peer review criteria are appropriately met at each stage of the process.

An overview of the optional stages and components in a peer review process and some of the alternative forms of peer review is shown in Figure 2. This provides a decision tree to assist in determining the most appropriate stage and form of peer review for different research projects or reports.

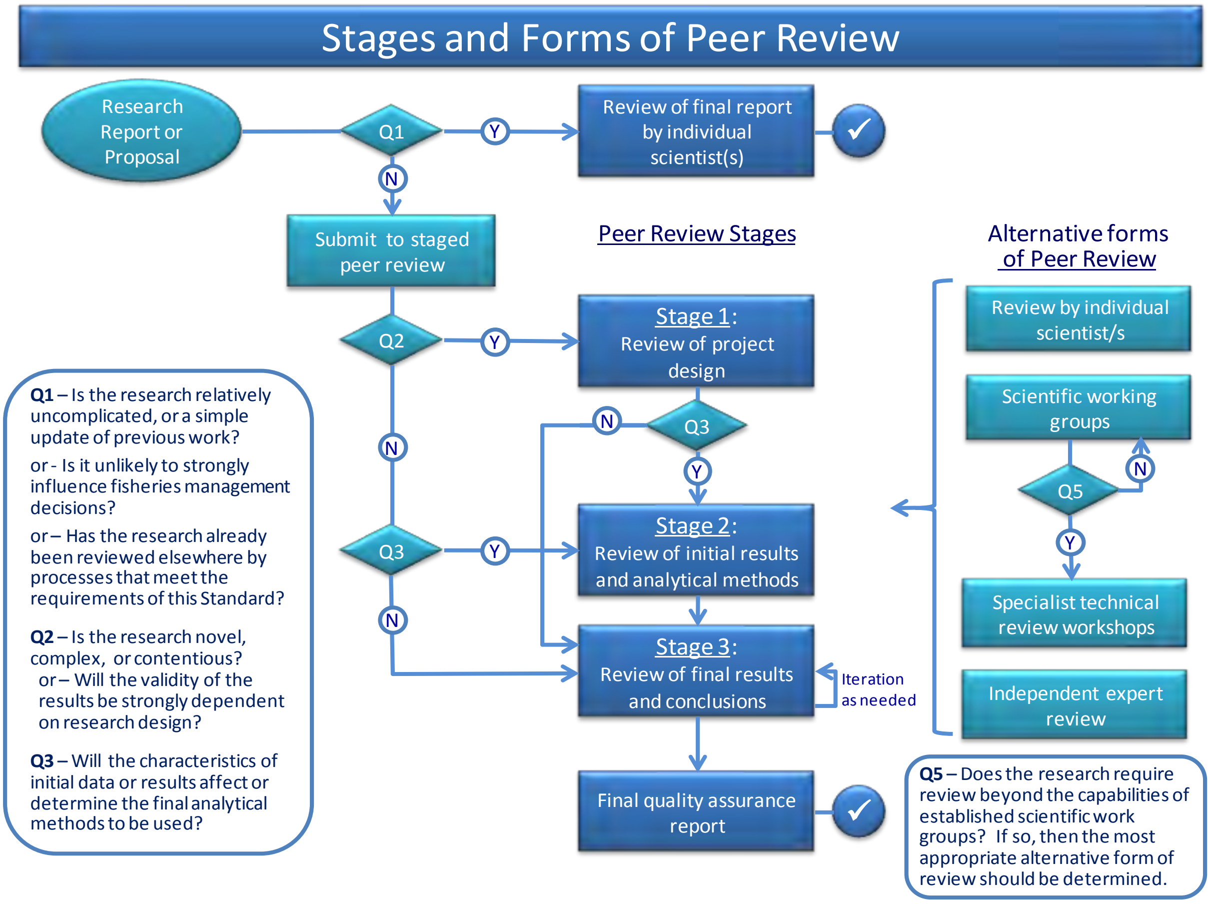

Figure 2. Decision tree to guide decisions regarding the stages and forms of peer review that should be applied to scientific research of increasing complexity and expected influence.

In addition to the stages during a research project at which peer review and staged technical guidance can contribute to ensuring the quality of scientific information, there are a number of alternative forms of peer review. Selection of the most appropriate form depends on characteristics of the research under review, particularly the complexity, contentiousness and expected influence of the research, and the urgency of decisions that need to be informed by resulting scientific information.

Review by Individual scientist(s) – if a research project is relatively uncomplicated or simply an update of previous work, or has already been peer reviewed elsewhere by processes that meet the requirements of these Guidelines, peer review of the final research report by one or more qualified scientists with the appropriate expertise may be adequate. Depending on the level of independence required, such scientific experts may be chosen from within the research provider organisation, or be contracted external experts.

Scientific Working Groups – where there is a requirement for regular and timely review and provision of scientific advice, peer review can most effectively be conducted by existing scientific working groups or advisory committees, or by establishing such working groups or committees. Scientific working groups are particularly suitable for review of regular fishery characterisations, updated biological studies, stock assessments, fisheries abundance surveys and regular evaluations of impacts of fisheries. For such research, where there is a long history of addressing similar questions, and technical protocols or agreed methods for reliable science have already been established and tested, the accumulated experience of members of established scientific working groups can result in efficient and reliable review of research results.

- Membership of established scientific working groups should tend towards being more inclusive, and should include an adequate range of scientific expertise and stakeholder experience in the range of research and scientific information referred to each working group. Such working groups will benefit from the experience of members familiar with the techniques used in the work being reviewed, and from established working relationships where conflicts of interest have been resolved.

- Where adequate expertise does not exist within working groups, but where members of other working groups or advisory committees possess expertise, experience and institutional knowledge relevant to the information to be reviewed, inclusion of additional invited experts as needed will provide broader perspectives and reduce the risk of inadequate peer review that might result from limited knowledge or fixed views of existing participants.

<u>Specialist Technical Review Workshops</u> – are more appropriate where the questions to be addressed, and the information to be reviewed, relate less to providing immediate science advice for fisheries management decisions, and more to reviewing novel, complex, or contentious research approaches in order to provide technical guidance to future peer review processes.

- Specialist technical review workshops should be led by, and primarily consist of, recognised technical experts in the scientific fields or methodologies being reviewed. Inclusion of additional experts in related fields, and of experienced individuals or stakeholder representatives, may be beneficial to fully identifying the benefits and shortcomings of alternative technical approaches to particular research questions.
- Emphasis in specialist technical workshops should be on technical expertise, wide canvassing of expert opinion and technical information, consideration of diverse expert perspectives and exploration of new ideas. Such workshops might include review and planning exercises for new data collection or survey methodologies, or technical workshops to reconsider old, and develop new, analytical methods.

<u>Independent Expert Peer Review</u> – may be required:

  - where the research is novel, complex, or contentious;
  - when there are strong conflicts of interest relating to potential impacts of fisheries management decisions on organisations, industries or groups with whom some participants in regular peer review processes are affiliated; or
  - where attempts at peer review using existing committees or panels have resulted in adversarial debate and irreconcilable opposing views.

- It may be adequate to commission one or more subject matter experts, rather than a panel, to provide independent expert peer review. This is particularly relevant to periodic reviews of research programmes and assessment methodologies to ensure their balance, efficiency and effectiveness in addressing specified management objectives and questions. Establishing the range and priority of questions to be asked, and the appropriate balance of research projects to address these, is as important as ensuring that individual projects are conducted correctly. Reviews of research programmes should be conducted by independent science experts who were not involved in the original design or development of those programmes or methodologies.
- Fully-independent *ad hoc* expert peer review panels can be constituted as and when necessary to provide the highest level of independent peer review under situations when one or a combination of the following circumstances applies:
  - questions exceed the technical expertise of the existing science working groups;
  - there is substantial uncertainty and a range of conflicting scientific opinions regarding the interpretation of results;
  - the findings are controversial; or
  - implications for fisheries management decisions are substantial.
- Fully-independent expert peer review panels should be facilitated and managed by a suitably qualified independent expert, with primary responsibility for the review residing with recognised and independent experts in the research field concerned, who are not directly affiliated with anyone involved in, or affected by, consequent fisheries management decisions.

- Government, industry-affiliated or other experts may be requested to provide input to the deliberations of an independent peer review panel, but the peer review report should be produced by the appointed independent experts, free from undue non-scientific influences and considerations.

1.4.3. Peer Review Terms of Reference

Irrespective of the chosen form of peer reviews, the scope of work and terms of reference for any peer review must be determined in advance of the selection of reviewers. Terms of Reference must:

- Specify the mandate, roles and responsibilities of the participants.
- Require all participants to be familiar with, and to adhere to, requirements for scientific quality assurance and effective peer review specified in these Guidelines,
- Identify the research projects or issues to be dealt with, including technical questions required to guide the peer review process.
- Allow peer reviewers the opportunity to express their views on the range of research and scientific information under review.
- Require that uncertainties and associated risks for fisheries management are clearly identified and appropriately and objectively characterised and documented.
- Specify expectations regarding peer review processes and reporting of peer review outcomes.

1.5. Data Retention and Management

Retention, secure storage and provision of access to data and information used in scientific analyses to inform management decisions for wild capture fisheries and their impact on the marine environment is required to allow for validation, verification and evaluation of reproducibility, accuracy and objectivity of the methodology and research results. Retention of such data and information ensures that it is available for future re-analysis, if this is required, allowing for the cumulative process of building on reviews and revisions of knowledge. Provision of access to data facilitates transparency of the research process, contributing to increased trust in analyses and advice produced using these data.

1.5.1. Retention of Data and Primary Materials

- Each research provider or research purchaser (where research purchasers retain ownership of fisheries research data) should have a policy on the retention of primary materials (such as research samples from which data are derived) and research data produced as a result of any research project that contributes scientific information used to inform fisheries management decisions.
- Research providers or purchasers should support or provide storage facilities, databases and archives for the secure storage of research data. All data used to inform fisheries management decisions should be stored in such facilities and retained for future verification or use, subject to applicable confidentiality requirements.
- In projects that span several institutions, an agreement should be developed at the outset covering responsibilities for the ongoing storage of research data and primary materials within each institution.
- Accurate and clear records should be kept of where research data are stored and a catalogue of research data should be maintained in an accessible form. Fisheries databases should include descriptive metadata for each relevant data set.
- Catalogues of stored data, and metadata for fisheries research databases, should include details of data ownership, identification of data sources, access arrangements, confidentiality requirements and contact details relating to data access and use. Adequate descriptions of data

characteristics and data collection methods should be provided, to allow prospective users to understand possibilities and limitations relating to data analysis.

1.5.2. Provision of Access to Data

- Each research provider and research purchaser should have a policy on the ownership of research materials and data during and following the conducting of fisheries research projects.
- Research data should generally be made available for wider use unless this is prevented by privacy or confidentiality requirements. Subject to contractual arrangements, confidentiality requirements or privacy legislation, research providers should provide access upon request to relevant datasets and analyses. Where relevant, this includes computer code used in filtering and error correction of those data.

1.5.3. Confidentiality of Information and Data

- Arrangements for access to fisheries data and information must be consistent with applicable confidentiality requirements, legislation, privacy legislation and other relevant guidelines.
- Where required to protect the commercial sensitivity of certain data, appropriate confidentiality arrangements and agreements must be developed regarding access to these datasets. Release of these data will be governed by these confidentiality arrangements.
- Where commercially sensitive data sets are protected by confidentiality agreements, but access to the data is necessary for the purpose of further analysis, non-sensitive data sets may be prepared upon request by, for example, aggregating data to a non-sensitive level.

1.6. Implementation and Reporting

Research purchasers and research providers intending to implement the provisions of these Guidelines to ensure the quality of scientific information used or produced by them should develop and maintain implementation plans appropriate to their particular circumstances, documenting how this will be done within their organisation.

Implementation plans should include:

- A statement of intention to implement these Guidelines for the purposes of ensuring the quality of scientific information used to inform management decisions for wild capture fisheries and their impact on the marine environment.
- Identification of roles and responsibilities within the organisation for implementation of processes relating to implementation of science quality assurance and peer review requirements under these Guidelines.
- Description of peer review processes that will be implemented, specifying:
  - requirement that scientific information to be submitted for peer review;
  - provisions for establishment of scientific working groups or peer review panels or other appropriate peer review process;
  - provisions for independent expert peer review and circumstances under which this would occur;
  - requirements for documentation and reporting on the deliberations and outcomes of peer review processes relating to quality of scientific information reviewed by them;
  - supporting documentation, including terms of reference for peer review processes.
- Annual reporting requirements on the implementation of peer review processes to evaluate the quality of scientific information used to inform fisheries management decisions.

Public reporting on the details and results of implementation of scientific quality assurance and peer review processes is important for ensuring transparency and increasing government, stakeholder and public trust in the quality of scientific information used to inform fisheries management decisions.

Research purchasers and research providers implementing science quality assurance and peer review processes under these Guidelines should document:

- Measures taken to implement processes relating to scientific quality assurance and peer review under these Guidelines, including the implementation plan.
- Details of peer review processes implemented, including composition of any scientific working groups, peer review panels or independent expert peer review processes used.
- Summary of scientific information submitted to these peer review processes for review, and outcomes of peer review relating to evaluation of the quality of this information.
- Overview of how the outcomes of peer review processes were taken into consideration during the development of fisheries policy and fisheries management decisions.

1.7. Appendix A: Definition of Terms

For the purposes of interpretation and implementation of these guidelines, the following terms are defined to have the following meanings.

<u>Accuracy</u> – the accuracy of data or analyses is a measure of the proximity of those data or results to the actual (true) values. As such, accuracy is a core component of information quality, but one that is impossible to measure directly when the true value is unknown. The processes of science quality assurance set out in these Guidelines provide the means to indirectly assess accuracy by checking at each stage of the scientific process for sources of statistical bias and imprecision, which are key factors that degrade accuracy.

<u>Bias</u> – may result from statistical bias, personal bias or a combination of the two. Statistical bias results from non-representative data collection methods or the use of inappropriate analytical methods by which data are reviewed or analysed, interpreted, or published, such that results and conclusions deviate systematically from the truth. Personal bias is an inclination or prejudice in favour of a particular viewpoint or conclusion. Both statistical and personal bias may contribute to the selective interpretation or presentation of results and uncertainties in a manner that influences subsequent interpretation of the most likely outcome of a scientific analysis.

<u>Data filtering and error correction</u> – is any process whereby data are checked for accuracy using objective rules, and data that are known or likely to be incorrect are corrected, deleted or replaced with appropriate estimated values derived from accurate data. This may initially be a data analysis stage rather than a data management process. However, where data filtering and error correction procedures become routine, they should be incorporated into established data management processes to avoid variation in processes or duplication of effort.

<u>Impartiality</u> – requires that decisions be based on objective criteria, and not on the basis of personal bias or prejudice towards or against any particular party or viewpoint. In the context of peer review, impartiality requires that a participant not act as an advocate for any particular group or organisation, and that conflicts of interest do not result in selective or biased interpretation of scientific information.

<u>Independence</u> – as it relates to science quality assurance and peer review processes, means that the evaluation of the quality of research and scientific information is conducted by persons who were not involved in producing the information being reviewed, and who do not have conflicts of interest.

<u>Integrity</u> – refers to the security of information, and to the protection of information from inappropriate alteration, selective interpretation or selective presentation. It must be ensured that the information is not compromised or biased, particularly with regards to presenting uncertainty in that information, to ensure that information remains complete throughout the science-to-decision process.

Objectivity – refers to whether the information presented is accurate, impartial and unbiased. Objective interpretations or conclusions do not depend upon the personal assumptions, prejudices, viewpoints or values of the person presenting or reviewing the information. Objectivity includes whether the information is presented within a proper context. Sources of information should be documented, so that the public can assess for itself whether there may be some reason to question the accuracy of the data sources.

Peer Review – is a process of evaluation of research or scientific information by one or more experts in the appropriate field, either with similar competence or in the same occupation, profession or industry to the producers of the work. Peer review methods are employed to ensure that the work meets appropriate or applicable standards of quality. Peer review usually emphasises the importance of independence of the reviewers in order to obtain an unbiased evaluation, recognising that a larger and more diverse group of people will usually find more weaknesses and errors in research, and will make a more impartial evaluation of it, than the person or group responsible for that research. There are many options for conducting effective peer review, depending on the novelty and complexity of information.

Precision – the precision of a measurement system is the degree to which repeated measurements under unchanged conditions show the same results. Precision does not necessarily imply accuracy: a method may be precise, but may not be providing an accurate (true) measure. Measurements that exhibit an unacceptably high level of imprecision are considered unreliable.

Quality – in relation to research and scientific information, is an encompassing term comprising peer review, relevance, integrity, objectivity and reliability. Scientific information that meets these requirements is considered to be robust and of high quality.

Relevance – refers to the usefulness of the information to its intended users, including government decision-makers, , stakeholders and the public. Scientific research must be relevant to the fisheries management question(s) being addressed, contributing directly to answering those questions and addressing fisheries management objectives for the fishery of concern.

Reliability – relates to the accuracy and reproducibility of information. Research and scientific information must be accurate, reflecting the true value of the results being reported within an acceptable level of imprecision or uncertainty appropriate to the data and analytical methods used. Information should not be biased and should not suffer from such a high level of imprecision that the results and conclusions are rendered meaningless. Methods and models used to produce scientific information must be verified and validated to the extent necessary to demonstrate that results may be reliably reproduced by an independent scientific expert using the same data and analytical methods.

Reproducibility – means that the scientific information is capable of being substantially reproduced, subject to an acceptable degree of imprecision or error, by another expert working independently from the expert who originally presented the information. With respect to analyses, ‘capable of being substantially reproduced’ means that independent analysis of the supporting data using identical methods would generate similar results, subject to an acceptable degree of imprecision or error.

Research – is a process of organised and systematic investigation or inquiry to find answers to specific questions by establishing facts or principles. When research is conducted using scientific methods, the resulting research results can be termed to be scientific information.

Scientific information – means any knowledge, facts or data that have been generated, tested and verified using scientific methods. Scientific information includes, but is not limited to, factual input, data, models, analyses, technical information, or scientific assessments, whether conveyed through data compiled directly from surveys or sampling programmes, or through statistical analyses and models that are mathematical representations of reality constructed using primary data. In the context of these Guidelines, relevant fields of research and science include, but are not limited to biology, ecology, oceanography, economics and sociology.

Scientific method – is a systematic and cumulative process, employing a range of techniques to acquire new knowledge, or to integrate or correct previous knowledge, by gathering observable, empirical and verifiable evidence that is used in the formulation and testing of hypotheses. Scientific methods must be objective to reduce biased interpretations of the results, and methodological process steps must be reproducible. All data and methodologies must be documented, archived and shared so that they are available for verification by other scientists, to confirm the reproducibility of results, and to allow statistical measures of the precision or reliability of these data to be established.

Transparency – a transparent peer review process is one that allows the public access to the results of peer review working group, workshop or panel meetings, background documents and reports, subject to relevant confidentiality requirements or agreements. Transparency also requires the communication to the public in plain language of how decisions were reached, the presentation of policies in open forums, and public access to the findings and advice of scientists as early as possible.

- Validation – refers to the testing of analytical methods to ensure they perform as intended. Validation should include evaluation of whether:
  - the analytical method has been programmed correctly in the computer software;
  - the accuracy of the estimates is adequate for the intended use;
  - the precision of the estimates is adequate; and
  - the estimates are robust to model assumptions.
- Verification – is the process of determining that the same results can be obtained from the application of the same methods to the same data. Providing for verification requires that the results, data and procedures used to produce the research and scientific information are documented in sufficient detail to allow the reproducibility of the results to be tested by others, within an acceptable degree of precision.

COUCHMAN, Natalie

From: Ian Knuckey <ian@fishwell.com.au>
Sent: Monday, 20 August 2018 4:29 PM
To: Brett Arlidge; Eva.Plaganyi-Lloyd@csiro.au; COUCHMAN, Natalie; BOLTON, Steve; Tom.Roberts@daf.qld.gov.au; John.Dexter@daf.qld.gov.au; Mark.ANDERSON@tsra.gov.au; Allison.RUNCK@tsra.gov.au; fisheries@tsra.gov.au; darrendennis1965@gmail.com; sevaly.sen@gmail.com; maludogai@gmail.com; phillipketchell_66@yahoo.com.au; mark.david@tsirc.qld.gov.au; Les.Pitt@TSIRC.qld.gov.au; terrence.whap@tsra.gov.au; whapt01@yahoo.com.au; torrescrays@gmail.com; d.takai@bigpond.net.au; morison.aqsci@gmail.com; andrew.penney@pisces-australis.com; dr.raymoore@bigpond.com; STOUTE, Selina; FINDLAY, James
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Subject: RE: Out of session item - preliminary results of the TRL Midyear Survey [SEC=UNCLASSIFIED]

Dear Brett

Many thanks for your email. As you know, there were a range of views expressed by various RAG members and observers about the 2018 season and its alignment (or otherwise) with the with the pre-season and mid-year survey results. I agree that this needs to be critically explored and is an important focus of the work of the RAG leading into 2019. Until this work is done, however, I do not believe we can presume that the survey(s) are necessarily at fault – the RAG has previously highlighted that there is a lot of uncertainty associated with commercial CPUE as an index of abundance.

Rather than try and prosecute this discussion any further over email, I agree that it is worth outlining what needs to be done to best support a comprehensive discussion at our next RAG meeting. I believe this is as follows:

1) Contact any fishers with outstanding 2018 logbook returns to get them to submit to AFMA as soon as possible (immediately).
2) Once all logbook data is received, CSIRO submit a data request to AFMA to obtain the data (end of August)
3) CSIRO conduct a detailed (spatial-temporal) analysis of the 2018 TIB and TVH commercial fishing data (September)
4) CSIRO complete the analysis and reporting of the mid-year survey (September)
5) Both the full survey results and CPUE analyses be distributed prior to the next RAG meeting– which I think was planned to be held in October - well before the planned time of the pre-season survey (mid-November).
   Discussions at the RAG should include:
   a. Comparison of commercial CPUE data analysis against results of the pre-season and mid-year surveys;
   b. Does this have implications for future survey design?
   c. Does this have implications for logbook data and how we interpret commercial CPUE data?
   d. Does this have Implications for the Harvest Strategy?
   e. What are the costs/benefits of an independent review of the survey design, stock assessment and harvest strategy?
6) Provide RAG advice to the TRL Working Group.

AFMA/CSIRO, I am assuming that this work and timeline are possible. If not, please let us know ASAP. If so, can we please try and lock in a date for the October meeting ASAP.

Cheers – Ian K

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Subject: RE: Out of session item - preliminary results of the TRL Midyear Survey [SEC=UNCLASSIFIED]

Well hello again everybody,

Three weeks have elapsed since my email and Eva's reply below.
The 2018 season has concluded, shut down thanks to the pre and mid-season survey outcomes and the corresponding RBC recommended by the RAG.
But I don't think there is a fishery stakeholder or industry participant who does not acknowledge that the catches of the 2+ cohort throughout the season, and the associated CPUE, were typical of a quite normal season with average stock abundance.
This was especially the case in July, when catches were if anything above average, some fishers doing very well indeed.
This July catch data and CPUE stands in stark contrast to the mid-season survey which found the second lowest 2+ abundance of all time and therefore confirmed the very low 299t RBC originally based on the low pre-season survey index of abundance.

Given this divergence, we, the people who are charged with the task of assessing the condition of the Torres TRL resource (the TRL RAG) and providing advice as to the management of the TRL fishery (the TRLWG), have a serious and unprecedented problem, one which I believe we must address head on and with urgency.

The livelihoods of commercial TRL fishers and post-harvest industry participants in Torres Strait were severely impacted by the closure of the fishery this season.
These people desire (and deserve) to know what we are going to do about it.
We should also note the consequences of this decision reach much further, impacting all the way to our markets in China and the USA, and affecting the livelihoods of many additional people in the various businesses right along the value chain.

I think it is time to call a spade a spade and acknowledge that for reasons we are yet to understand, in both pre and mid-season 2018, the independent survey did not prove to be the reliable measure we thought it was.
Given this experience, how can we have confidence it is suitable for use as the primary tool in stock assessment of the fishery going forward?

Both surveys failed to correspond to actual stock abundance in the fishery in 2018.
This is obvious and indisputable to anyone involved in the commercial industry.

How and why this has happened we don't know. But we need to know!

We can’t just blithely go ahead as if it didn’t happen.

We (the RAG, WG, AFMA, CSIRO) are responsible.

What are we going to do about it?

In lieu of suggestions from anyone else, I propose the following urgent action and call on all RAG members to support it:

1. That the 2018 industry CPUE data be processed and released as soon as possible so the RAG can review and compare with the survey-based index of abundance.

2. That there be an independent audit of the two 2018 CSIRO surveys, reviewing methodology, protocols, operational procedures and instructions as to the methods of swimming transects and counting lobsters. We recommend that the audit also include prior surveys for at least two years, whilst under the management of the previous leadership team.
   That is, this independent audit would encompass the preseason surveys in November 2015, 2016, 2017, as well as the 2018 mid-season survey.

3. That the review carefully investigate how the July mid-season survey could report the second lowest 2+ cohort count of all time, whilst concurrent commercial catches of the 2+ cohort in many different parts of Torres strait were very good indeed.

People’s livelihoods are on the line here, and only an independent review process can deliver the confidence we need.
To continue to manage the fishery with primary reliance on survey data that has twice in succession proven extremely inaccurate, is simply unacceptable.

I hope this can be achieved before any decision on 2019 season management settings is put in place.
But until this is done I believe the management of the fishery should go back to the traditional input controls that are still in place and have served the industry well to date.
The de facto “Olympic Quota” management system used in 2018 was a disaster.
It imposed an extremely precautionary output limit on an input-controlled fishery for what proved to be very dubious reasons.
The result was a closed fishery and considerable hardship to a multitude of TRL industry people while abundant stocks of 2+ TRL wandered about unfished across Torres Strait.
Farcical really….

It would be negligent of us in our duties on the RAG if we simply proceed with business as usual for the 2019 season and pretend there was no problem with the 2018 surveys.
We must ensure we do not find ourselves in a similar situation in 2019.

If there are alternative proposals I am keen to hear them, but in the absence of such alternatives I call on RAG and WG members to endorse and support the course of action proposed above.

Thanks, and best regards

Brett Arlidge

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Cc: Ian.BUTLER@afma.gov.au; chairperson.malulamar@gmail.com; ali.bboy.nona@gmail.com; joseph.posu@gmail.com; Ugar.Member@tsra.gov.au; trent@fnqfish.com.au; moonmouse@bigpond.com; iliviko@fisheries.gov.pg; suz@rebeltours.com.au; jposu@fisheries.gov.pg; procfis@gmail.com; Mark.Tonks@csiro.au; Robert.Campbell@csiro.au; kwemyss@bigpond.com; seristephen67@gmail.com
Subject: RE: Out of session item - preliminary results of the TRL Midyear Survey [SEC=UNCLASSIFIED]

Dear Brett

Thanks for your comments. My team will need to wait until we've analysed all the catch and CPUE data before we can provide further comment, but we look forward to working with everyone involved in the fishery to increase understanding of these complex lobsters, the CPUE and the scientific basis underpinning management.
Cheers
Eva

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Subject: RE: Out of session item - preliminary results of the TRL Midyear Survey [SEC=UNCLASSIFIED]

Hi All,

Firstly, please forgive my tardy response.
We are currently extremely busy handling the large quantities of live two plus TRL recently caught in Torres Strait.

Well, the 2018 Torres TRL season is officially over next Tuesday.
What a year….
Let's ensure we never do this again.

Thanks to AFMA and CSIRO for funding, organising, and expediting the mid-season survey.
And thanks to Eva and Co for quickly completing the data analysis and providing the report.

Although the mid-season survey result supports the pre-season analysis and the existing RBC, nevertheless we have a serious problem which we need to resolve.
Otherwise there is a big chance that the events of this season could be repeated.

For the first time in the history of this fishery (I know of no other such instance) we have an enormous divergence between actual fishery catch and CPUE i.e. actual stock abundance, on the one hand, and the survey index of abundance on the other. Which has now been repeated for two consecutive surveys of the same 2018 season stock.

The pre-season survey reported very low numbers of all cohorts, 0+,1+ and 2+
But, as we all know, from the start of the season two weeks later, right up until the fishery was first closed to hookah at the end of April, catches and CPUE did not correspond at all.
Catches and CPUE were pretty much average, and the stock size structure was normal.
The low RBC was caught very quickly.
So, because of this anomalous situation, we (the RAG) requested a mid-season survey be conducted to hopefully give more certainty re the stock status.

Now we have the results of that survey.
While the smaller(1+ cohort) numbers look very encouraging, the spawning stock (2+ cohort) is the second lowest count of all time, confirming the pre-season result.

As that survey was conducted, commercial hookah fishing had recommenced, due to the outcome of the Malu Lamar vs James Findlay case, and it continued over both neaps this month.
I can provide an up to the minute industry report of those catches to RAG and WG members.
Of course, the animals being caught are the 2+ cohort.
Catches of all sectors, TIB, TVH, and PNG have been very good right throughout this period.
What's more, it is not a matter of all fishers targeting a concentrated aggregation in one small area.
On the contrary, large numbers of 2+ TRL have been taken all over the place – Badu, Mabuiag, Turnagain, Warrior, Dungeness, Warraber etc., and in PNG waters.

How this can happen when the survey simultaneously found the second lowest 2+ count of all time is a mystery. But it has happened.
The last of the hookah catch will be unloaded and tallied by this coming Sunday. All of the data will then be immediately available for analysis.

My personal livelihood depends on understanding the Torres, PNG and Queensland TRL Fisheries and their fishing industries very well.
In my estimation if this Torres/PNG season had been allowed to run its full course under the normal input controls the catch would have been at least 500t, and probably more. That is, catch of 200t over and above the 2018 RBC of 299t. (This equates to loss of potential income to the Torres Strait economy of approximately $65 x 200,000 kg i.e. $13 million)
There is no way this could occur if the stock abundance was the second lowest of all time as the two surveys indicate. It is impossible.

That of course is just my estimate. I can't prove it.
However, I think we can state two solid facts.

1. 2018 season catches, CPUE, and stock size structure, are incompatible and totally at odds with the survey data. There is abundant evidence to put this beyond dispute.
2. Based on the actual catch data and CPUE there is no basis to close the fishery in 2018.

Therein lies the problem we have to resolve.
Yes, there have been minor variations between the survey index of abundance and actual catch abundance in the past, but certainly not of this magnitude.
And never such anomalous results for two consecutive surveys.
It is unprecedented.
And we need to understand why it has happened, as a matter of urgency.

Thanks,

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Subject: Out of session item - preliminary results of the TRL Midyear Survey [SEC=UNCLASSIFIED]

UNCLASSIFIED

Good afternoon TRL RAG and Working Group members,

Please find attached for your information, the preliminary results from the Torres Strait TRL Midyear Survey conducted between 28 June and 9 July 2018. Key findings are:

- The survey has shown convincingly that the original scientific results and recommendations hold, i.e. the observed 2018 2+ survey index is NOT significantly different to the stock assessment model-predicted value. The survey results therefore recommend no increase in this year's RBC based on the process agreed at the May 2018 TRLRAG; and
- The survey suggested that the incoming 1+ recruiting cohort is slightly above average and hence preliminarily suggests that next year will be a much better year.

Based on the preliminary results, AFMA is not proposing an urgent meeting of the TRLRAG at this time.

I will be out of the office for the next two weeks, returning 6 August. Should you have any questions in my absence, please contact Ian Butler on ian.butler@afma.gov.au or 07 4069 1990.

Kindest regards

Natalie Couchman

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TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
PLANNING AND DESIGN OF FUTURE SURVEYS AND ASSESSMENTS	**Agenda Item 7** **For Discussion and Advice**

RECOMMENDATIONS

1. That the RAG **NOTE** plans for the November 2018 pre-season survey.

KEY ISSUES

2. The November 2018 pre-season survey will be conducted from 11-24 November 2018. Additional information regarding this survey will be presented by CSIRO at the meeting.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	MEETING 24 18-19 October 2018
BETTER ALIGNING THE TAC SETTING PROCESS WITH THE FISHING SEASON FOR THE 2018/19 SEASON AND FUTURE SEASONS	**Agenda Item 8** **For Discussion and Advice**

RECOMMENDATIONS

1. That the RAG:
    a. **NOTE** the timing of the survey and stock assessment process means a TAC based on the latest survey results cannot be determined before the current season start date (1 December);
    b. **NOTE** that under the proposed management plan a TAC must be determined before the season start;
    c. **NOTE** that the proposed plan provides for a TAC to be increased. This provision could be used to set a conservative TAC for the start of the fishing season which could then be updated;
    d. **NOTE** that the TRLWG (meeting 5, 5-6 April 2016) sought advice from the TRLRAG on any findings relating to the risks or impacts of changing the season start date from 1 December to 1 January;
    e. **NOTE** advice from CSIRO on the biological and scientific considerations regarding a change to fishing season dates for TRL Fishery at **Attachment 8a**;
    f. **DISCUSS** and **PROVIDE ADVICE** on the technical and scientific considerations concerning the following two possible options to better align the TAC setting process with the fishing season in the longer-term under the proposed management plan:
        i. **Option 1**: delay the fishing season start date so that it occurs after the TAC setting process is able to be finalised (e.g. 1 March); or
        ii. **Option 2:** set a conservative TAC that can be determined before the start of the season and increased when the TAC setting process is finalised. Note the conservative TAC would need to be determined before the results of the pre-season survey become available;
    g. **DISCUSS** and **PROVIDE ADVICE** on implementing option 2 above for the 2018/19 fishing season noting that until otherwise directed by the PZJA, AFMA is working to enable the implementation of a management plan for the Fishery by 1 December 2018.

KEY ISSUES

2. The current TRL Fishery fishing season starts on 1 December each year. The timing of the survey and stock assessment process means that a TAC based on the latest survey results cannot be finalised before the season starts. Historically the notional TAC has not been finalised until 4-5 months into the 10 month fishing season.
3. The proposed draft management plan, requires a TAC to be set prior to the start of a fishing season but also allows for the TAC to be increased within a fishing season. Under the proposed draft management plan, in setting a TAC the PZJA must consult with any group it has established to give advice relating to the area of the TRL Fishery.

4. Although it will be possible to finalise a RBC more quickly through the application of the proposed empirical Harvest Control Rule (eHCR) administratively, a TAC could still not be finalised by 1 December. Further, the draft Harvest Strategy requires annual RBCs to be set using the integrated stock assessment model if the if the data, analyses or other conditions indicates the eHCR recommended RBCs are outside the ranges tested by the Management Strategy Evaluation process conducted. Under this scenario the eHCR should be revised and annual RBCs need to be set using the integrated stock assessment model until a revised eHCR is agreed (draft Harvest Strategy is provided at **Attachment 8b**).

5. There are a two possible options to better align the TAC setting process with the draft management plan in the long term:
   a. develop a TAC setting process whereby a conservative TAC can be set at the start of the season and increased when the TAC setting process is finalised; or
   b. delay the fishing season start date so that it occurs after the TAC setting process is able to be finalised. This may require timeframes for some components of the TAC setting process to be completed earlier or compressed.

6. Advice from CSIRO on the biological and scientific considerations regarding changes to the TRL Fishery fishing season dates is at **Attachment 8a**.

7. As well as seeking advice on arrangements in the longer term, AFMA is also seeking advice from the RAG on options for setting a TAC for the 2018/19 fishing season. Until otherwise directed by the PZJA, AFMA is working to enable the implementation of a management plan by 1 December 2018. Under this scenario the PZJA may be required to set a TAC before the season start on 1 December 2018.

8. Noting the administrative arrangements required to change the fishing season date and notwithstanding further advice from the RAG, it is likely the only viable option for the PZJA would be to determine a conservative TAC prior to the season start on 1 December 2018. The TAC could then be updated based on the final results of the integrated stock assessment.

9. A mid-year survey has been conducted this season. Mid-year surveys have been used in the past to provide advice on preliminary RBCs. Note that any further stock assessment work to support the setting of a conservative TAC for the coming season will require further work and funding. There may be more timely and cost-effective options for setting a conservative TAC using available data and analysis. For example having regard for the stock assessment outcomes for 2017/18 season, indicative results from the mid-year survey, previous testing on a constant catch harvest strategy and historic monthly rates. Importantly with each possible option the economic and operational impacts on industry should be considered.

BACKGROUND

10. At the Working Group meeting held on 5-6 April 2016 (TRLWG5) members noted that it would be important under a quota management system (given effect under a management plan) to provide industry with time to prepare adequately for a fishing season by providing more time between the notification of the TAC, the value of quota units and the season start date.

11. Working Group action item no. 5 (meeting 5 held on 5 6 April 2016) tasked the TRLRAG to provide advice on any findings relating to the risks or impacts of changing the season start date from 1 December to 1 January.

12. To assist the RAG the following information is provided:
    a. Potential timeline for setting a final TAC using the eHCR or integrated stock assessment model see **Attachment 8c**;

b. Administrative steps required to change the TRL Fishing season dates see **Attachment 8d**; and

c. Monthly catches by season see **Attachment 8e**.

Biological and scientific considerations regarding change to fishing season dates for TRL Fishery

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SUMMARY

- The current cycle of opening the fishery (hookah ban in Dec-Jan) in December fits well with the biology of the stock and hence data and analysis requirements for informing catch limits. However, as the pre-season survey is conducted in November each year (and there are several reasons why this date shouldn't be changed), this leaves very little time for review and bilateral discussions regarding the Recommended Biological Catch (RBC). Hence a later fishing season opening date (e.g. 1 February or 1 March) as proposed by AFMA might be more practical from a management perspective.
- The key information required to support recommendations for the following fishing season are:
    - November pre-season survey index of recruitment strength (this measures the abundance of the incoming 1+ cohort that will comprise the majority of the 2+ cohort that is fished the following calendar year)
    - Total Annual Catch from previous season – this catch needs to include all 2+ lobsters caught up until the end of September, by which time most have migrated north-east out of Torres Strait towards breeding grounds. Hence the fishery is closed in October-November. The total catch thus needs to be summed over the period December to October the following year. The PNG catch total is also required.
    - Catch-Per-Unit-Effort (CPUE) from TIB and TVH sectors. These data provide an index of the 2+ cohort abundance and hence an indication of the spawning biomass. It isn't essential to include data from Dec-Jan in an analysis as most of the lobsters caught during that time are residual non-migratory large males that do not contribute to spawning (as shown in previous CSIRO analyses). Although some larger faster-growing animals from the new cohort will be included in the December-January catch, this is a relatively small proportion and the new 2+ cohort currently starts entering the fishery from February-March. Hence it is important to use a CPUE index from the period February-September, when most 2+ lobsters have recruited, as an index of relative abundance to inform management recommendations for the next season. The CPUE data are standardised (see eg Campbell *et al.* 2017) before being input to the stock assessment model or empirical Harvest Control Rule (eHCR). At the moment the TVH analyses included a month-effect and use the months February-September while the TIB analyses include a quarter-effect and use data from all quarters (and hence all months, with diving method recorded as another variable i.e. data for the hookah closure periods are standardised

accordingly). There is always a concern that fishing practices may change with a change of the start of a season, but hopefully the information on methods, and so forth is enough to account of any such changes. Also, it would be possible to just standardise both the TVH and TIB over the February-September period as suggested above to best capture the spawning 2+ abundance. If this change is done, then a change in the season start from 1-December to 1-February should not be a concern.

- Other considerations include:
    - o There is a high market demand for lobsters early in the year (Jan-Feb) due to Chinese New Year. The recent dates for Chinese New Year were 19 February (2015), 8 Feb (2016), 28 January (2017), 16 February (2018) and 5 February 2019 and these dates likely influence the pattern of fishing as shown in Figures 1-2.
    - o There is an increased cultural and economic demand from the TIB sector for catching lobsters during the Christmas period
    - o Based on recent total catch statistics, when compared to the TAC (Total Allowable Catch), it can be assumed that the TAC is likely to be caught in most years, and hence consideration needs to be given to reducing the risk that the TAC will be caught and the fishery closed before one of the high demand periods as outlined above. In addition, to be consistent with the previous history of the fishery and the methods used to date in the analysis and assessment, the TAC that is set includes an assumption that a component of the catch is comprised of residual males, and hence the TAC as currently specified should not be filled solely on the basis of the new 2+ cohort, i.e. if the season opens in February and the entire TAC is caught by end of September, this effectively means an overharvest of 2+ lobsters because it doesn't include the residual males (which play a less important biological role as they don't contribute to spawning). A portion of the TAC therefore needs to be set aside to be comprised of the residual males if the period Dec-Jan occurs at the end, rather than start, of the season (noting the economic incentives to otherwise catch the TAC earlier in the year).
- Based on the above biological and scientific considerations, we suggest that it would be feasible to change the Torres Strait TRL season date to a start date of 1 February (but anything later than this date becomes problematic – see for example Fig. 2 showing the much higher proportion of the catch that is caught in February). However, the TAC for the Australian sector would need to be partitioned into two components, for example, with a fixed proportion reserved for the fishing period Dec-Jan each year. Based on the available data, the average over the seasons from 2005-18 are 13.1% for TIB, 0.21% for TVH and 5.84% (STD 3%) for total catch (Fig. 1). The percentage taken in the Dec-Jan period is quite variable, but is clearly an important component of the TIB catch given an average of 13% with standard deviation (STD) 4.3% and range 5-22% (Fig. 1). Figure 1 suggests that in the 2018 season the percent taken early in the season jumped substantially (this may be suggestive of a race to fish given the low quota, but also reflects that fact that a higher proportion of the total would be taken in each month fished in the 2018 season given that there was no catch in Aug-Oct). So identifying a proportion of the TAC to be set aside for the Dec-Jan period may be difficult and lead to either TAC being wasted or not enough TAC remaining (especially

if market demand is high - which would also possibly lead to an economic loss given prices are also high when demand is high). One method could be to set a fixed proportion based on the above (e.g. 6%) of the total catch as reserved each year for December-January. A fixed catch could also be selected based on socio-economic considerations. An alternative that could be discussed by the TRLRAG and WG would be to increase the size limit during the Dec-Jan fishing period.

The points above will be discussed in more detail at the TRLRAG, and background documentation can be provided on request.

A summary of the proposed change in timeline is provided below:

Date – current	Date - proposed	Activity
1 December	1 February	TS TRL season opens
Oct-Nov	Oct-Nov	Commercial fishing closure
October-November	October-November	Analyse Catch and CPUE data from Feb-Sept, assuming Dec-Jan catch is 5% of Aus TAC (for 1 Feb opening) and excluding Dec-Jan CPUE data
November	November	Preseason Survey conducted
Early December	End November	RBC computed and TAC set (if using eHCR); preliminary stock assessment could be available early December, and final stock assessment when required in March following year
December - January	December-January	Seasonal closure – hookah gear
October?	December-January	Bilateral discussions?

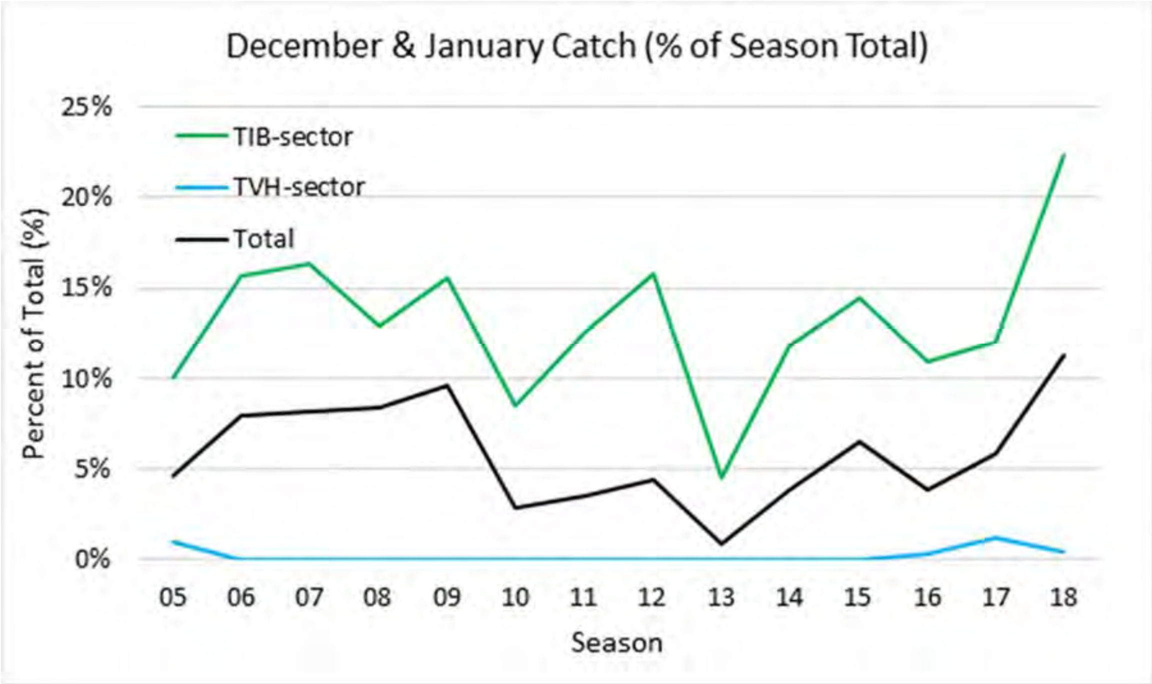

Fig. 1. Plot showing the percent of the total seasonal catch for each sector caught in December and January. Averages over the seasons from 2005-18 are 13.1% for TIB, 0.21% for TVH and 5.84% for total catch.

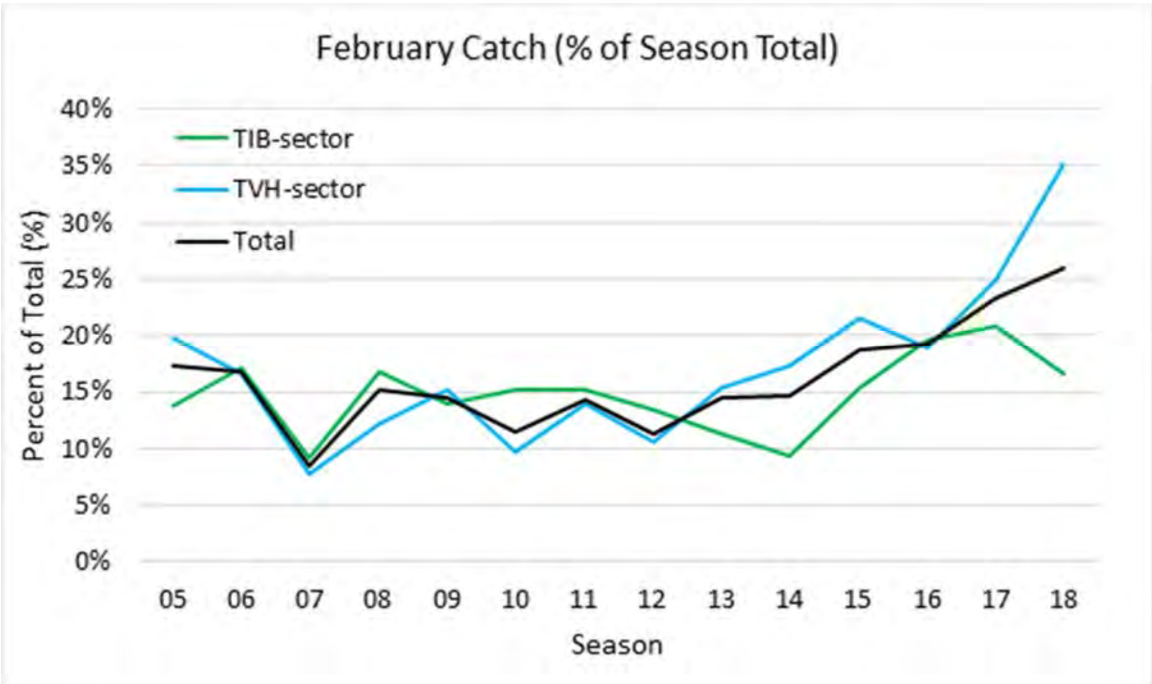

Fig. 2. Plot showing the percent of the total seasonal catch for each sector caught in February. Note the trend seems to have been increasing over the past 6-7 seasons.

Australian Government

Australian Fisheries Management Authority

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GLOSSARY

Types of reference points:

Reference Point	Description
Metarule	A rule that describes how the RBCs obtained from an assessment should be adjusted in calculating a recommended TAC
Target	Relates to a target reference point as per the HSP. Expressed in terms of biomass
Limit	Relates to a limit reference point as per the HSP. Fishing stops if this reference point is exceeded a specified number of times. Expressed in terms of biomass
MEY	Maximum economic yield occurs when the total profit from the Fishery is maximised
MSY	Maximum sustainable yield is the maximum that can be taken from a stock in perpetuity

Notation:

Notation	Description
B	Spawning biomass level
B_0	The unfished spawning biomass (determined from an appropriate reference point)
F	Fishing mortality rate

Other acronyms:

Acronym	Description
CPUE	Catch per unit effort
HSP	Commonwealth Harvest Strategy Policy and Guidelines 2007
HS	Harvest Strategy
HSF	Harvest Strategy Framework
HCR	Harvest Control Rule
RBC	Recommended Biological Catch
TRLRAG	Tropical Rock Lobster Resource Assessment Group
TRLWG	Tropical Rock Lobster Working Group
TAC	Total Allowable Catch
Tiered approach	A framework that uses different control rules to cater for different levels of uncertainty about a stock
TIB	Traditional inhabitant boat
TVH	Transferrable vessel holder

OVERVIEW

The Torres Strait Tropical Rock Lobster Fishery (the Fishery) Harvest Strategy (HS) sets out the management actions needed to achieve the agreed Fishery objectives. The Fishery HS describes the performance indicators used for monitoring the condition of the stock, the fishery-independent survey and stock assessment procedures and the rules applied to determine the recommended biological catch and the notional total allowable catch each fishing season.

The HS uses a single tier approach with an empirical harvest control rule (eHCR) that is used to determine a recommended biological catch (RBC). The eHCR uses the pre-season survey to estimate an index of abundance of juvenile (1+) and newly recruited (0+) TRL and the catch per unit effort (CPUE) indices for the traditional inhabitant boat (TIB) and transferrable vessel holder (TVH) fishing sectors. The RBC is the best available scientific advice on what the total fishing mortality (landings from all sectors and discards) should be for the stock. The RBC is currently used to monitor the performance of the fishery, in future years it will be used to recommend Total Allowable Catches (an enforced limit on total catches).

The HS meets the requirements of the *Commonwealth Fisheries Harvest Strategy Policy and Guidelines 2007 (*HSP) by applying a precautionary approach to the reference points and measures to be implemented in accordance with the reference points. This is reflected in the use of proxy reference points that are more precautionary than those specified in the HSP. The eHCR is designed to decrease exploitation rate as the stock size decreases below the target reference point. The HS uses a biomass target reference point equal to recent levels (2005-2015) that take account of the fact that the resource is shared and important for the traditional way of life and livelihood of traditional inhabitants and is biologically and economically acceptable. The HS proxies are B_{LIM} is 32% of B_0, B_{TARG} is 65% of B_0.

Further work for the HS will include the development of a tiered approach. The tiered approach applies different types of control rules to cater for different amounts of data available and to account for changes to uncertainty on stock status. A tiered approach adopts increased levels of precaution that correspond to increasing levels of uncertainty about the stock status, in order to maintain the same level of risk across the different tiers.

The status of the stock and how it is tracking against the HS, is reported to the RAG, Torres Strait Tropical Rock Lobster Working Group (the Working Group) and the Protected Zone Joint Authority (PZJA). The stock assessment is conducted periodically to evaluate performance of the eHCR. The stock assessment includes considerations of the catch rates in current and previous fishing seasons, how the catches compare to the RBCs, stock status indicators in relation to the reference points and an RBC for the upcoming fishing season.

1 BACKGROUND

This Torres Strait Tropical Rock Lobster Fishery (the Fishery) Harvest Strategy (HS) has been developed in accordance with the *Commonwealth Fisheries Harvest Strategy Policy and Guidelines 2007* (HSP) and consistent with objectives of the *Torres Strait Fisheries Act 1984* (the Act).

The Fishery HS takes into account key fishery specific attributes including:

a) there is potential for large, unpredictable inter-annual variations in availability and abundance of tropical rock lobster (TRL);

b) TRL is a shared resource important for the traditional way of life and livelihood of traditional inhabitants, commercial and recreational sectors (RAG, 4-5 April 2017); and

c) advice from the Tropical Rock Lobster Resource Assessment Group (the RAG) industry members to maintain stock abundance at recent levels (2005-2015) (RAG, 31 March 2016). (NOTE: Working Group advice to be added)

1.1 COMMONWEALTH FISHERIES HARVEST STRATEGY POLICY

The objective of the HSP is the sustainable and profitable use of Australia's Commonwealth fisheries in perpetuity through the implementation of harvest strategies that maintain key commercial stocks at ecologically sustainable levels, and within this context, maximise the economic returns to the Australian community.

To meet the HSP objective, harvest strategies are designed to pursue an exploitation rate that keeps fish stocks at a level required to produce maximum economic yield (MEY) and ensure stocks remain above a limit biomass level (B_{LIM}) at least 90 per cent of the time. Alternative reference points may be adopted for some stocks to better pursue the objective of maximising economic returns across the Fishery as a whole or other fishery specific objectives.

The HSP provides for the use of proxy settings for reference points to cater for different levels of information available and unique fishery circumstances. This balance between prescription and flexibility encourages the development of innovative and cost effective strategies to meet key policy objectives. Proxies must ensure stock conservation and economic performance as envisaged by the HSP. Such proxies, including those that exceed these minimum standards, must be clearly justified.

With a harvest strategy in place, fishery managers and stakeholders are able to operate with pre-defined rules, management decisions are more transparent, and there are likely fewer unanticipated outcomes necessitating hasty management responses. However, due to the inherently natural variability of TRL abundance there may be a need for significant changes in recommended catch on an annual basis.

1.2 DEVELOPMENT OF THE TRL HARVEST STRATEGY

The HS has been developed in consultation with the RAG (meeting no. 18 on 2-3 August 2016; meeting no. 19 on 13 December 2016 and meeting no. 20 on 4-5 April; 2017). The HS has been endorsed by the Working Group meeting no. X on 25-26 July 2017. This HS replaces the interim HS developed for the Fishery in 2008 ~~.(Attachment A).~~

NOTE: TRLWG advice to be provided once TRLRAG advice finalised – this statement is to be updated as required.

2 TRL FISHERY HARVEST STRATEGY

2.1 SCOPE

This HS applies to the whole fishery and it takes into account catch sharing arrangements between Australia and Papua New Guinea (PNG).

The HS outlines the control rules used to develop advice on the recommended biological catch (RBC) and in future years it will be used to recommend Total Allowable Catches (an enforced limit on total catches)[1]. The HS sets the criteria that pre-agreed management decisions will be based on in order to achieve the Fishery objectives.

Overtime the HS may be amended to use a tiered approach to cater for different amounts of data available and different types of assessments (for example mid-year surveys and annual assessments). Underpinning a tiered HS is increased levels of precaution with increasing levels of uncertainty about the stock status. Each tier has its own harvest control rule (HCR) and associated rules that are used to determine a RBC.

2.2 OBJECTIVES

The operational objectives of the Harvest Strategy are to:

a) Maintain the stock at (on average), or return to, a target biomass point B_{TARG} equal to recent levels (2005-2015) that take account of the fact that the resource is shared and important for the traditional way of life and livelihood of traditional inhabitants and is biologically and economically acceptable.

    o The agreed B_{TARG} is more precautionary than the default proxy B_{MEY} (biomass at maximum economic yield) level as outlined in the Commonwealth Harvest Strategy Policy and Guidelines 2007 (HSP).

b) Maintain the stock above the limit biomass level (B_{LIM}), or an appropriate proxy, at least 90 per cent of the time.

    o The agreed B_{LIM} is more precautionary than the default proxy HSP B_{LIM}.

[1] The total allowable catch (TAC) for the Fishery is currently notional and is not used to control harvest. It is used to inform catch sharing arrangements with Papua New Guinea and to inform the status of the stock.

c) Implement rebuilding strategies, if the spawning stock biomass is assessed to fall below B_{LIM} in two successive years.

2.3 RECOMMENDING TACs FROM RBCs

The Recommended Biological Catch (RBC) is the recommended total catch of TRL (both retained and discarded) that should be taken by all sectors of the Fishery. The HSP states that when setting the TAC for the next fishing season the HS should take into account all sources of fishing mortality.

The HS does not include catches taken by non-commercial fishing sectors, for example traditional, recreational or research catches. The RAG recommended at Meeting No.18 on 2-3 August 2016 that non-commercial catches should not be accounted for, because the overall catches are likely to be relatively low and there would be limited impact on the stock assessment. The HS may be updated in the future to account for changing circumstances in the Fishery, the review provisions are described in **Section 2.13**.

> *The total allowable catch (TAC) for the Fishery is currently notional (not enforced) and is not used to control harvest. It is used to inform catch sharing arrangements with Papua New Guinea and to inform the status of the stock.*

2.4 MONITORING

Biological data for the Fishery are monitored by a range of methods listed below. Currently there is no ongoing monitoring strategy in place to collect economic information.

Fishery independent surveys

A key component of the monitoring program is the fishery-independent survey which provides a time-series of relative abundance indices for TRL. Fishery-independent surveys have been conducted in the Fishery since 1989. Historically (1989-2014), mid-season (July) surveys focused on providing an index of abundance of the spawning (age 2+) and juvenile (age 1+) lobsters. Mid-season surveys have been replaced with pre-season (November) surveys (2005-2008; 2014 to current) which focus on providing an index of recruiting (age 1+) lobsters as close as possible to the start of the fishing season to support the transition to quota management and setting of a TAC. Pre-seasons surveys also provide indices of recently-settled (age 0+) lobsters, which may become useful under quota management as they allow forecasting of stock one year in advance.

Catch and effort information

Fishers in the transferrable vessel holder (TVH) sector are required to record catch and effort information in the Torres Strait Tropical Rock Lobster Daily Fishing Log (TRL04). The following data are recorded for each TVH fishing operation: the port and date of departure and return, fishing area, fishing method, hours fished and the weight (whole or tails) of TRL retained. Fishers in the traditional inhabitant boat (TIB) sector voluntarily report catch and effort information to buyers and processors who record the information in the Torres Strait Seafood Buyers and Processors Docket Book (TDB01). Some processors previously (2014-2016) reported aggregate TIB catch information directly to AFMA, these processors are currently reporting with the TDB01 docket book.

2.5 INTEGRATED STOCK ASSESSMENT MODEL

The stock assessment model (termed the 'Integrated Model') (Plagányi *et al.* 2009) was developed in 2009 and is an Age-Structured Production Model, or Statistical Catch-at-Age Analysis (SCAA) (e.g. Fournier and Archibald 1982). It is a widely used approach for providing RBC advice and the associated uncertainties.

The model integrates all available information into a single framework to assess resource status and provide a RBC. The model addresses all of the concerns highlighted in a review of the previous stock assessment approach (Bentley 2006, Ye *et al*. 2006, 2007). The model is fitted to the mid-season and pre-season survey data and TIB and TVH CPUE data. The growth relationships used in the model were revised from the previous stock assessment model (Ye *et al*. 2006) to ensure that the modelled individual mass at age more closely resembled field measurements. The model is compatible as an Operating Model in a Management Strategy Evaluation (MSE) framework to support the management of the Fishery.

The stock assessment model is non-spatial and assumes that the Torres Strait Tropical Rock lobster Fishery stock is independent of the Queensland East Coast Tropical Rock Lobster Fishery stock. A spatial version of the model has been developed as part of an earlier MSE project, and can be used to investigate plausible linkages between these stocks (Plagányi *et al*. 2012, 2013).

The model includes three age-classes only (0+, 1+ and 2+ age lobsters) as it is assumed that lobsters migrate out of Torres Straits in October each year. Torres Strait TRL emigrate in spring (September-November) and breed during the subsequent summer (November-February) (MacFarlane and Moore 1986; Moore and Macfarlane 1984). A Beverton-Holt stock-recruitment relationship is used (Beverton and Holt 1957), allowing for annual fluctuation about the average value predicted by the recruitment curve. The model is fitted to the available abundance indices by maximising the likelihood function. Quasi-Newton minimisation is used to minimise the total negative log-likelihood function (using the package AD Model Builder™) (Fournier *et al*. 2012).

2.6 EMPIRICAL HARVEST CONTROL RULE

The empirical harvest control rule (eHCR) recommended by the RAG uses the pre-season survey 1+ and 0+ indices, both standardised CPUE indices (TVH and TIB), applies the natural logarithms of the slopes of the five most recent years' data and includes an upper catch limit of 1,000 t. The relative weightings of the eHCR indices are 70 per cent pre-season survey 1+ index, 10 per cent pre-season survey 0+ index, 10 per cent TIB sector standardised CPUE and 10 per cent TVH sector standardised CPUE.

The basic formula is:

$$
\begin{aligned}
RBC_{y+1} &= wt\_s1 \cdot \left(1 + s_y^{presurv,1}\right) \cdot \bar{C}_{y-4,y} + wt\_s2 \cdot \left(1 + s_y^{presurv,0}\right) \cdot \bar{C}_{y-4,y} \\
&\quad + wt\_c1 \cdot \left(1 + s_y^{CPUE,TVH}\right) \cdot \bar{C}_{y-4,y} + wt\_c2 \cdot \left(1 + s_y^{CPUE,TIB}\right) \cdot \bar{C}_{y-4,y}
\end{aligned}
$$

Or if RBC_{y+1} > 1000t, TAC_{y+1} = 1000.

Where:

$\bar{C}_{y-4,y}$ is the average achieved catch during the past 5 years, including the current year i.e. from year *y*-4 to year *y*,

$s_y^{presurv,1}$ is the slope of the logarithms of the preseason survey 1+ abundance index, based on the 5 most recent values;

$s_y^{presurv,0}$ is the slope of the logarithms of the preseason survey 0+ abundance index, based on the 5 most recent values;

$s_y^{CPUE,TVH}, s_y^{CPUE,TIB}$ is the slope of the logarithms of the TVH and TIB CPUE abundance index, based on the 5 most recent values;

wt_s1, wt_s2, wt_c1, wt_c2 are tuning parameters that assign relative weight to the preseason 1+ (wt_s1) and 0+ (wt_s2) survey trends compared with the CPUE TVH (wt_c1) and TIB (wt_c2) trends.

2.7 REFERENCE POINTS

The HS reference points are:

a) The unfished biomass B_0 is the model-estimate of spawning stock biomass in 1973 (start of the Fishery). $B_0 = B_{1973}$.

b) The target biomass B_{TARG} is the spawning biomass level equal to recent levels (2005-2015) that take account of the fact that the resource is shared and important for the traditional way of life and livelihood of traditional inhabitants and is biologically and economically acceptable. B_{TARG} is the proxy for B_{MEY}, $B_{TARG} = 0.65\ B_0$.

  - The agreed B_{TARG} is more precautionary than the default proxy B_{MEY} (biomass at maximum economic yield) level as outlined in the (HSP). The RAG noted a B_{TARG} higher that the HSP default was considered important for the Fishery because: 1) the stock: is a shared resource that is particularly important for traditional fishing; 2) the stock has high variability; and, 3) all industry members recommended the HS maintain the stock around the relatively high current levels (RAG meeting no. 17, 31 March 2016 and meeting no. 18, 2-3 August 2016).

c) The limit biomass B_{LIM} is the spawning biomass level below which the risk to the stock is unacceptably high and the stock is defined as 'overfished'. B_{LIM} is agreed to be half of B_{TARG}, $B_{LIM} = 0.32\ B_0$.

  - The agreed B_{LIM} is more precautionary than the default proxy HSP B_{LIM}.

d) If the limit reference point (B_{LIM}) is triggered in two successive years then the Fishery is closed.

e) The target fishing mortality rate F_{TARG} is the estimated level of fishing mortality rate that maintains the spawning biomass around B_{TARG}. $F_{TARG} = 0.15$.

  - $F_{TARG} = 0.15$ is the target fishing mortality rate that corresponds to an optimal level in terms of economic, biological and social considerations (RAG meeting no. 18, 2-3 August 2016).

Rational for reference points

The HSP recognises that each stock/species/fishery will require an approach tailored to the fishery circumstances, including species characteristics. The HSP identifies that for highly variable stocks that may naturally (in the absence of fishing) breach B_{LIM}, the default reference point proxies may not be appropriate. The HSP states 'with highly variable species it is important to develop a harvest strategy that meets the intent of the HSP.' Further, 'stocks that fall below B_{LIM} due to natural variability will still be subject to the recovery measures stipulated in the HSP.' A number of adaptive management approaches may be used to deal with this, such as pre-season surveys to provide estimates of abundance to which the eHCR is applied.

The Fishery is characterised by a highly variable stock where majority of the catch (since 2001 due to the introduction of a minimum size limit) is from a single cohort. The stock assessment model and MSE testing have identified the target biomass should be set between 65 and 80 per cent of the unfished biomass to account for the importance of the stock for the traditional way of life and livelihood of traditional inhabitants and to achieve biological and economic objectives. The HS higher average target biomass level, compared to the default HSP target of 0.48 per cent of unfished biomass, reduces the risk of recruitment being compromised.

The unfished biomass (B_0) is calculated within the stock assessment model, the value of unfished biomass and target biomass have therefore varied over time in response to annual data updates and model parameter settings and estimates. Estimates of unfished biomass and target biomass are particularly sensitive to changes to parameter *h*, which determines the steepness of the stock-recruit relationship, and the input parameter that controls the level of stock-recruit variability.

Independent of variability to the unfished biomass value, the target fishing mortality rate F_{TARG} =0.15 is applied to maintain the spawning biomass around the biomass target reference point (B_{TARG}), which is the average level over the past two decades. This is assumed to be a proxy for B_{MEY} because stakeholders agreed that this target level corresponded to an optimal level in terms of economic, biological and social considerations (TRLRAG meeting no. 18, 2-3 August 2016).

The biomass limit reference point (B_{LIM}) is 32 per cent of unfished biomass. The higher limit reference point, compared to the HSP proxy of 20 per cent of unfished biomass, is supported by recommendations of similar limit reference points for other highly variable species such as forage fish (Pikitch *et al.* 2012). Due to the changing values of unfished biomass and target biomass the value of the limit reference point, taken as half the target reference point, has previously varied between 32 and 40 per cent of unfished biomass.

Recent MSE testing identified that a limit reference point of 40 per cent unfished biomass is too conservative, it would result in the limit reference point being breached more frequently and add unnecessary precautionary to the HS The RAG agreed to set the limit reference point at 32 per cent of unfished biomass with the condition that if the stock falls below the limit reference point in two successive years it triggers a Fishery closure. The eHCR is more precautionary than the HSP criterion to ‘ensure that the stock stays above the limit biomass level at least 90 per cent of the time.’ The HSP states that for highly variable species the risk criterion can be amended to increase the frequency the limit reference point may be breached or by altering the reference point value.

2.8 eHCR AND STOCK ASSESSMENT CYCLE

The eHCR and stock assessment cycle is as follows:

- The eHCR is run in November each year to provide a RBC by 1 December for the following fishing season.
- A stock assessment is run on a three year cycle in March, unless the stock assessment is triggered by a decision rule **(Section 2.10)**. The stock assessment determines the Fishery stock status and evaluates the performance of the eHCR and identifies if any revisions to the eHCR are required.
- If the eHCR needs to be revised, the stock assessment is conducted annually to estimate the RBC until the revised eHCR is agreed.

2.9 DATA SUMMARY

The annual data summary reviews the nominal and standardised catch per unit effort (CPUE) from the TIB and TVH sectors, as well as total catch from all sectors, the size-frequency information provided from a sub-sample of commercially caught TRL and the fishery-independent survey indices of +0 and +1 age lobsters. The data summary is used as an indicator to identify if catches correspond to the RBC, and to monitor CPUE.

2.10 DECISION RULES

The decision rules for the Fishery Harvest Strategy are:

Maximum catch limit

- The eHCR includes a maximum catch limit of 1000 t. Once the HS is implemented the cap will be reviewed after three years using MSE testing with the updated stock assessment model.

Pre-season survey trigger

- If in any year the pre-season survey +1 indices is 1.25 or lower (average number of +1 age lobsters per survey transect) it triggers a stock assessment.

Biomass limit reference point triggered

- If the eHCR limit reference point is triggered in the first year, a stock assessment update must be conducted in March.
    - If after the first year the stock is assessed below the biomass limit reference point, it is optional to conduct a mid-season survey, the pre-season survey must continue annually.
- If the eHCR limit reference point is triggered two years in a row, a stock assessment must be conducted in December (of the second year).

Fishery closure rules

- If the stock assessment determines the stock to be below the biomass limit reference point in two successive years, the Fishery will be closed to commercial fishing.
    - Management strategy evaluation (MSE) testing of the eHCR has shown that it is extremely unlikely (<1%) for the Fishery to be closed based on its current performance.

Re-opening the Fishery

- Following closure of the Fishery, fishery-independent mid-season and pre-season surveys are mandatory. The Fishery can only be re-opened when a stock assessment determines the Fishery to be above the biomass limit reference point **(Attachment A, Figure 5)**.

Based on the decision rules, there are four alternative possible scenarios **(Section 2.11)** that may occur under the application of the eHCR. Graphic representations of the four scenarios are provided in **Attachment A**.

2.11 DECISION RULE SCENARIOS

Scenario 1 – eHCR limit not breached and the eHCR does not require revision

- The eHCR assesses the Fishery to be above the biomass limit reference point.
- The eHCR RBCs appear to remain within ranges tested by management strategy evaluation (MSE).
- The updated stock assessment does not indicate any need for revision of the HCR.
- Application of the eHCR continues unchanged.
- A graphic representation of Scenario 1 is provided in **Attachment A, Figure 1**.

Scenario 2 – eHCR limit not breached, eHCR and stock assessment require revision

- The eHCR assesses the Fishery to be above the biomass limit reference point.
- The eHCR RBCs appear to remain within ranges tested by MSE.
- The updated stock assessment indicates the eHCR recommended TACs are outside the revised ranges tested by MSE, indicating that the eHCR should be revised.
- Annual RBCs need to be set using annual stock assessments until a revised eHCR has been agreed, after which the revised eHCR is applied.

A graphic representation of Scenario 2 is provided in **Attachment A, Figure 2**.

Scenario 3– limit is breached, eHCR is reviewed by stock assessment and the limit is not breached

- The eHCR assesses the Fishery to be below the biomass limit reference point in one year.
- A stock assessment update (March) is required to confirm if the limit has indeed been breached. This assessment update determines that the limit has not been breached.
- If the biomass limit reference point is breached once, discussions will be held on preventative measures to reduce the risk of closure.
- The eHCR RBC is applied and consideration is given to revising the eHCR to prevent future incorrect triggering of the biomass limit reference point.
- The stock assessment continues on a three year cycle, unless triggered to occur by a decision rule.
- A graphic representation of Scenario 3 is provided in **Attachment A, Figure 3**.

Scenario 4 – limit is breached, stock assessment confirms the limit is breached

- The eHCR assesses the Fishery to be below the biomass limit reference point in two successive years.

- A stock assessment update (March) is required to confirm if the limit has been breached. This assessment update determines that the limit has been breached.

- The eHCR assesses the Fishery to be below the biomass limit reference point for a second successive year.

- A second stock assessment update (December) is required to confirm whether the trigger has been breached a second time. This assessment update determines that the limit has been breached a second time.

- The commercial fishery is closed until an assessment update confirms that the stock has recovered to above the limit.

    - If the Fishery is closed to commercial fishing, discussions are held on future management arrangements.
    - Fishery independent mid-season and pre-season surveys are mandatory and conducted on an annual basis. The Fishery will only re-open when the Fishery is assessed to be above the biomass limit reference point by the stock assessment.
    - The eHCR must be revised before being re-implemented to reduce the risk of the Fishery breaching the biomass limit reference point and for the eHCR to incorporate rebuilding requirements.

- A graphic representation of Scenario 4 is provided in **Attachment A, Figure 4**.

2.12 GOVERNANCE

The status of the Fishery and how it is tracking against the HS is reported to the RAG, Working Group and the PZJA as part of the yearly RBC and TAC setting process.

2.13 REVIEW

Under certain circumstances, it may be necessary to amend the harvest strategy. For example if:

- there is new information that substantially changes the status of a fishery, leading to improved estimates of indicators relative to reference points; or

- drivers external to management of the fishery increase the risk to fish stock/s; or

- it is clear the strategy is not working effectively and the intent of the HSP is not being met; or

- alternative techniques are developed (or a more expensive but potentially more cost-effective harvest strategy that includes mid-year surveys and annual assessments is agreed) for assessing the Fishery. The HSF may be amended to incorporate decision rules appropriate for those assessments.

3 REFERENCES

Bentley, N. 2006. Review of chapter 5 of Ye et al (2006) “Sustainability Assessment of the Torres Strait Rock Lobster Fishery”. Report submitted to AFMA.

Beverton, R.; Holt, S. On the dynamics of exploited fish populations. UK Ministry of Agriculture and Fisheries Investigations (Ser 2). 19; 1957.

Fournier, D.A.; Skaug, H.J.; Ancheta, J.; Ianelli, J.; Magnusson, A.; Maunder, M.N.; Nielsen, A.; Sibert, J. AD Model Builder: using automatic differentiation for statistical inference of highly parameterized complex nonlinear models. Optimization Methods and Software. 27:233-249; 2012.

MacFarlane, J.; Moore, R. Reproduction of the ornate rock lobster, Panulirus ornatus (Fabricius), in Papua New Guinea. Mar Freshwater Res. 37:55-65; 1986.

Moore, R.; Macfarlane, J.W. Migration of the Ornate Rock Lobster, Panulirus-Ornatus (Fabricius), in Papua-New-Guinea. Aust J Mar Fresh Res. 35:197-212; 1984.

Pikitch, E., Boersma, P.D., Boyd, I.L., Conover, D.O., Cury, P., Essington, T., Heppell, S.S., Houde, E.D., Mangel, M., Pauly, D. Plagányi, É.E., Sainsbury, K., and R.S. Steneck. 2012. Little Fish, Big Impact: Managing a crucial link in ocean food webs. Lenfest Ocean Program. Washington, DC. 108 pp.

Plagányi, É.E., Darren Dennis, Marco Kienzle, Yimin Ye, Michael Haywood, Ian Mcleod, Ted Wassenberg, Richard Pillans, Quinton Dell, Greg Coman, Mark Tonks, Nicole Murphy (2009). TAC estimation & relative lobster abundance surveys 2008/09. AFMA Project Number: 2008/837. CSIRO Final Report, October 2009. 80 pp.

Plagányi, É.E., Kienzle, M., Dennis, D., Venables, W. Tonks, M., Murphy, N. and T. Wassenberg, 2010. Refined stock assessment and TAC estimation for the Torres Strait rock lobster (TRL) fishery. Australian Fisheries Management Authority Torres Strait Research program Final Report. AFMA Project number: 2009/845. 84 pp.

Plagányi, É.; Deng, R.; Dennis, D.; Hutton, T.; Pascoe, S.; van Putten, I.; Skewes, T. An integrated Management Strategy Evaluation (MSE) for the Torres Strait Tropical Rock Lobster Panulirus ornatus fishery. CSIRO/AFMA Final Project Report; 2012.

Plaganyi, E.E.; van Putten, I.; Hutton, T.; Deng, R.A.; Dennis, D.; Pascoe, S.; Skewes, T.; Campbell, R.A. Integrating indigenous livelihood and lifestyle objectives in managing a natural resource. P Natl Acad Sci USA. 110:3639-3644; 2013.

Ye, Y., Dennis, D., Skewes, T. (2008). Estimating the sustainable lobster (*Panulirus ornatus*) catch in Torres Strait, Australia, using an age-structured stock assessment model. *Continental Shelf Research.* **28:** 2160-67.

Potential process and timeline for setting a final TAC using the proposed empirical Harvest Control Rule OR integrated stock assessment

Steps	Description	Timeline
Pre-season survey	Generally conducted between 5 and 20 November.	November
Assessment	Empirical Harvest Control Rule (eHCR) within 2-3 weeks of the pre-season survey.	Late November- early Dec
	Preliminary stock assessment results within 4-5 weeks of the pre-season survey.	Mid-late December
TRLRAG and TRLWG advice	If applying the eHCR. TRLRAG and TRLWG to convene on consecutive days.	Mid-late December
	If applying the stock assessment model. TRLRAG to meet mid-late December to consider preliminary stock assessment results, then the TRLRAG and TRLWG to convene in Early February on consecutive days to consider final stock assessment results.	Preliminary - mid-late Dec Final – Early February
Treaty obligations (agree global TAC and catch shares)	If applying the eHCR.	Mid-late January
	If applying the stock assessment model.	Mid-February
PZJA decision (within 4 weeks of TRLRAG/WG meetings	If applying the eHCR.	End- January
	If applying the stock assessment model.	End of February

Notes:

- Timeline does not include determining an initial TAC.
- PZJA out-of-session decisions ordinarily take three months.

- Historically final TRLRAG advice on the season RBC/TAC is settled in March.
- Seeking administrative decisions (and systems implementation of those decisions) carries some risk over the Christmas period due to the availability of staff and decision makers. This risk was a primary diver for moving fishing season start dates for some Commonwealth fisheries from 1 January to later in the year.

Implementation requirements for changing the fishing season dates

In order to implement a change to the TRL Fishery fishing season dates, the following will need to occur and will require a lead time of at least 6 months:

d. RAG to recommend a change to the fishing season dates;

e. Working Group to recommend a change to the fishing season dates and any other associated management changes;

f. RAG to endorse a method for calculating the TAC during the changeover between the two fishing season dates;

g. PZJA to make the decision to change the fishing season dates and any other associated management changes;

h. Backend adjustments to AFMA IT systems;

i. Amendment to *Torres Strait Fisheries (Tropical Rock Lobster) Management Instrument 2018* (the Instrument) to give effect to the change to fishing season dates and any other associated management changes;

j. Changes to individual staff work plans to ensure resources are available to complete the schedule of tasks.

Monthly catches by season

Source: *Torres Strait Rock Lobster Fishery – Summary of the Catch and Effort Data pertaining to the 2018 Fishing Season (Dec-17 to Jul-18)*

SEASON	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
2004	4,949	15,994	83,274	108,754	74,879	100,907	107,954	92,215	66,990	35,498	24	25	691,463
2005	26,632	15,496	159,587	164,497	121,085	116,233	96,679	94,577	75,477	46,902	314	71	917,550
2006	12,532	9,447	46,530	51,674	36,582	33,178	21,304	31,862	24,428	8,336	0	51	275,924
2007	19,002	24,941	45,484	103,429	77,165	96,692	77,861	49,882	27,540	15,288	0	0	537,284
2008	10,435	13,461	43,522	53,293	34,444	27,520	22,802	38,998	26,096	15,514	18	0	286,103
2009	9,716	13,273	34,452	41,984	36,481	26,126	26,650	23,217	18,156	8,289	529	0	238,873
2010	5,764	6,198	48,570	47,993	44,197	41,372	46,663	63,807	69,027	47,452	1,610	0	422,653
2011	6,929	18,215	100,135	135,497	103,734	89,505	80,770	80,723	53,955	33,131	0	0	702,594
2012	9,036	13,403	58,256	84,354	71,302	44,848	62,681	80,912	59,795	28,276	0	0	512,863
2013	3,080	1,371	71,368	54,696	66,707	63,636	57,826	75,474	62,046	43,895	0	0	500,100
2014	10,773	13,339	65,717	75,626	58,615	67,543	55,068	56,516	40,806	25,852	187	0	470,041
2015	18,513	9,495	64,805	42,838	51,507	34,835	62,425	27,664	31,601	13,403	283	0	357,369
2016	10,156	16,354	98,934	68,236	47,650	74,392	76,558	53,879	41,289	19,900	220	168	507,735
2017	12,226	9,341	60,771	33,309	29,398	38,941	27,035	25,835	23,742	6,876	155	0	267,629
2018	15,097	13,632	66,137	44,544	39,866	10,238	13,257	52,030	0	0	0	0	254,801

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
DRAFT FIVE-YEAR RESEARCH PLAN FOR 2019/20 TO 2022/23	**Agenda Item 9** **For Discussion and Advice**

RECOMMENDATIONS

1. That the RAG:

   a. **DISCUSS** and **PROVIDE ADVICE** on the draft Rolling Five Year Research Plan for 2019/20-2022/23 for the Torres Strait Tropical Rock Lobster (TRL) Fishery (**Attachment 9a**); and

   b. **NOTE** that the Rolling Five Year Research Plan will be used to inform the Torres Strait Scientific Advisory Committee's (TSSAC) annual call for research funding proposals.

KEY ISSUES

2. Research needs for the TRL Fishery have been previously identified in the TSSAC Annual Operational Plan (2015) (AOP). The AOP and research that has been more recently conducted against those needs is shown at **Attachment 9b**. The RAG has also provided advice on research and data needs over the last few years. This advice is summarised in **Attachment 9c**.

3. The AOP has now been replaced by Rolling Five Year Research Plans (Further detail in Background section). AFMA has drafted a Rolling Five Year Research Plan for the TRL Fishery (**Attachment 9a**). This has been prepared as a starting point for RAG discussion. Research priorities proposed align with the new TSSAC Strategic Research Plan (SRP) Theme 1, Strategy 1a – Fishery stocks, biology and marine environment and Theme 3, Strategy 3a – Develop technology to support the management of Torres Strait fisheries. It is open to the RAG to provide advice on broader priorities.

4. Having regard for RAG advice a final Rolling Five Year Research Plan will be prepared and provided to the WG for consideration. It is necessary that the WG consider the plan before submitting to the TSSAC. TSSAC will consider the plan at its meeting in December.

Climate change

5. Understanding the impacts of climate change and having adaptable management arrangements is a priority for fisheries management. At its meeting on 4-5 April 2017 the RAG considered updates on climate change initiatives and needs relevant to Torres Strait Fisheries. Since that meeting the CSIRO led *Decadal-Scale Forecasting of Australian Fish and Fisheries* project has been completed and the AFMA led project on the adaption of *Commonwealth fisheries management to climate change* has commenced. A non-technical summary of the decadal-scale forecasting project is provided at **Attachment 9d.**

6. In terms of assessing the likely impacts of climate change on Torres Strait Fisheries the following has been undertaken:

   a. Qualitative Sensitivity Analysis: Assessing the vulnerability of Torres Strait fisheries and supporting habitats to climate change (Welch and Johnson 2013);

   b. Management Strategy Evaluation to integrate climate changes into the TRL Stock Assessment: An Integrated Management Strategy Evaluation (MSE) for the Torres Strait Rock Lobster *Panulirus ornatus* fishery (Plaganyi *et al* 2012);

c. System Modelling: Models of Intermediate Complexity of Ecosystems (MICE) – applied to TRL in the Torres Strait. Used in the following projects:

   i. AFMA project 2017/0816 – Environmental drivers of variability and climate projections for the Torres Strait tropical lobster *Panulirus ornatus.* (Plaganyi *et al* 2018).

   ii. Decadal-Scale Forecasting of Australian Fish and Fisheries (Fulton *et al 2018*).

7. In June 2018 the TSRA and National Environmental Science Programs (NESP) Earth Systems and Climate Change Hub convened a workshop on climate change implications for fisheries and marine ecosystems in the Torres Strait. The workshop identified initial thoughts on priority areas for research that may help fisheries and marine ecosystem management in the Torres Strait (**Attachment 9e**).

8. AFMA's adaption project is due for completion in 2020. The objectives are:

   a) How well does existing Commonwealth fisheries management framework cope with climate change impacts (i.e. Risk Assessment);

   b) Develop methodology and approach for AFMA (and other fisheries) to adapt regulatory environment to climate change impacts;

   c) Develop strategies and priorities to account for effects of climate change in management of fisheries.

9. Whilst AFMA adaption project and is likely to give some guidance around future research investment into possible management responses to the impacts of climate change on Torres Strait Fisheries, RAG advice is sought on other priorities, in particular to address any gaps in assessing vulnerability.

BACKGROUND

10. Over the past 12 months, AFMA and the TSSAC have been drafting a new five year SRP for Torres Strait research. The SRP is the overarching document providing the TSSAC's strategic themes which guide priority setting for research in the Torres Strait fisheries over a five year period. The document identifies three research themes, and under these, strategies and possible research activities against these themes. The document also provides guidance to researchers on research application development and the TSSAC and PZJA forums in assessing applications through the assessment criteria in the SRPs appendices. The SRP was finalised by the TSSAC in mid-July. A copy of the SRP is provided at **Attachment 9f**.

11. The TSSAC now requires each fishery to develop a rolling five year research plan, which fits into the themes identified in this SRP.

Torres Strait Fisheries Strategic Research Plan 2018-2023

12. The SRP specifies the research priorities and strategies that the PZJA intend to pursue in Torres Strait fisheries, and provides background to the processes used to call for, and assess, research proposals. The research priorities can be broad, covering all topics within the SRP, some of which may be funded by AFMA, and some of which may require funding from other funding bodies.

13. There are 3 research themes, under which the RAG could identify research priorities for the TRL Fishery (**Attachment 9g**). This has been taken from the SRP. There are several strategies under each theme and suggested ideas to help RAGs consider the sorts of projects which may go under these themes and strategies.

Rolling five year research plans

14. In the past, fishery specific research planning was undertaken through fishery specific research priorities being included in the SRP and each Torres Strait fishery completing a

list of annual research priorities, which fed into the TSSAC annual research statement. This process has now been simplified by combining individual fishery planning into one rolling five year research plan per fishery. The plans are written by the relevant Torres Strait forum (Working group, MAC or RAG) based on the themes and strategies identified in the 5 year SRP. These plans are then used by AFMA and the TSSAC to create an annual research statement (ARS), listing annual priorities for Torres Strait research across all fisheries. The new plan should simplify this process.

15. The rolling five year research plans will be updated annually, thus always having a five year projection for research. It is possible that these plans will not be finalised in time for the development of the TSSAC 2019-20 ARS. In this case, fisheries will be asked to submit a one year list of research priorities for 2019-20, and the rolling five year research plan will be applied to the following year (2020-2021 and beyond).

TSSAC Annual Research Statement

16. In the past, the TSSAC has had an Annual Operational Plan (AOP) which detailed its annual research priorities, in addition to the fishery specific annual priorities. The AOP has been changed to the Annual Research Statement (ARS). The ARS includes only the limited number of priority projects selected by the TSSAC to progress to funding application stage through a ranking process.

17. It is developed based on the project ideas and priorities identified in each rolling five year research plan. The number of projects in the ARS will vary each year depending on the available funding. The ARS details:

    a. Current research project ideas identified by the TSSAC, as priority areas for research. The TSSAC will prioritise the projects based on the evaluation criteria and develop project scopes for the chosen priorities. This document will then be sent to researchers in a call for research each year.

    b. The operational aspects of assessment and evaluation of research proposals considered by the TSSAC including:

        i. How the TSSAC prioritise research projects;

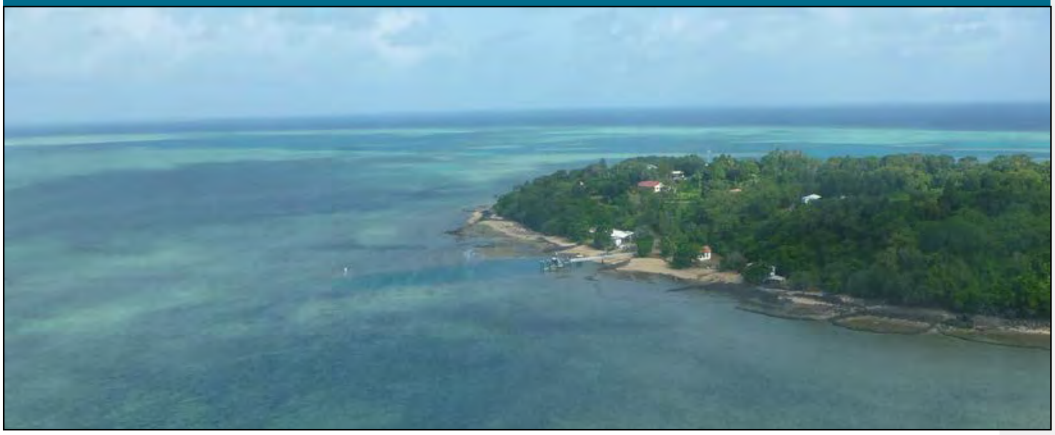
        ii. The criteria used for assessing research proposals.

18. The TSSAC has an annual research cycle, which fits with the AFMA budgeting cycle (**Attachment 9h**).

Rolling Five Year Research Plan

2019/20-2022/23

Torres Strait Tropical Rock Lobster Fishery



Compiled by AFMA

October 2018

ABOUT THIS PLAN

The Torres Strait Scientific Advisory Committee (TSSAC) seeks input from each fishery advisory body (Resource Assessment Group (RAG), Management Advisory Committee (MAC) or Working Group (WG)) to identify research priorities over five year periods from 2019/2020 to 2022/23. This template is to be used by the relevant advisory body to complete their five-year plan. The plans are to be developed in conjunction with the TSSAC Five-year Strategic Research Plan (SRP) with a focus on the three research themes and associated strategies within the SRP.

All fishery five-year plans will be assessed by the TSSAC using a set of criteria, and used to produce an Annual Research Statement for all Torres Strait fisheries.

The TSSAC then develop scopes for the highest ranking projects in order to publish its annual call for research proposals. There are likely to be more scopes that funding will provide for so TSSAC can consider a number of proposals before deciding where to commit funding.

The fishery five-year plans are to be reviewed and updated annually by the Torres Strait forums to add an additional year onto the end to ensure the plans maintain a five year projection for priority research. Priorities may also change during the review if needed.

RESEARCH PRIORITIES

Table 1. Five year Torres Strait Tropical Rock Lobster Fishery research plan for 2018/19 – 2022/23.

Proposed Project	Objectives and component tasks	Year project to be carried out and indicative cost*						Other funding bodies[1]	Evaluation		
		2018/19	2019/20	2020/21	2021/22	2022/23	Notes on project timings		Priority essential /desirable	Priority ranking (1-5 – 1 being highest priority)	Theme
Fishery surveys, stock assessment, harvest control rules and recommended biological catch (RBC)	Monitor ongoing changes in the fishery and update or develop fishery performance indicators as required; Recommend a recommended biological catch (RBC) annually for each season; Every third year update and implement the long-term stock assessment; Conduct a pre-season survey in November each year, including seabed habitat monitoring; Continue development of a harvest strategy for the TRL Fishery including an empirical harvest control rule.	277,477 (funded under 2016/ 0822)	260,000	240,000	240,000	240,000	Nil	CSIRO (in-kind)	Essential	1	1

Commented [CN1]: Needs 1a-1d and 2a from the 2015 AOP have been rewritten to reflect work completed under the existing project (AFMA project 2016/0822 -Torres Strait Tropical Rock Lobster fishery surveys, stock assessment, harvest control rules and RBC) and to provide a single project description. Advice sought on project description (e.g. any additional component tasks for inclusion).

Ecological risk assessment (ERA)	Conduct an update to the 2007 ERA for the TRL Fishery.	0	20,400	0	0	0	Nil		Desirable	3	1
Tiered harvest strategy	Development of a tiered harvest strategy for the TRL Fishery.	TBA	TBA	TBA	TBA	TBA	Nil		Desirable	3	1
Stock assessment peer review	Consistent with best practice Guidelines for quality assurance of Australian fisheries research and science information (the Guidelines), a peer review be conducted of the TRL Fishery survey design, stock assessment and draft Harvest Strategy.	0	10,000-30,000 (depen-dent on final scope)	0	0	0	Nil		Desirable	3	1
Understanding changes to fishing power overtime	Understanding changes in fishing behaviour and power over time (e.g. changes to the size of engines, use of GPS, gear, areas fished, time fished, experience of divers), to inform the standardisation of CPUE data.	TBA	TBA	TBA	TBA	TBA	Nil		Desirable	5	1
Understanding fishing behaviour	Understanding the drivers and incentives in determining fishing behaviour in all sectors; Understanding fishing behaviour under output	TBA	TBA	TBA	TBA	TBA	Nil		Desirable	5	1

Commented [CN2]: New research need (i.e. not identified in 2015 AOP). Advice is sought on timing and level of priority.

Commented [CN3]: New research need (i.e. not identified in 2015 AOP). Considered at TRLRAG 19 (December 2016) – refer to **Attachment 9i**. Advice sought on indicative costing, timing and level of priority.

Commented [CN4]: New research need (i.e. not identified in 2015 AOP). To be discussed under Agenda Item 6. Advice sought on form and scope of project, and timing and level of priority.

Commented [CN5]: New research need (i.e. not identified in 2015 AOP). Advice sought on form of project, and on indicative costing, timing and level of priority. To be discussed under Agenda Item 6.

Commented [CN6]: These are needs 3a-3b of the 2015 AOP. The 2012 MSE project (AFMA project 2009/0839 - An integrated Management Strategy Evaluation (MSE) for the Torres Strait tropical rock lobster *Panulirus ornatus* fishery) modelled some behavioural impacts that might occur in the fishery and impacts of different quota allocation arrangements. Advice sought on form of project (e.g. should it be integrated with the above) and on indicative costing, timing and level of priority.

	controls: the impact of ITQs or competitive quota on the fishery; the extent and impact of discard mortality; the effect of changing market preferences on fishing behaviour under output controls; the extent of value adding e.g. moving to live product, targeting different sizes; the extent of high grading under output controls.										
Continuation and improvement of data collection	Improved monitoring of commercial catch and effort in all sectors of the fishery; Estimate of non-commercial take of TRL; Alternative monitoring techniques of effort, for example GPS tracking; Understanding the effect of the use of hookah on recruitment of stock on shallow reefs.	TBA	TBA	TBA	TBA	TBA	Nil		Desirable	5	1,3
Movement and recruitment connectivity between areas within Torres	Understanding of migration of settled lobster between, and within, jurisdictions. e.g.	TBA	TBA	TBA	TBA	TBA	Nil		Desirable	5	1

Commented [CN7]: This is need 2b of the 2015 AOP. Advice sought on whether to retain this research need in this Plan, noting this is being pursued through the implementation of the Fish Receiver System and proposed amendments to the *Torres Strait Fisheries Act 1984*.

Commented [CN8]: This is need 2c of the 2015 AOP. Advice sought on indicative costing, timing and level of priority.

Commented [CN9]: This is need 2d of the 2015 AOP. Advice sought on whether to retain this research need in this Plan. If so, clarification of need required.

Commented [CN10]: This is need 1e of the 2015 AOP. Advice sought on whether to retain this research need in this Plan.

Commented [CN11]: This is need 4a-4b of the 2015 AOP. These needs were pursued by the 2018 environmental drivers project (AFMA project 2017/0816 - Environmental drivers of variability and climate projections for the Torres Strait tropical lobster *Panulirus ornatus*). The project has been completed but the oceanographic model underlying CONNIE 3 does not resolve the complex tides in Torres Strait and ongoing work is needed on the complex system dynamics of the Coral Sea and Torres Strait. Advice sought if additional work required, and if so a description of its scope and on indicative costing, timing and level of priority.

Strait and between Torres Strait and neighbouring jurisdictions, including QLD and PNG	linkages between deep and shallow and among reefs; Understanding of recruitment connectivity between, and within, jurisdictions; Management implications of movement and recruitment connectivity between, and within, jurisdictions.										
Environmental impacts	Collect relevant baseline information to assess environmental change impacts on TRL populations; Analyse the impact of environmental change on the TRL Fishery.	TBA	TBA	TBA	TBA	TBA	Nil		Desirable	5	1

Commented [CN12]: This is need 5a-5b of the 2015 AOP. These needs have been pursued through collection of data through TRL surveys. Some habitat monitoring is also undertaken by the TSRA. A number of projects investigating the impacts of climate change have also been undertaken. Advice sought on retention of these research needs in this Plan e.g. are there are other more specific climate change vulnerability work that should be pursued?

2015 Annual Operational Plan – research priorities for the TRL Fishery and research projects conducted

AOP 2015		Research project
Research area	**Research need**	
1. Providing advice for fisheries management	a. Evaluation of alternative management strategies including harvest control rules and spatial and seasonal management controls b. Development of simulation operating models of the fishery to be used for the evaluation of management strategies c. Regular updates of stock assessments to provide estimates of stock status and reference points d. Improved monitoring of catch and effort in all sectors of the fishery e. Understanding the effect of the use of hookah on recruitment of stock on shallow reefs	Needs 1a-1d pursued by AFMA project 2016/0822 – Torres Strait Tropical Rock Lobster fishery surveys, stock assessment, harvest control rules and RBC. This is an ongoing project for the TRL Fishery.
2. Continuation and improvement of data collection	a. Fishery independent surveys of resource abundance b. Improved monitoring of commercial catch and effort in all sectors of the fishery c. Estimate of non-commercial take of rock lobsters d. Alternative monitoring techniques of stock status, for example GPS tracking	Need 2a pursued by AFMA project 2016/1201 – Torres Strait Tropical Rock Lobster fishery surveys, stock assessment, harvest control rules and RBC. This is an ongoing project for the TRL Fishery. Need 2b pursued through implementation of the Fish Receiver System and proposed amendments to the *Torres Strait Fisheries Act 1984*.
3. Understanding fishing behaviour	a. Understanding the drivers and incentives in determining fishing behaviour in all sectors b. Understanding fishing behaviour under output controls: i. the impact of ITQs or competitive quota on the fishery; ii. the extent and impact of discard mortality; iii. the effect of changing market preferences on fishing behaviour under	

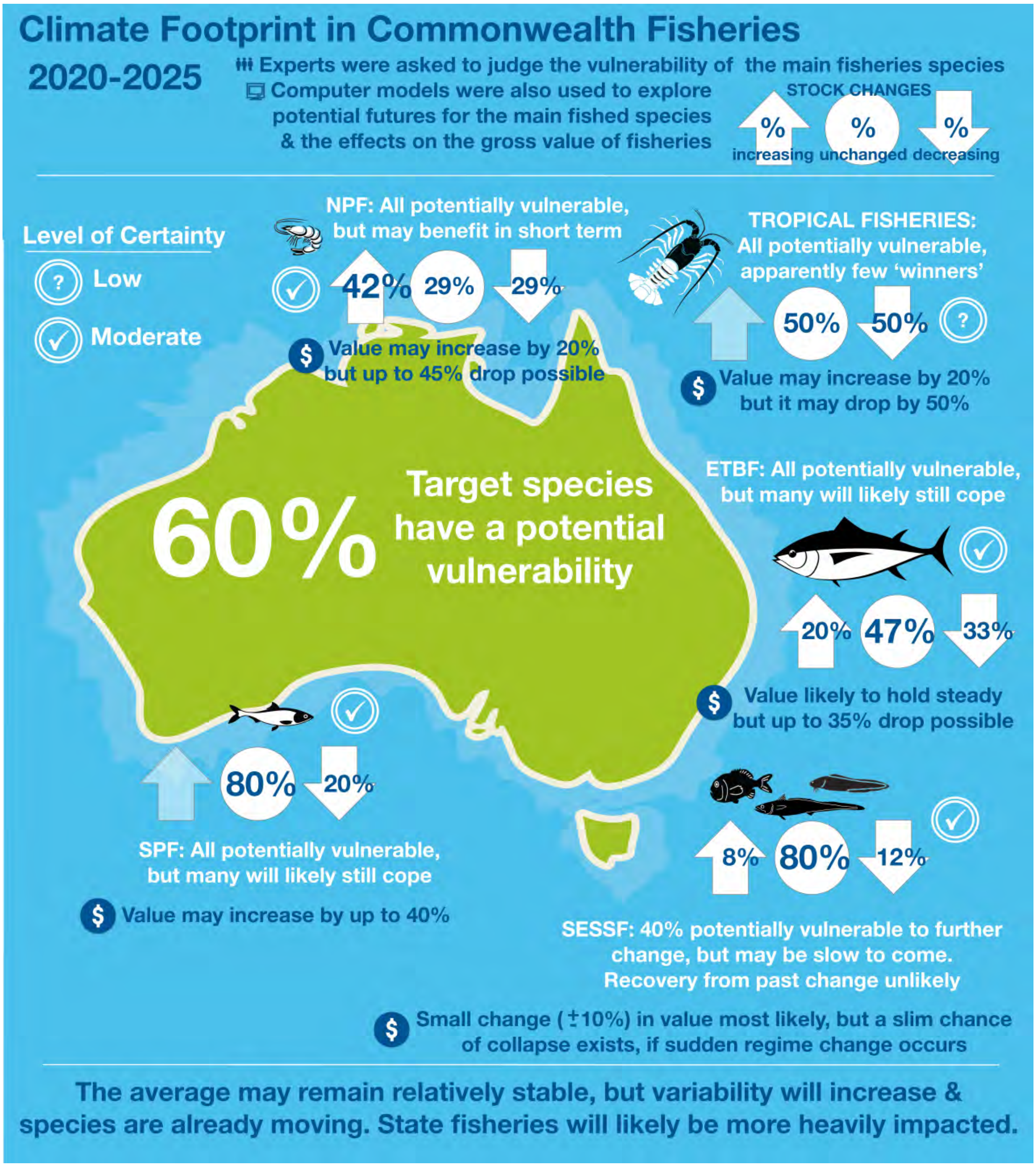
	output controls; iv. the extent of value adding e.g. moving to live product, targeting different sizes; v. the extent of high grading under output controls.	
4. Movement and recruitment connectivity between areas within Torres Strait and between Torres Strait and neighbouring jurisdictions, including QLD and PNG	a. Understanding of migration of settled lobster between, and within, jurisdictions. e.g. linkages between deep and shallow and among reefs; b. Understanding of recruitment connectivity between, and within, jurisdictions; c. Management implications of movement and recruitment connectivity between, and within, jurisdictions.	Needs 4a-4c pursued by AFMA project 2017/0816 – Environmental drivers of variability and climate projections for the Torres Strait tropical lobster *Panulirus ornatus*. Project has been completed but the oceanographic model underlying CONNIE 3 does not resolve the complex tides in Torres Strait and ongoing work is needed on the complex system dynamics of the Coral Sea and Torres Strait.
5. Environmental impacts	a. Collect relevant baseline information to assess environmental change impacts on lobster populations b. Analyse the impact of environmental change on the fishery	Need 5a pursued through collection of data through TRL surveys. Some habitat monitoring is also undertaken by the TSRA. Need 5b has been pursued through a number of projects investigating the impacts of climate change – as discussed above.

Advice from the TRL Resource Assessment Group on research and data needs

Meeting	Description	Member discussion
TRLRAG19 (13 Dec 16)	**Discard data** Data on discards, an important source of mortality for the TRL stock, is not currently collected.	The RAG agreed that AFMA look into incorporating discards into the Torres Strait Fisheries Catch Disposal Record (TDB02).
TRLRAG19 (13 Dec 16)	**Tiered harvest strategy** The amount and quality of data and surveys available to inform assessments of the TRL stock has varied over time. A tiered harvest strategy approach would be better able to accommodate potential changes in the amount of monitoring information available as well as number and timing of surveys and hence changes in the associated level of confidence in the scientific advice for decision making	The RAG noted that further work is required to develop a tiered approach for the TRL Harvest Strategy and that development of a tiered approach will be considered by the RAG in the future (**Attachment 9i**).
TRLRAG23 (23 May 18)	**Fishery-dependent data** A range of improvements are needed to the catch and effort data used in assessments of the TRL stock.	The RAG recommended that the accuracy of catch and effort data for the TRL Fishery be improved as a matter of priority, with a particular focus on: a. improving the accuracy of the spatial information on catch and effort data (e.g. point of capture as opposed to point of anchoring or landing) and providing further guidance to fishers on how this data should be recorded; b. developing a finer scale measure of effort for the TDB02 catch disposal record (e.g. 'hours fished' as opposed to 'days fished') and providing further guidance to all fishers on how effort should be recorded in both the TDB02 catch disposal record and TRL04 logbook (e.g. to include time spent travelling, searching and actively fishing); c. developing a better understanding on changes in fishing behaviour and power over time (e.g. changes to the size of engines, use of GPS, gear, areas fished, time fished, experience of divers), to inform the standardisation of CPUE data. This should be done through close consultation with industry; d. in the longer term, consider the inclusion of travelling time, searching time and fishing time as separate effort fields in the logbooks.

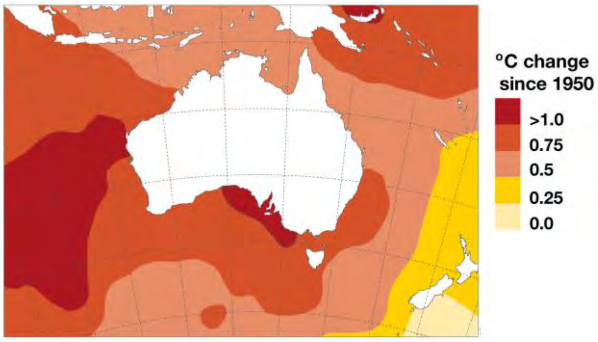
Australian fisheries stocks under climate change

Over the next twenty years Australia's marine ecosystems are expected to exhibit some of the largest climate-driven changes in the Southern Hemisphere. These changes will extend from the ecosystems to the local communities and businesses of the Australian fisheries sector. The CSIRO and its collaborators have pulled together all available information on how climate may affect fished species in Australia – identifying those most sensitive to climate. This information helps highlight those species that may be at risk and those that might benefit, allowing fisheries to be better prepared.



Climate change in Australian Waters

Australia's oceans are undergoing rapid change. The waters off south-east and south-west Australia are hotspots, warming much more rapidly than most of the world's oceans. Australia's tropical ocean is also warming rapidly, almost twice as fast as average for the rest of the world. It is important to understand what this means for the ecosystems in these warming waters if we are to continue to be sustainably manage Australian fisheries. Understanding the changes and being climate ready is important for both industry and management, because it allows them to plan their operations to avoid or mitigate negative impacts and to make the most of new opportunities that arise.



Water temperature change around Australia since 1950. Image updated from BOM data. These temperature increases mean water temperatures often record breaking.

Australian fish species have already begun to move. Over 100 Australian species have already started migrating south towards cooler southern waters. There have also been a series of marine heatwaves and other extreme events that have harmed Australia's seagrass, kelp forests, mangroves and coral reefs. These changes in the distribution, abundance and species composition in Australia's marine ecosystems mean that Australia's commercial fisheries are being affected by climate change. It is unavoidable. The ocean also has a long memory, which means that the effects of past and present human activities have already locked the world in to a further 0.5-1 °C warming. This is why fisheries managers (e.g. at AFMA) have asked for a rapid and thorough update of information so that they can base their strategic planning on the latest and best information.

Sensitivity of Australian Fisheries Target Species

Australian fisheries catch more than 100 species. There is not enough data or resources available to perform fine scale assessments for each species. Instead experts on the fisheries and target species were asked identify the key target species in State and Commonwealth fisheries. The experts then had to rank each species in terms of how sensitive it was to climate change. This sensitivity was judged in terms of factors that affect:

- abundance (how old they are when they mature, how often they reproduce, number of eggs, diet and habitat needs);
- movement and spatial distributions (distance they can move, how widely spread they are already, available habitats):
- behaviour (needing special triggers for reproduction or migration, having special behaviours that only happen for short periods)

Across all Australia 70% of all key target species are have moderate to high sensitivity in one of these factors. Within the AFMA managed fisheries at least 50% of the target species per fishery are moderately to highly sensitive and in many AFMA managed fisheries all the target species are sensitive in one way or another.

Most species were sensitive to factors determining their distribution or behaviour, while only about 25% were sensitive in terms of factors that directly influence abundance. The greatest sensitivity to the timing of key behaviours was along the coastline of eastern Australia (north and south), while shifts in distribution are the most likely responses in the west and in the tropical north. Invertebrates had higher sensitivity scores than other species. As a consequence, dive – and other gears targeting invertebrate – show the highest sensitivities. Purse seine fisheries for small pelagic species has the lowest sensitivities.

The sensitivity analysis suggests that fisheries should first consider how changes in distribution and the timing of key events affect them and their management and then consider potential than changes in abundance.

Sensitivity of Species Targeted by Australian Fisheries

Summary of sensitivity per fishery. Low sensitivity is for those species with a low rating across all 3 factors – abundance, distribution and behaviour. Moderate sensitivity indicates that a species had 1 factor that was scored as being moderately sensitive to climate change. High sensitivity covered both the case where a species was rated as having a factor that was highly sensitive to climate change or they had multiple factors rated as moderately sensitive. Sensitivity does not automatically indicate a likely decline it indicates the potential for change (including possible increases)

Commonwealth Fishery	Low	Moderate	High
Bass Strait Scallop			Scallops: behaviour and distribution
Coral Sea			Coral trout: distribution and abundance
Eastern Tuna and Billfish		Behaviour of all target species	
Northern Prawn			Behaviour and distribution of all target species
South and Eastern Scalefish and Shark	Species already showing shifts (warehou, morwong, redfish, ling) show low sensitivity to further climate driven change	Gemfish: abundance. Trevalla, flatheads, and whiting behaviour.	**All/majority** of properties of squids, sharks, blue grenadier and orange roughy.
Small Pelagics		Behaviour of sardine and blue mackerel	Jack mackerel and red bait behaviour and distribution
Torres Strait			**All** properties of tropical rock lobster
State Fisheries			
New South Wales, Victoria, South Australia		Behaviour of snapper, tuna and some small pelagics.	Many small pelagic, estuarine and invertebrate species (mainly via behaviour and distribution). **All** properties of sharks and blue grenadier.
Queensland		Behaviour of estuarine and shelf fish, as well as Spanish mackerel and billfish.	Behaviour and distribution of all reef fish. **All** properties of the majority of invertebrates and sharks.
Gulf of Carpentaria (Queensland and Northern Territory)	Bream and sharks	Majority of mackerels, estuarine fish and mangrove associated species (due to a mix of factors).	**All/majority** of properties of snappers, emperors and all valuable invertebrate species (prawns, lobster, sandfish).
Northern Territory and Western Australia	Many sharks, estuarine and large pelagic fish	Large sharks: abundance. Behaviour or distribution of fish non-reef shelf fish	**All/majority** of properties of reef associated fish and all invertebrates.
Western Australia		Distribution or behaviour of herring, reef associated predators, some abalone, octopus and sandfish.	**All/majority** of properties of prawns, crabs, many small pelagics, some abalone, oysters, bream and dhufish.

Fisheries projections

The other approach to consider the future climate change effects on Australia's fisheries was to take existing models of Australian marine ecosystems (which together cover the entire EEZ) and run them under the conditions that might exist over the next 40 years. The results of these models were then used to see how species abundance and distribution might change and how ecosystems might restructure.

The modelling work found that the different ecosystems around Australia face different types and levels of climate change – including temperature changes, changes in rainfall patterns, ocean acidification, shifting ocean oxygen levels. For fisheries as large as the SESSF different parts of a fishery will be undergoing different levels of change. In most instances, larger changes in the climate led to larger model responses. The tropics, however, might see some large changes despite only small shifts because those shifts will influence the productivity of phytoplankton that supports the entire food web.

Those models that only look at the physical environments preferred by species predicted there would be reasonably large declines for the majority of fish populations around Australia. However, once all the other processes that occur in ecosystems (e.g. feeding, movement, habitat use) were included in the models the picture is more complicated – some species decline, but others benefit and grow in abundance, though perhaps living in new locations.

The models also predict that the ecosystems will become more variable. The Tasman Sea, for example, could have strings of very productive years interspersed by series of years with exceptionally low production. This variability is reflected across the entire food web, with many of the species shifting their distributions in response – seeking out desirable habitats and food sources.

For many species the different models are in agreement, increasing confidence in the robustness of results. When the models disagree this highlights uncertainty and where more information is needed. Many of the species ranking highly in the sensitivity analysis also show enhanced responses to climate change in the models. In the short term many of the models predict little further change for most species (noting that this means that already depleted species do not show signs of recovery). Further in to the future (30-40 years) things become more uncertain, with the different models not always agreeing on whether species will increase or decrease in abundance. This is because simple physical responses alone may not dictate a species response to climate change. As abundances change, predation and competition within food webs will also change. This means that new or novel food webs may form, changing ecosystems unexpected ways. In some regions (such as south eastern Australia) the ecosystem may eventually shift into a new state that is quite different to today, though this will be dependent on exactly how the physical climate drivers interact with the many different responses of all the species making up the food web and habitats in that region.

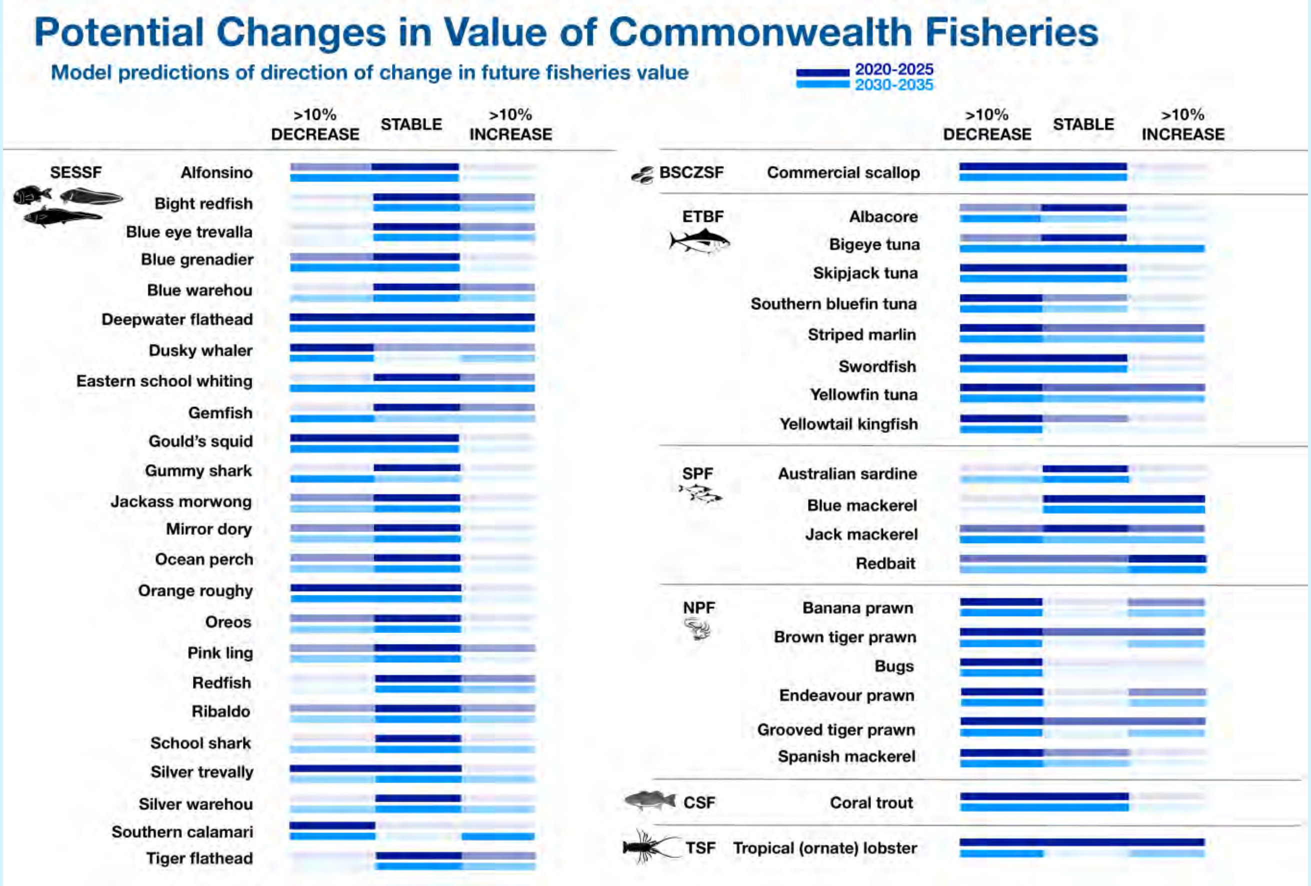
Implications of Climate Change

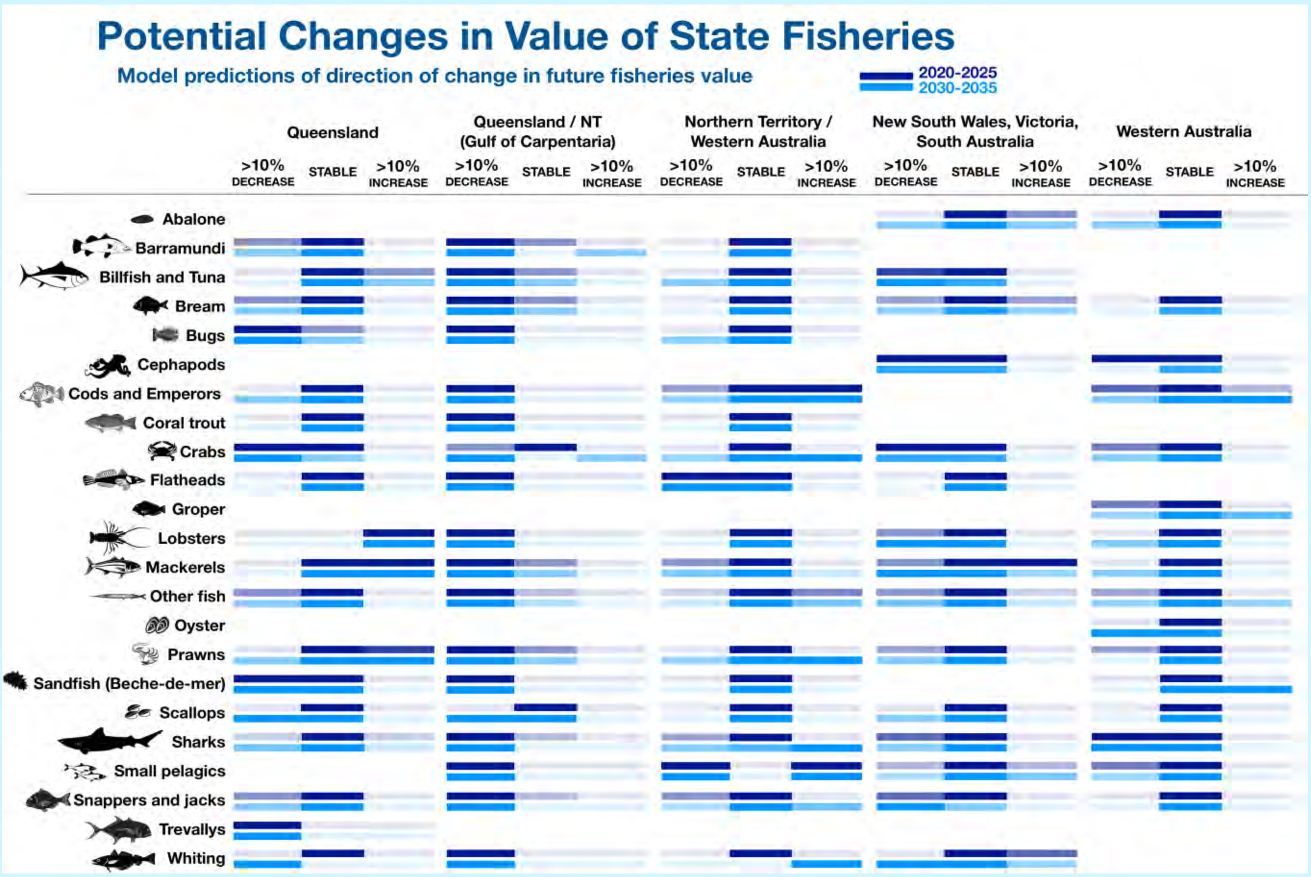
It is clear from the changes that have already occurred, and what the sensitivity and models predict, that there will be strong differences in the level of effects and responses across different species and food webs. Demersal food webs, those species that live near to or amongst habitats on the seabed, appear to be more strongly affected by climate change. Invertebrates, who are amongst Australia's most valuable target species, are particularly sensitive. Pelagic food webs, where species live up in the water column, appear less sensitive and may even benefit from the environmental changes.

This is a concerning finding as much of Australia's seafood is sourced from species that are members of demersal food webs or reliant upon them. Individuals in shallower (more effected) waters, or already living on the edge of what they can tolerate, will be the first to respond and will show the greatest magnitude of response. Some of these changes have already begun. The decline of species such as abalone associated with marine heatwaves and tens of species already observed to be moving south (e.g. into Tasmania and other places where they have not previously been recorded).

Invertebrates may be among the most heavily impacted species. They are often highly productive, but with relatively short life spans; meaning they can respond quickly, but often have little buffering capacity (they cannot ride out many poor years before suffering significant decline at the population level). Many invertebrates also have specific habitat requirements. Altogether these characteristics mean that invertebrates are more volatile and are quite sensitive to variation in climate and extreme events.

Both Commonwealth and State fisheries will face changes in gross value as a result of climate change effecting both the fish stocks and (potentially) the behaviour of the fishers. While the majority of the model results suggest little change in the short term, some simulations did suggest that larger changes (both positive and negative) were possible.





Ecosystem responses will not only respond to changes in temperature, precipitation or to ocean acidification. Variability in primary production (i.e. production by the plants and algae at the bottom of the food web) will also be important. For instance, if there is little change in primary production then ecosystems will likely show little change (so long as temperatures do not shift beyond what may species can physically tolerate). Unfortunately, it is not yet clear what future primary productivity will look like around Australia – as some important processes are still not completely understood. This means that understanding and predicting future changes in primary production remains an active area of research and updates will be provided as rapidly as possible.

Many mechanisms can lead to changes in ecosystems – whether through behaviour, distribution or abundance of the species and habitats in them. The drivers causing the changes can be different species to species. For some it will be due to changes in environmental conditions, this can cause the timing of seasonal events (like spawning) to move which can affect the success of those behaviours. If environmental conditions move beyond preferred ranges species will move to more favourable conditions or dwindle in abundance. For many species change will result from a loss (or shift) in habitat but for others changes will occur because the availability of their prey changes. For still other species it could be due to a shift in what their predator(s) are doing – if a predator moves away the prey abundance might grow, whereas if a predator starts to eat more of the prey (due to a shift in diet) then the prey population might decline. As frustrating as it may be for managers, industry and researchers looking for simple explanations and a way to make things more straight forward, it will likely come down to a case-by-case basis (which may even vary spatially across a species' geographic range).

Human responses to all these changes could also complicate things. Well informed decisions are one of the best ways of avoiding negative outcomes and maximising opportunities. A nested approach – where models and vulnerability assessments are used to identify the most at risk species and locations – appears to be the best way of targeting monitoring and management responses.

Given existing understanding of ecosystems, climate change and the sensitivities highlighted in this project a small set of management recommendations can be made:

i. A staged response might be necessary, where fishing activities are first adjusted due to shifts in behaviour (e.g. changing the timing of seasonal closures to make sure they continue to line up with seasonal behaviours like spawning or migrations), before looking to respond to changes in spatial distributions.

ii. Not all fisheries and operators will be exposed to the same level of change. Likewise, not everyone will have the same capacity to adapt. This will compound the differential outcomes seen across species and fisheries. One option is to simply accept uneven social and economic consequences. A more attractive alternative is to have information services (websites, newsletters, radio updates) to help explain what is going on, what the options are and the need for change as well as to provide support mechanisms to help those that are struggling to adjust.

iii. Successful management will require a diverse set of good scientific tools. No single approach will be sufficient due to existing uncertainty and the interplay of climate and fishing with the ecosystem components and processes. New management and assessment tools will also be needed. The complexity of possible species responses and the increasing importance of environmental drivers means that current models used in stock assessments to advise on acceptable catch levels maybe insufficient for understanding stock patterns under climate change. Key interactions and dependencies may need to be included to better reflect how the species is responding. This means that models used in fisheries assessments will likely need to be extended along the lines of the approach known as "MICE", which are models that not only include the target species but also the most important environmental (and other) drivers that set the context for the species' responses.

iv. Existing management strategies and objectives must be reviewed in terms of whether they help or hinder long term ecological and resources management objectives. Are they likely to deliver as desired into the future, if a stock is depleted can they rebuild it or help to recover degraded ecosystems? These considerations must go beyond focusing on fisheries to think about the structure of the whole ecosystem and which species are needed to maintain ore rebuild them. Such a rethink will require a greater coordination between conservation and fisheries management.

v. Fisheries policy, management and assessment methods need to allow for the concept of regime shifts and extreme events and for contextual management decision making. Taking lessons from locations that have already faced such challenges suggests that indicators that can track what state the environment is in can be used to let managers know when they need to adjust acceptable levels of fishing pressure and protection.

vi. Fisheries management methods should be made as flexible as possible, so they can change as rapidly as need to respond to changing system state. The speed of change means a no (or at least minimal) regrets approach to management needs to be taken, with updates as new information comes to light. Management instruments may also need to be adapted. Reference points defining an overfished state or a desirable state for target species might need to be modified if there is a regime shift in ecosystem state or stock productivity. Fisheries closures may need to be based on water bodies (large areas of water of a specific temperature) rather than simply relying on the protection of fixed geographic locations.

vii. Management decision making will need to (i) more explicitly prioritize resources and awareness around vulnerable/ sensitive species and fisheries or (ii) have a clear discussion around whether some species are beyond management (as the environment has made it impossible for the species to recover). Such decisions can't be taken lightly but might be necessary if large environmental changes occur.

viii. Australia-wide coordination of management will be imperative as species shift or environmental changes span State and Commonwealth boundaries. Without such coordination (or centralised management) local stress for fishing communities could become significant and new opportunities will likely be missed.

ix. Fisheries management will need to interlink with the management of other uses of the marine environment – that is Australia will need to use ***integrated marine management***. The number of uses of the marine environment is rapidly expanding and growing to a scale not seen before in the oceans. Mining, energy generation, transport, aquaculture (farming), recreation etc. are now all competing for space and resources in the oceans and along increasingly crowded coastlines. It is important for fisheries to see themselves in the context of all of this activity so they respond appropriately given that bigger picture.

Providing information to industry operators and managers so they can address all these changes will require good data sources. There are still many things we do not know about Australia's ecosystems and how they respond. Fishers and managers (and the scientists helping them) will require as much information as possible if they are to understand what is happening and act wisely to mitigate undesirable outcomes and make the most of any new opportunities. Such a climate robust approach to fisheries will require the combination of a number of different sources of information, including:

- Measurements and forecasts of the physical environment (temperature, salinity, rainfall, storm patterns) extending what is already provided by the Bureau of Meteorology. Sharing the data from net net sensors (for example) can help provide a more accurate picture of the current conditions and the conditions fish prefer.
- Satellite images of ocean colour (which can be used to estimate how much plankton is in the water) can help predict where fish will be and can also forewarn of coming issues with stock productivity and recruitment. Plankton recorders voluntarily mounted on ships (e.g. tankers) can also help collect very useful information about what is happening at the bottom of the food web (this can help us understand how that effects the rest of the food web including those fish that are targeted by fisheries).
- Good quality catch and effort data is the longest and one of the best sources of information on target species in Australia.
- Survey data is also important as it helps give a more complete picture of what is going on. Catch data is very useful but having a second set of information from surveys helps to be sure about what is going on – catches don't always reflect what the fish are doing, especially of the fishers have changed their behaviour in response to markets (for example).
- Citizen science data collected by Australians using smart phones and cameras represents a new source of potential data. Nearly every Australian citizen now owns a 'smart phone' which has sensors and an on-board computer that is more powerful than what was available to scientists as little as a decade ago. Data collected via photographs and voluntary reporting can be a very valuable source of information once it has been processed and scientifically collated. Australians see themselves as an ocean loving people so we shouldn't turn down any help they are eager to provide.

Looking Forward

Australian fisheries are in the midst of a period of rapid environmental change. This change is going to continue into the future and will differ place to place around Australia. Fishers and managers will need to be flexible if they are to cope with these changes. A failure to do so will bring economic (and likely social) hardship. Management will need to allow for spatial shifts and potentially for shifts in targeting and relevant management reference points. Management that is coordinated across State and Commonwealth fisheries and that links with the other users of marine waters is likely to do better than if those links are ignored. Healthy fisheries will also require good information services that are updated regularly with the latest understanding of what Australia's climate, fish, ecosystems and fisheries are doing. This is the summary of the latest (2018) update. If you would like more information please contact us (details below) or check out the websites listed below.

Useful Websites

Redmap (Range Extension Database & Mapping project) – www.redmap.org.au – this website invites the Australian community to spot, log and map marine species that are uncommon in Australia, or along particular parts of our coast. This helps keep everybody up to date on how Australia's species are moving. The website includes useful summarise on what climate change is and what it means for Australia's oceans.

BOM – www.bom.gov.au/climate – this website has a long list of climate time series and updates, including annual reports on what Australia's climate is doing.

Images: Shutterstock.com

WORKSHOP REPORT

Climate change in the Torres Strait

Implications for fisheries and marine ecosystems

June 2018

Earth Systems and Climate Change Hub Report No. 4

The Earth Systems and Climate Change Hub is supported by funding through the Australian Government's National Environmental Science Program. The Hub is hosted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and is a partnership between CSIRO, Bureau of Meteorology, Australian National University, Monash University, University of Melbourne, University of New South Wales and University of Tasmania. The role of the Hub is to ensure that Australia's policies and management decisions are effectively informed by Earth systems and climate change science, now and into the future. For more information visit www.nespclimate.com.au.

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AT A GLANCE

Key messages from the workshop

The climate is changing in the Torres Strait. Research shows that it is changing, communities see it on country (land and sea) and fishers see it in the changing state of natural resources.

Marine impacts from climate change in the Western and Central Torres Strait will include coastal erosion and declines in reef health and diversity, loss of critical inshore habitat, increased sea temperatures and sea levels and changes to currents and water quality; all of which will have a variety of direct and indirect impacts on fish stocks and marine ecosystems. Climate change will affect fisheries productivity, species distributions and seasonality, so subsistence and commercial fishery practices will need to be able to adapt to shifting circumstances.

It is important that all relevant parties are engaged in conversations about what climate change means for fisheries and marine ecosystems in order to prepare for the changes. Local traditional knowledge and scientific knowledge from the research community are important tools which can and should be integrated to help understand and prepare for future changes.

Torres Strait fisheries and marine ecosystems

- Torres Strait has diverse, productive and commercially, ecologically and culturally valuable fisheries and marine resources.
- There are complex traditional and regulatory management and resource sharing arrangements.
- Marine resources are likely to constitute a large proportion of protein for local communities.
- Traditional values of marine resources are very important to Torres Strait communities.

Climate change and impacts

- Being island based and heavily dependent on their marine resources, Torres Strait communities have certain inherent vulnerabilities in relation to climate change impacts compared to other parts of Australia.
- Climate change will strongly impact the Torres Strait marine environments and fisheries due to increased frequency and intensity of extreme events such as marine heatwaves, sea-level rise and changes to ocean oxygen content and ocean pH.
- Possible changes to ocean circulation and currents could have major ramifications fisheries and marine ecosystems.

Managing impacts

- Traditional fishers already practice many of the approaches needed to help ensure they can adjust to some of the likely impacts of climate change, such as providing

spatial flexibility in fishing effort by observing Traditional boundaries between each community's sea country.
- Community values have an important role to play in determining management and adaptive responses to the impacts of climate change.
- Traditional cultural spatial management of resources between Australia and Papua New Guinea, while effective when observed and well supported, could contribute to conflict between the haves and the have-nots as climate change impacts increase.

Information to support management and adaptation

- There are already many climate projections data and information products available for the region, ranging from relatively large spatial scale (e.g. global and regional climate projections located at www.climatechangeinaustralia.gov.au) to smaller scale (e.g. downscaled CCAM projections for some parts of northern Australia and Papua New Guinea) and some regional ocean and fisheries modelling, but it is not necessarily accessible.
- Global model projections have limited value for the Torres Strait Islands because of the geography (small size and limited topography) of the islands and the poor resolution of El Niño–Southern Oscillation/Pacific Decadal Oscillation influences. Instead, higher resolution modelling (including ocean modelling and fisheries modelling) is needed to provide information at the appropriate spatial scale.
- Tidal dynamics need to be further taken into account to improve the climate downscaling in the Torres Strait region.
- Important oceanographic and environmental data are intermittent and/or absent, and there is a need for dedicated Torres Strait modelling across a range of applications related to fisheries.
- Although a lot of climate information is being continually generated, very little targeted information at required intervals is available to Torres Strait fishers to inform their seasonal fishing practices.
- Provision of regular climate, adaptation and management information via an annual forum or other updates may be useful.
- Managers seeking to adapt to climate/climate change issues in Torres Strait can glean valuable information from relevant projects around Australia and in the Pacific.
- Researchers need to have due diligence to present information appropriately for local communities so useful information can be placed in the hands of the local decision makers who are the traditional custodians of the resource.
- Communities in the Torres Strait are keen to be involved in discussions about how a changing climate affects fisheries.
- There is enough information now from studies in Torres Strait and adjacent areas (as proxies and examples) to make management decisions in the short term. Filling some key knowledge gaps and downscaling climate change projections will provide information to refine actions, but we don't need to wait for this information to act now.
- Consultation and engagement with traditional owners and fishers is paramount to appropriately target actions for key fisheries and vulnerabilities.

Background

The National Environmental Science Program (NESP) Earth Systems and Climate Change (ESCC) Hub and Torres Strait Regional Authority (TSRA) jointly convened a workshop in December 2017 to bring together key researchers and managers to review the current state of relevant scientific knowledge about climate change impacts on communities of the Torres Strait Islands, with a particular emphasis on inshore fisheries and marine ecosystems. This is the first time that climate and fisheries researchers and managers working in the Torres Strait have come together in this way.

The workshop is the first in a series of engagements that aim to:

- build relationships and raise awareness and understanding of key stakeholders (including traditional owners/local fishers, natural resource managers, other local communities of interest and scientists)
- identify data and information gaps and needs where appropriate
- develop options for the delivery of relevant science-based products and services to target end-users to inform policy development, management/adaptation planning and associated decision-making.

The objectives of this workshop are to:

1. Assess current state of knowledge and understanding on climate projections and impacts as they relate to the marine environment in the Torres Strait.
2. Capture knowledge of any observed or reported shifts in environmental variables
3. Identify key data and knowledge gaps and assess priority areas and issues from a scientific and managerial perspective and make recommendations for further focus or investigation
4. Determine communication products that should be developed to increase awareness and understanding of key stakeholders of climate change impacts on Torres Strait marine fisheries and ecosystems
5. Improve coordination and collaboration across relevant agencies and stakeholders and scope next steps in the proposed series of engagements.
6. Determine the nature of ongoing engagement with traditional owners on this issue. In practice, it will likely be facilitated through the TSRA and the fisheries working groups/management forums.

The workshop program and participant list are included in the appendices of this report.

This report, which provides a brief synthesis of the workshop presentations and key discussion points, is the primary workshop output.

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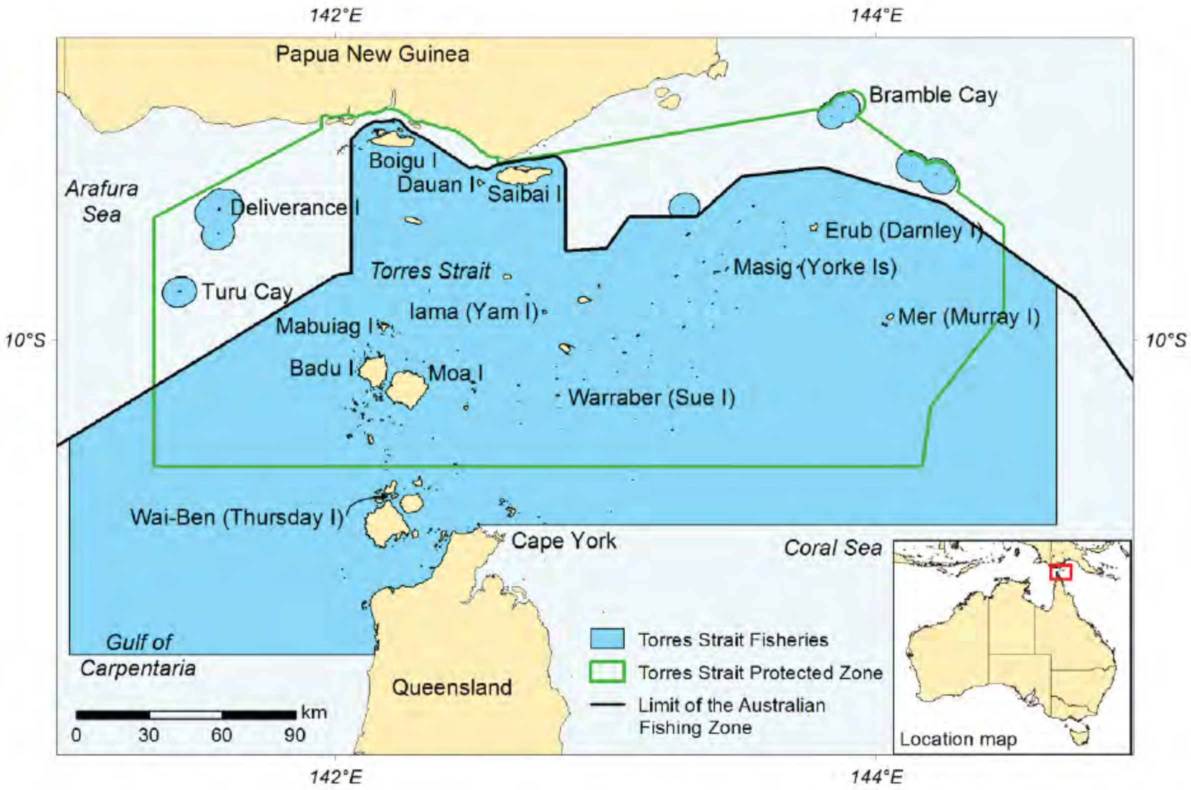
Fisheries in Torres Strait

Ian Butler, AFMA

- Torres Strait fisheries have complex arrangements for resource sharing.
- Torres Strait fisheries cover a diverse range of species.
- Historical catch data have been difficult to obtain, but improvements are being made (fish receiver data).

Region



The Torres Strait Protected Zone (TSPZ) is jointly managed by Australia and Papua New Guinea (PNG) through bilateral discussions. Within Australian waters in the TSPZ, traditional and commercial fishing are managed by the Protected Zone Joint Authority.

The fisheries in this region are shared between traditional inhabitant commercial fisheries, traditional artisanal fisheries, PNG fisheries and recreational fishers. Formal catch arrangements between Australian and PNG fishers are established under the Treaty.

The fisheries have commercial, cultural and lifestyle value.

Key fisheries

Torres Strait Finfish Fishery	Spanish mackerel but some other species	Trolling lure	2016 catch: 86.9 t Value: n/a (total finfish $1.2 m)
Torres Strait Finfish Reef Line Fishery	Mostly coral trout but also other groupers, snapper, emperor, barramundi and trevally	Hook and line, spear, nets and traps	2016 catch: 38.7 t Value: n/a (total finfish $1.2 m)
Torres Strait Tropical Rock Lobster Fishery	Tropical rock lobster	Hand diving (surface air supply, free diving); 306 commercial licenses (294 traditional inhabitants); artisanal; shared resource with PNG	2015–16 catch: 445 t Value: $14.3 m
Torres Prawn Fishery	Brown tiger prawns, blue endeavour prawns, also other prawn species, bugs, octopus and squid	Caught at night using demersal otter trawl	2016 catch: 412 t Value: $8.9 m
Torres Strait Beche-de-Mer Fishery	Sea cucumber (e.g. black teatfish, prickly redfish, sandfish, white teatfish, surf redfish)	Collected by hand free diving or on reef flats; scuba and hookah banned; traditional inhabitant and artisanal fishers only	2016 catch: 14.9 t Value: not assessed Illegal fishing from other countries
Trochus	Trochus	Collected by hand free diving or on reef flats; scuba and hookah banned; traditional inhabitant and artisanal fishers only	Catch: 0 t Illegal fishing from other countries
Pearl shell	Gold-lipped and black-lipped pearl shells	By hand for use in farming (Qld); traditional inhabitants only (with PNG)	Catch: limited to small amounts
Torres Strait Crab Fishery	Mostly mud crabs, some blue swimmer	Hand or scoop net; traditional inhabitants and artisanal fishers	Value: unknown
Turtle		Traditional artisanal fishers	Culturally important for food
Dugong		Traditional artisanal fishers	Culturally important for food

Understanding Torres Strait stakeholders

Charles David, TSRA

- The Torres Strait economy benefits significantly from the ocean. Jobs etc. often stem from the health of and access to fisheries – traditional fishing is commercial fishing.
- Climate change impacts shift movement patterns of fish and directly affect the health of coral and other less mobile aquatic resources.
- Wild stocks, in some cases, are at lower levels than recently observed and others are not recovering from past overfishing. To what degree these are attributed to or compounded by the impacts of climate change is unknown. Employment opportunities for Islanders could reduce as a consequence of continued decline in stocks.
- There are implications for ownership and management arrangements, aspiration and the current status of the fishery.
- Traditional knowledge considerations are important for management of Torres Strait Island fisheries.
- A summation of climate change in Torres Strait and what to expect in a given timeframe needs to be delivered to traditional owners and/or full-time commercial and community fishermen.

The Torres Strait Treaty and *Torres Strait Fisheries Act 1984* (Commonwealth) are in place to acknowledge and protect the traditional way of life in the Torres Strait and the traditional inhabitants.

The Protected Zone Joint Authority (PZJA) is responsible for management of commercial and traditional fishing in the Australian area of the Torres Strait Protected Zone (TSPZ) and designated adjacent Torres Strait waters.

The PZJA is comprised of the Commonwealth and Queensland Ministers with responsibility for fisheries and the Chairperson of the TSRA. The PZJA is advised by a framework of management advisory committees made up of Torres Strait Islander fishers, commercial fishers, fishery managers and scientists. Recreational fishing is managed under Queensland law.

The Torres Strait fisheries management structure does not exist anywhere else in the country. The structure can make it seem difficult to get things done; however, this is not the case – you just have to have the traditional owners at the table.

There are five cluster groups in the Torres Strait. Traditionally you seek permission to go into someone else's sea country, but commercial fishing licences are for the whole zone so there's a disconnect between the two systems.

Roadmap to 100% fisheries ownership

The TSRA is working with key regional stakeholders and traditional inhabitants to achieve 100% ownership of the region's fisheries for traditional inhabitants. Both the finfish and bêche-de-mer fisheries are 100% owned by traditional inhabitants. The tropical rock lobster fishery is 66.18% owned by traditional inhabitants (at 20 November 2017, as reported on the TSRA website).

Traditional management of Torres Strait fisheries

Traditional areas and boundaries are important to traditional owners and their maintenance can be advantageous both culturally and for sustainability. Traditional owners want traditional boundaries and management to be recognised (which is why bringing traditional owners to the table is important).

Torres Strait Islanders have seen the changes, especially in fish stocks – and believe this is a strong reason why returning to traditional management (because it's more sustainable) is crucial. Turtle and dugong are success stories for traditional management.

Things in the past have resulted in some distrust of the science and 'westerners'; this is being overcome slowly.

The climate context: variability, extremes, change and risk relevant to impacts on marine systems in the Torres Strait

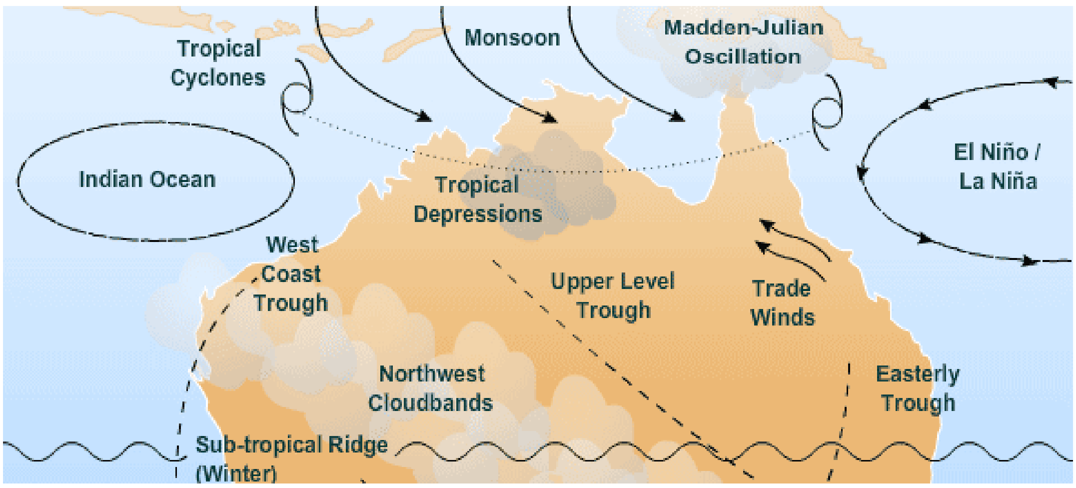
Neil Holbrook, ESCC Hub

- Torres Strait Islands are subjected to considerable ocean and climate variability (dominated by the monsoon and El Niño–Southern Oscillation) and extremes (including sea-level extremes, marine heatwaves, tropical cyclones and storms – and the associated winds, waves and storm surges – and extreme rainfall.
- Impacts of long-term changes in ocean temperatures (surface and deep), sea level and storminess will be both physical (e.g. inundation, erosion, coral damage) and ecological (affecting habitats, communities and species).
- Ocean acidification (reduction of ocean pH) affects calcifying organisms.

Variability

The climate of the Torres Strait is characterised by the monsoon wet season (December–April) with north-westerly winds and the dry season (May–November) with south-easterly winds.

The El Niño–Southern Oscillation (ENSO) contributes to year-to-year variability. During El Niño events, northern Australia is drier than normal, while during La Niña events it is wetter than normal. ENSO also plays a strong role in year to year variability of sea level.



(Source: Commonwealth of Australia 2010, Bureau of Meteorology. http://www.bom.gov.au/climate/about/)

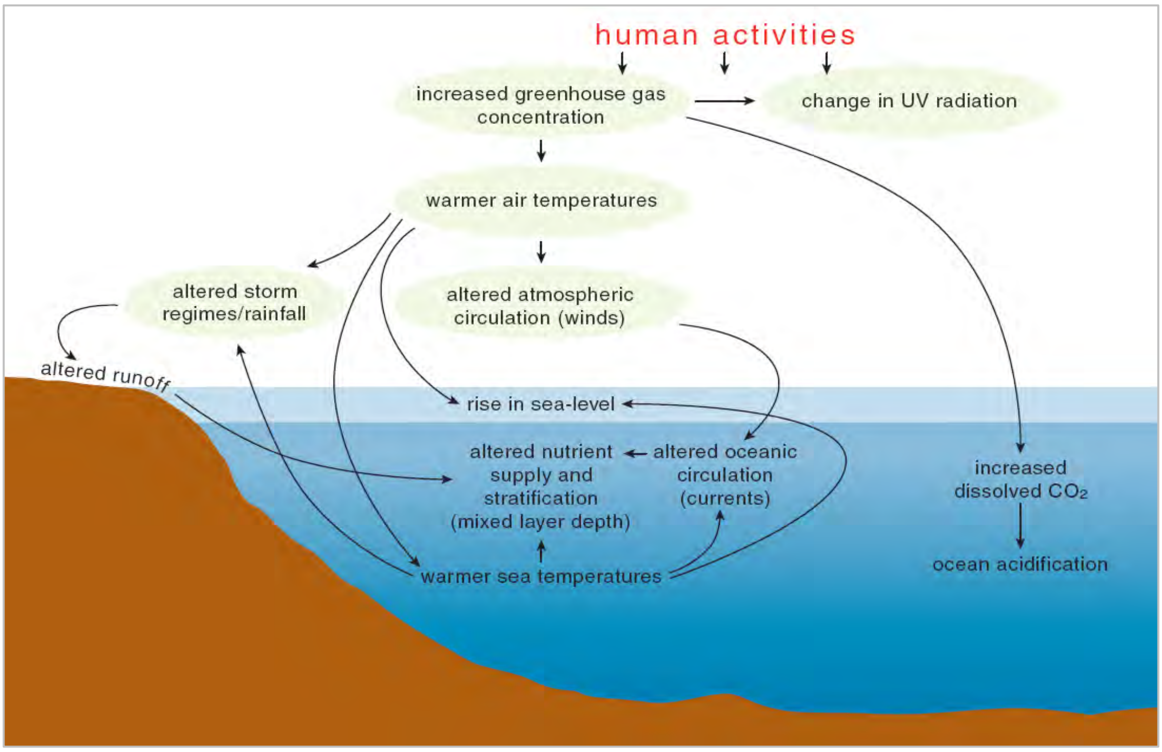
Extremes

By definition, extremes are rare and intense. They include tropical cyclones, storm surge, heatwaves (including marine heatwaves) and heavy rainfall.

Climate change, sea level rise and extremes

The impacts of sea-level rise will be felt most profoundly during extreme sea-level events. Increased sea level will increase the frequency of these events and the frequency of coastal inundation and erosion. Extreme sea levels may also change due to changes in storms (their frequency and intensity may change).

Climate change will also increase the frequency of extreme El Niño and La Niña events.



Physical and chemical changes in atmosphere and oceans due to climate change (Source: Poloczanska *et al*. 2007)

Implications

Coastal systems are particularly sensitive to sea-level rise, warming oceans and ocean acidification. The Intergovernmental Panel on Climate Change Working Group 2 contribution to the fifth assessment report gives examples of key risks.

Table 29-4 | Selected key risks and potential for adaptation for small islands from the present day to the long term.

Climate-related drivers of impacts								Level of risk & potential for adaptation
Warming trend	Extreme temperature	Drying trend	Extreme precipitation	Damaging cyclone	Sea level	Ocean acidification	Sea surface temperature	Potential for additional adaptation to reduce risk Risk level with **high** adaptation Risk level with **current** adaptation

Key risk	Adaptation issues & prospects	Climatic drivers	Timeframe	Risk & potential for adaptation
Loss of livelihoods, coastal settlements, infrastructure, ecosystem services, and economic stability (*high confidence*) [29.6, 29.8, Figure 29-4]	• Significant potential exists for adaptation in islands, but additional external resources and technologies will enhance response. • Maintenance and enhancement of ecosystem functions and services and of water and food security • Efficacy of traditional community coping strategies is expected to be substantially reduced in the future.		Present Near term (2030–2040) Long term (2080–2100) 2°C 4°C	Very low — Medium — Very high
Decline and possible loss of coral reef ecosystems in small islands through thermal stress (*high confidence*) [29.3.1.2]	Limited coral reef adaptation responses; however, minimizing the negative impact of anthrogopenic stresses (ie: water quality change, destructive fishing practices) may increase resilience.		Present Near term (2030–2040) Long term (2080–2100) 2°C 4°C	Very low — Medium — Very high
The interaction of rising global mean sea level in the 21st century with high-water-level events will threaten low-lying coastal areas (*high confidence*) [29.4, Table 29-1; WGI AR5 13.5, Table 13.5]	• High ratio of coastal area to land mass will make adaptation a significant financial and resource challenge for islands. • Adaptation options include maintenance and restoration of coastal landforms and ecosystems, improved management of soils and freshwater resources, and appropriate building codes and settlement patterns.		Present Near term (2030–2040) Long term (2080–2100) 2°C 4°C	Very low — Medium — Very high

(Source: Table 29-4 in Nurse et al. 2014)

References/more information

- Nurse LA, McLean RF, Agard J, Briguglio LP, Duvat-Magnan V, Pelesikoti N, Tompkins E, Webb A (2014) Small islands. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [VR Barros, CB Field, DJ Dokken, MD Mastrandrea, KJ Mach, TE Bilir, M Chatterjee, KL Ebi, YO Estrada, RC Genova, B Girma, ES Kissel, AN Levy, S MacCracken, PR Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1613–1654.
- Poloczanska ES, Babcock RC, Butler A *et al*. (2007) Climate change and Australian marine life. *Oceanography and Marine Biolo*gy 45, 407–478. doi:10.1201/9781420050943

Climate trends and projections for the Torres Strait Islands

Josephine Brown, ESCC Hub

- There is an observed warming trend in both air and sea-surface temperatures in the Torres Strait.
- Rainfall is highly variable, with a strong influence from the El Niño–Southern Oscillation. A trend due to global warming cannot be identified in the observations.
- Regional projections for the Torres Strait include warmer sea-surface temperatures and higher sea level. Rainfall will become more variable with more intense extreme events.

Climate projections

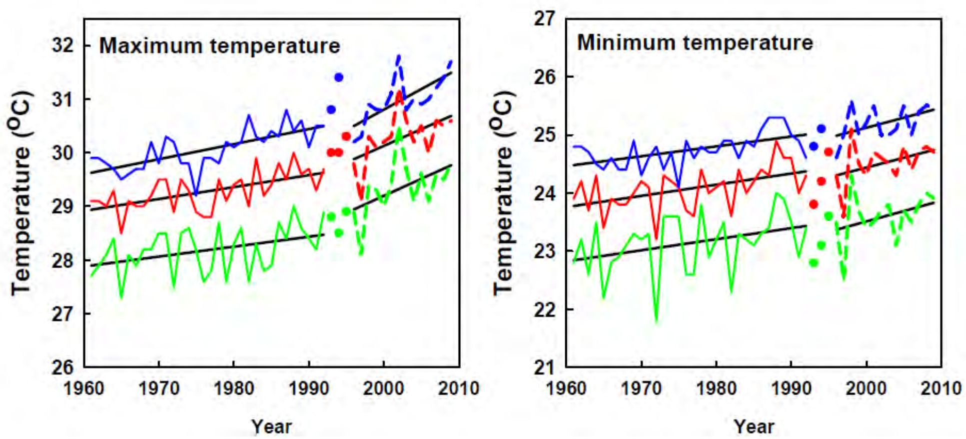
Projections based on global climate models generally cannot resolve the details of islands, topography or ocean currents in the Torres Strait. Global model information can be useful for some applications, while higher resolution (downscaled) model output may be needed for other applications. It is also important to evaluate whether the model can reproduce the observed present-day climate of the variable of interest (e.g. rainfall, temperature), and to consider the influence of model biases and errors on the climate of the Torres Strait.

Climate drivers

Climate in the Torres Strait is heavily influenced by the monsoon and the El Niño–Southern Oscillation (ENSO). In the future, monsoon rainfall is likely to be more variable than it is now and the influence of ENSO on rainfall will be greater.

Temperature

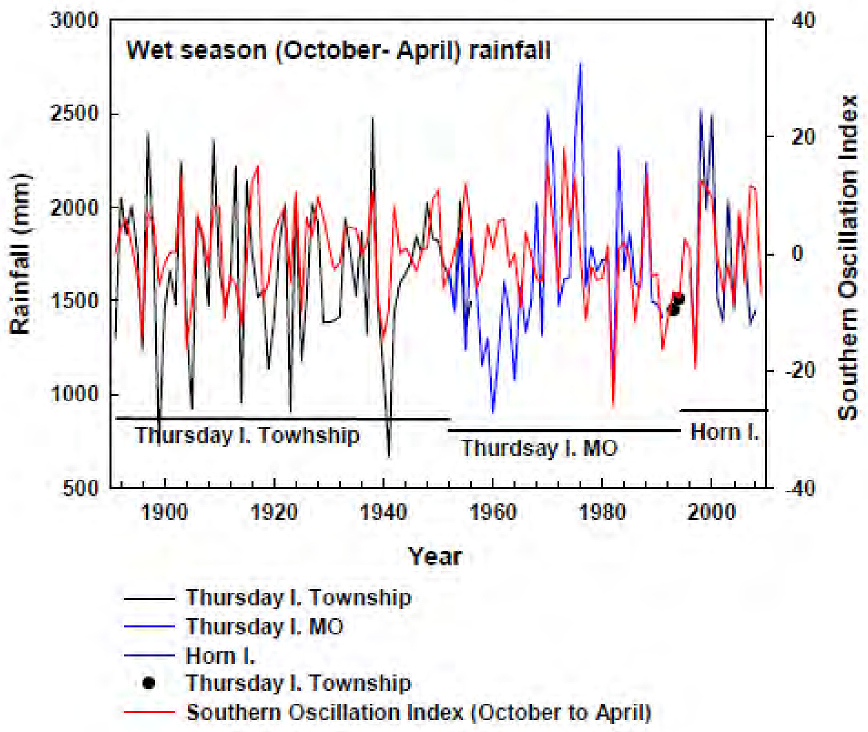
Mean temperature currently ranges annually from about 22–25 °C (min) to 28–32 °C (max). Temperatures have increased over the past century, with the rate of warming higher since 1960. Average temperatures will continue to increase in all seasons as a result of long term climate change, and there will be more hot days and warm spells.



Observed temperatures. Solid lines are records taken at Thursday Island MO. The observation site changed to Horn Island (dotted lines).

Rainfall

Rainfall has a strong seasonal cycle due to the influence of the monsoon. ENSO also influences rainfall, with drier years during El Niño events and wetter years during La Niña events. Changes to rainfall as a result of climate change are possible but unclear, but intensity of extreme daily rainfall events will increase.



Sea-surface temperature

The oceans around Australia have warmed. In the Torres Strait, this warming has occurred at 0.08–0.12 °C per decade since 1950. Sea-surface temperature will continue to increase as a result of climate change.

Ocean acidification

The pH of waters around Australia is decreasing (i.e. becoming more acidic). In the Torres Strait, the pH has dropped by 0.085–0.095 between 1880–89 and 2000–09, and ocean acidification will continue as a result of climate change.

Tropical cyclones

Tropical cyclones are generally located south of Torres Strait, but six have tracked through Torres Strait since1906 and many more over Cape York. Since the 1970s there has been an overall trend for fewer tropical cyclones in the Australian region, and it is expected that there will be fewer but more intense tropical cyclones in the future as a result of climate change.

Sea level

In the period 1993–2015, sea level has increased in the Torres Strait by 6–7 mm per year. Mean sea level will continue to rise as a result of climate change, and height of extreme sea-level events will also increase.

References/more information

- Climate Change in Australia https://www.climatechangeinaustralia.gov.au/en/
- State of the Climate 2016 http://www.bom.gov.au/state-of-the-climate/index.shtml
- CoastAdapt https://coastadapt.com.au/
- Pacific Climate Futures https:/www.pacificclimatefutures.net

Vulnerability of Torres Strait fisheries to climate change

Johanna Johnson, Tropical Water Quality Hub

- Torres Strait fishers already operate under climate variability and practice flexible approaches that will help with adaptation to future climate change impacts.
- There is enough information now from studies in Torres Strait and adjacent areas (as proxies and examples) to make management decisions immediately. Filling some key knowledge gaps and downscaling climate change projections will provide information to refine actions, but we don't need to wait for this information to act now.
- Consultation and engagement with traditional owners and fishers is important to target appropriate actions to key fisheries and vulnerabilities (and within the local/cultural context)

Potential climate change impacts on species

Species	Key potential impacts of climate change (2030)
Coral trout – common/barcheek/ passionfruit	• Reduced catchability after intense storms • Reduced survival/development of early life stages due to increased sea-surface temperature (SST+) • Adult movements into deeper waters due to SST+ • Impacts on coral reef habitat may affect juvenile survival

Dugong	• Declines in seagrass negatively impact dugong due to:
	  o primary food source
	  o preferred habitat
	• Increased stranding mortality due to intense storms

Blue endeavour prawn & brown tiger prawn	• Impacts on seagrass may decrease juvenile growth and survival • Compromised growth and survival due to SST+ (near northern limit)
Turtle	• Female biased populations due to higher air temperatures during egg incubation • Decrease in available nesting sites/disrupt successful nesting due to sea-level rise (SLR), more intense storms and extremes in rainfall • Increased stranding mortality due to intense storms • Impacts on seagrass may decrease growth and survival
Trochus	• Unknown and previously assessed as minor
Sandfish	• Generally unknown
Black teatfish	• Reproductive success may be compromised (winter spawner) with SST+

Species	Key potential impacts of climate change (2030)
Tropical rock lobster	• Faster growth and higher larval supply, but decreased juvenile survival due to SST+. Net result reduced spawning biomass • Adult movement into deeper water due to SST+ • Settlement areas and recruitment rates may change due to altered north-west Coral Sea currents
Mud crab	• Higher catch rates due to SST+ • Possible population increases due to increases in rainfall
Spanish mackerel	• Possible links between SST and larval survival but generally unknown
Gold-lipped pearl oyster	• Reduced larval growth due to increased rainfall/lower salinity
Black-lipped pearl oyster	• Lower abundance due to upper thermal limits of ~32 °C for adults and reduced larval growth >29 °C

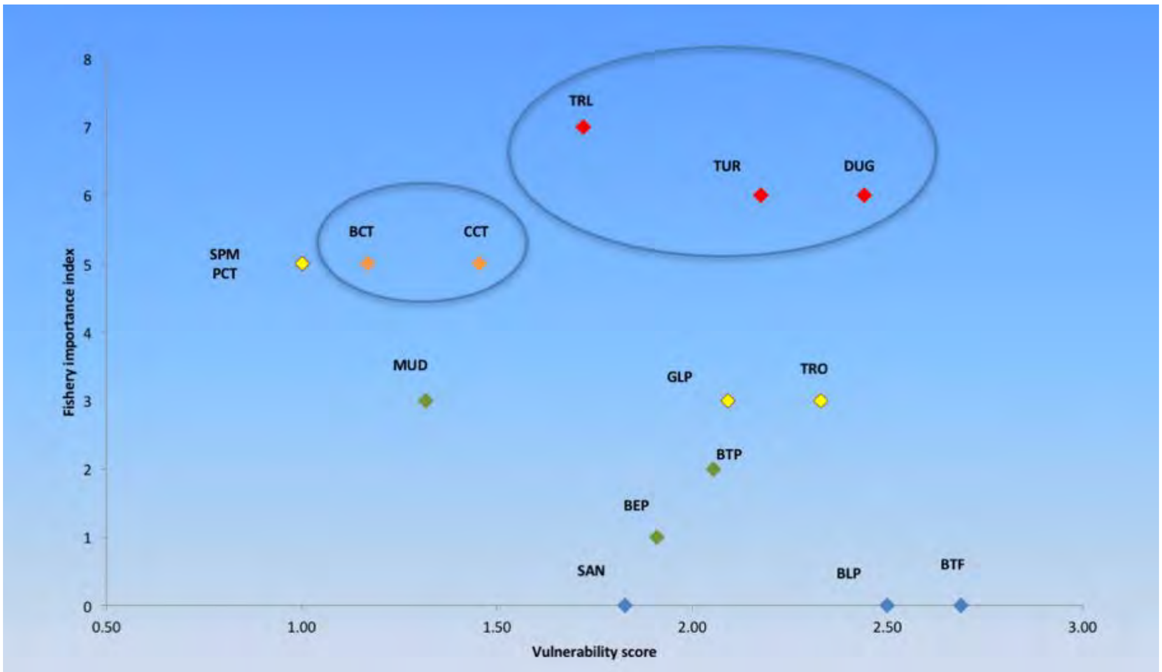
Vulnerability of supporting habitats

	SST	Rainfall/ river flow	Sea level	Cyclones & storms	Ocean pH	Solar radiation	Productivity /circulation
Coastal wetlands	very low	moderate	high – very high	moderate	very low	low	moderate
Seagrass	high	moderate	moderate	high	very low	high	moderate
Coral reefs	very high	high	low	high	very high	low	moderate

Prioritising species for management

Fisheries were ranked according to vulnerability and an ‘importance’ index that considered cultural and economic value. This process identified three species as management priorities – dugong, turtle and tropical rock lobster (red diamonds on the following figure). Second order priorities were coral trout (common and barcheek; orange diamonds on the following figure).

Importantly, any changes to fishing effort and therefore the pressure and value of fisheries could change the management priorities. For example, the reopening of the *bêche-de-mer* (specifically black teatfish) fishery since the assessment was conducted is likely to have increased the management priority of the main target species, and therefore requires a review and possible adaptations.



References/more information

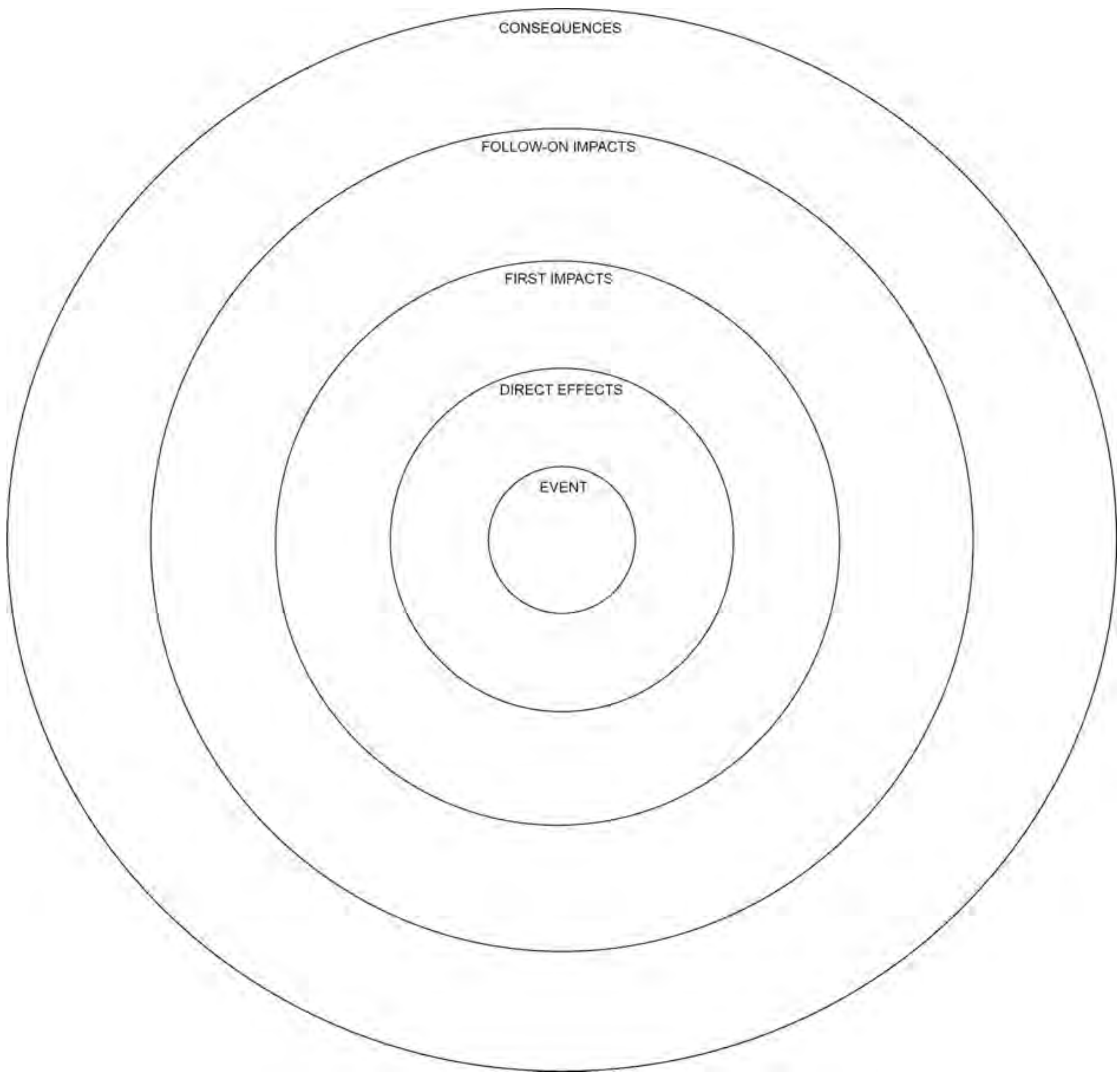
- Johnson JE, Marsh H, Hamann M, Duke N, Burrows D, Bainbridge S, Sweatman H, Brodie J, Bohensky E, Butler J, Laurance S (2015) Tropical Research in Australia's Torres Strait region. Report to the National Environmental Research Program. Reef and Rainforest Research Centre Limited, Cairns, 33 pp, DOI:10.13140/2.1.2391.1209
- Johnson JE, Welch DJ (2016) Climate change implications for Torres Strait fisheries: assessing vulnerability to inform adaptation. *Climatic Change*, 135(3): 611–624.
- Sweatman H, Johns K, Jonker M, Miller I, Osborne K. (2015) Report on Second Monitoring Field Trip to Torres Strait, January 2014. Report to the National Environmental Research Program. Reef and Rainforest Research Centre Limited, Cairns (10 + iv pp.).
- Taylor HA, Carter AB, Davies J, McKenna SA, Reason CL, Rasheed MA. (2013) Seagrass Productivity, Resilience to Climate Change and Capacity for Recovery in the Torres Strait – 2011-2013 Report. JCU Publication 13/40, Centre for Tropical Water and Aquatic Ecosystem Research, Cairns, 80 pp.
- TSRA (2016) Torres Strait Long-Term Coral Reef Monitoring Project 2015–16. Land and Sea Management Unit, Torres Strait Regional Authority, Australia, 42 pp.
- Welch DJ, Johnson JE (2013) Assessing the vulnerability of Torres Strait fisheries and supporting habitats to climate change. Report to the Australian Fisheries Management Authority, C2O Fisheries, Australia.

Cascading consequences

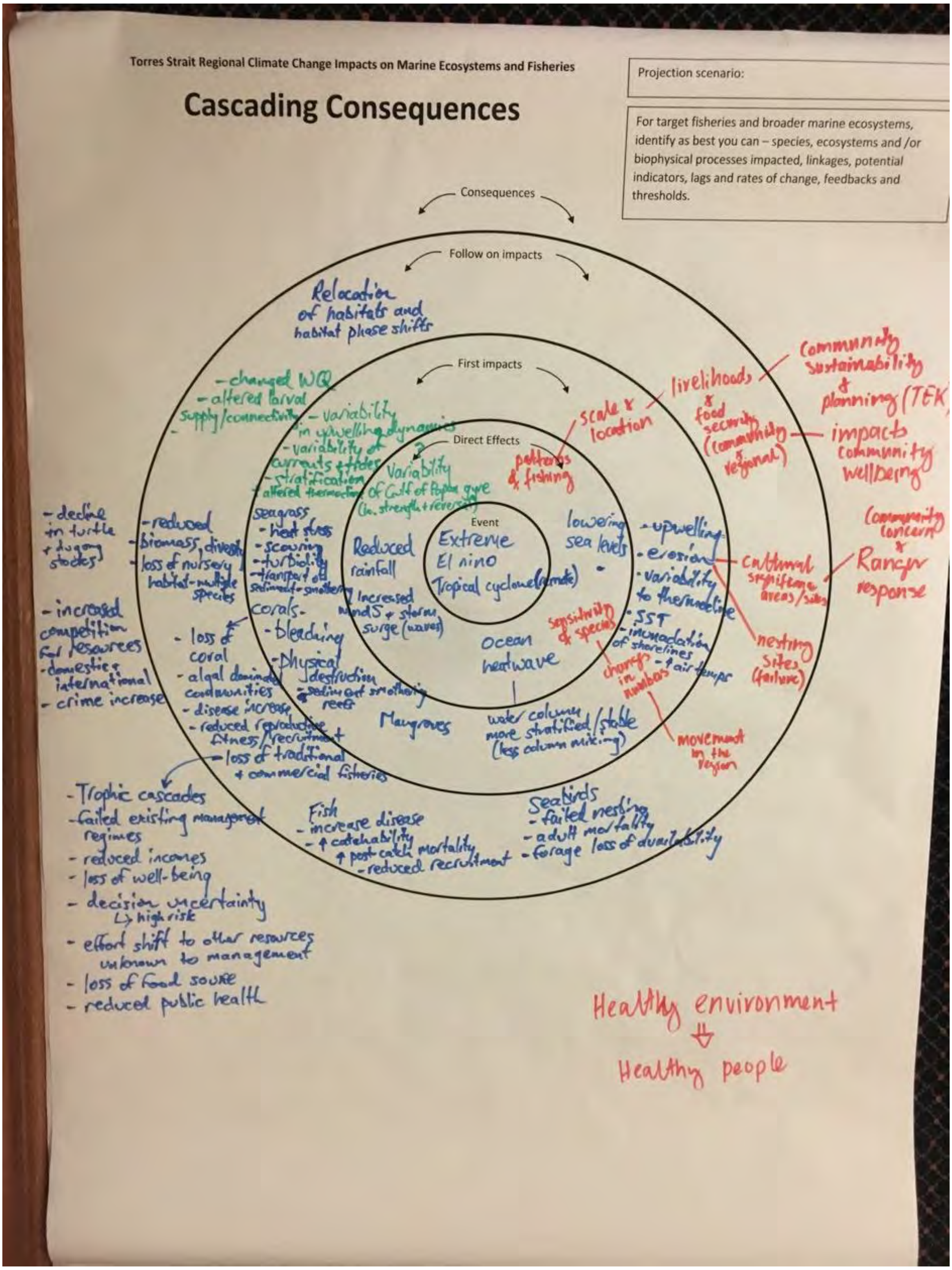
The impacts of climate change in the Torres Strait are not limited to the direct impact of climate events, and the 'ripples' or flow-on effects can be more significant than the primary impacts – particularly when considering co-incident climate events or impacts.

The consequences of two climate scenarios were explored in a 'cascading consequences' exercise, where workshop participants split into groups to map the impacts and consequences of climate change on Torres Strait fisheries and marine ecosystems. The following template was used.

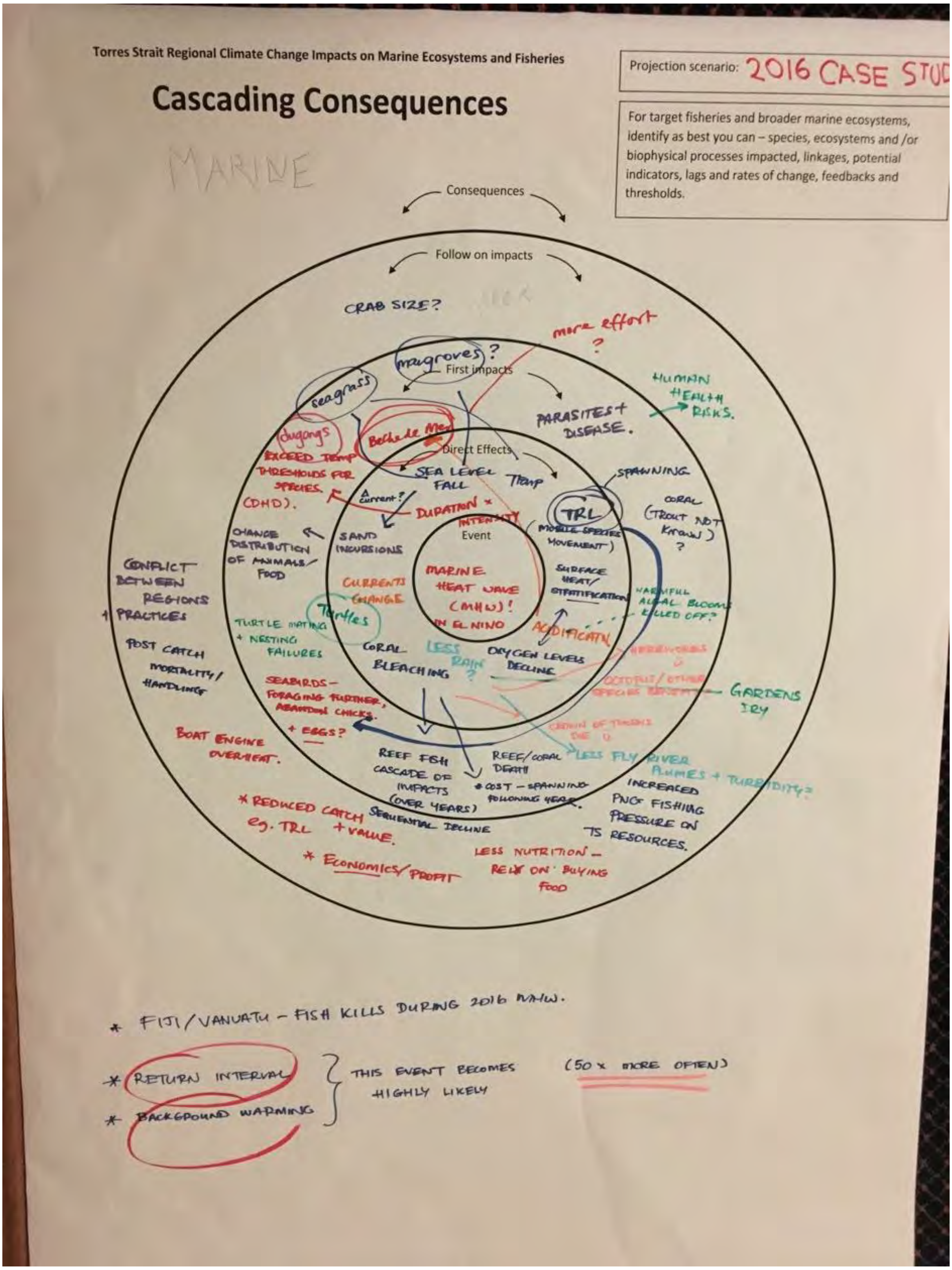
(This template is also a useful community engagement tool and can serve as the basis of insightful discussions when communities think about the consequences of climate events in their context.)



SCENARIO 1: Tropical cyclone occurring during an extreme El Niño event



SCENARIO 2: Marine heatwave during an El Niño event



This example was based on an event examined in this paper: Oliver ECJ, Perkins-Kirkpatrick SE, Holbrook NJ, Bindoff NL (2017) Anthropogenic and natural influences on record 2016 marine heat waves. *Bulletin of the American Meteorological Society*, 98(12), S44-S48, DOI:10.1175/BAMS-D-17-0118.1 (and 10.1175/BAMS-D-17-0118.2).

Adapting to a changing environment: learning with the Torres Strait community to understand future impacts on wellbeing

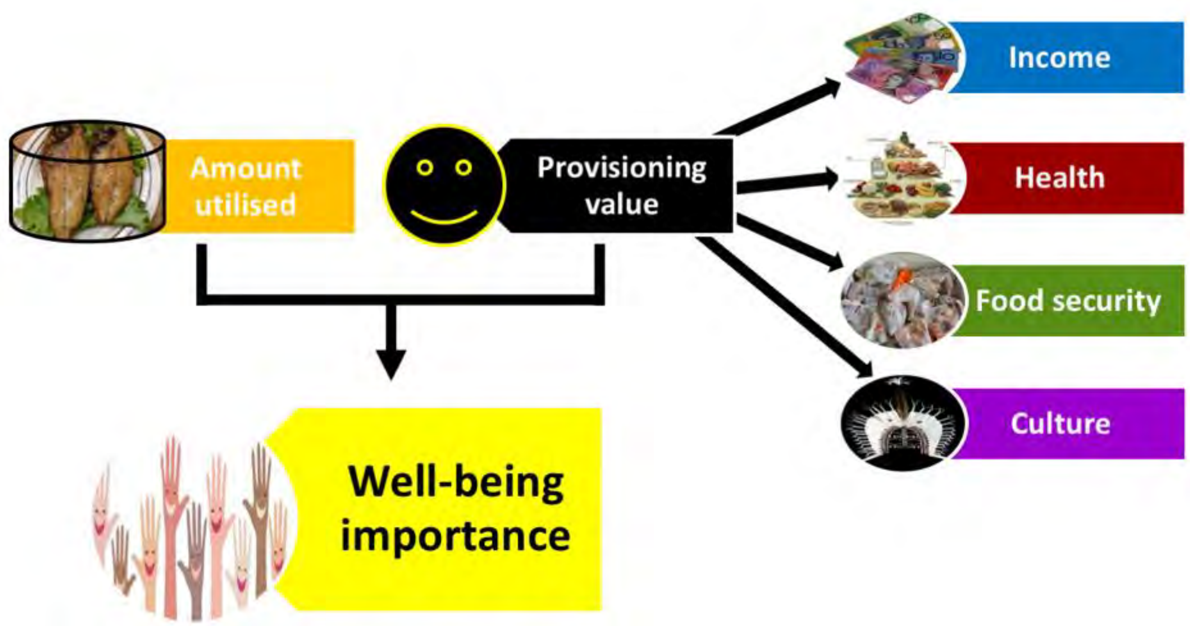
Cass Hunter, CSIRO

- Our science engagement and information needs to be relevant to communities by incorporating local views into the discussions
- Turning community visions about adaptation into reality involves being prepared to work across multiple sectors and the TSRA Climate Program
- Getting the right narrative for adaptation to climate change is about more than just our precision with science predictions.

Understanding impacts

- What are the drivers of change for livelihoods?
- What are the desired possible futures?
- What impact will the ‘business as usual’ (climate) future have on well-being?
- What is the resilience of the community today?
- What are the priority adaptation strategies to build resilience?

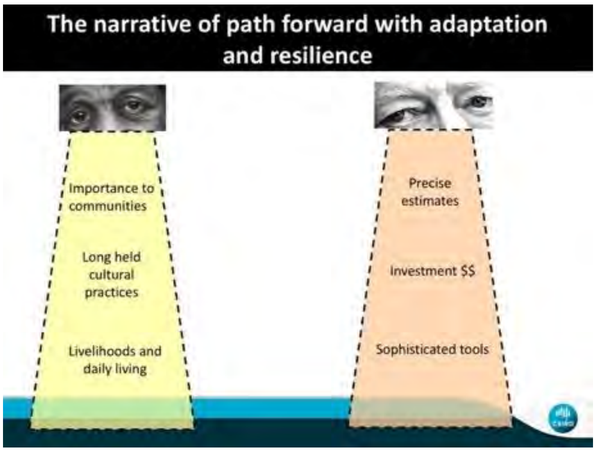
Understanding the importance of ecosystem goods and services

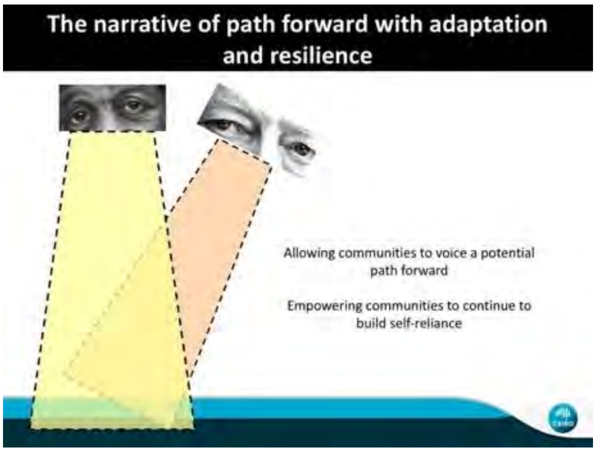


Adaptation strategies

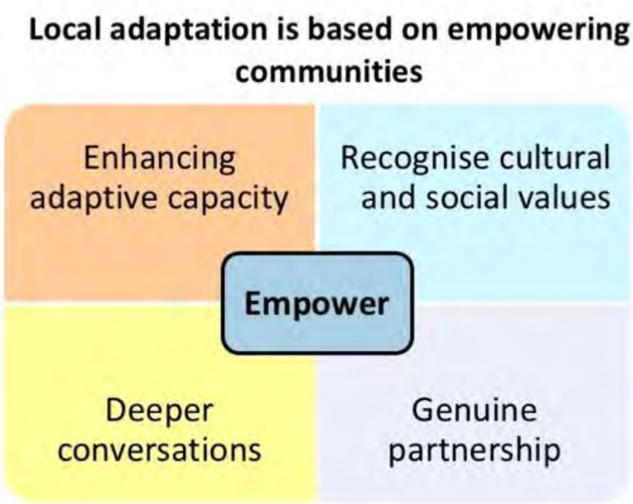
Make it relevant – communities want to see their views and importance factored into climate conversations.

Culture is key – keeping culture strong helps the community to be sustainable and self-reliant.





Need collaborative partnerships to advance forward – to turn visions into reality (conversations into actions) we need to work across sectors (e.g. land use planners, renewables, sustainable housing, employment)



Lessons from the Pacific

Johanna Johnson, TWQ Hub and Mandy Hopkins, ESCC Hub

The Torres Strait is more like the Pacific than Australia – islands are geographically remote with decentralised and dispersed populations, and communities are critically dependent on marine resources for food and income.

In addition to the direct impacts, climate change is affecting habitats, which in turn affects fisheries, which in turn affects livelihoods and income, food security and economic development. It follows that Pacific Islands are highly exposed and vulnerable to climate change.

So, it is useful to consider how communities in the Pacific are using projections science to drive risk assessments, and how this informs adaptation planning and associated decision-making and on-ground actions.

Case studies

Food security

Pacific per capita fish consumption (98–147 kg/person/year) is 3–5 times the global average. Projected climate-related habitat declines (loss of coral cover, reduced seagrass, reduced mangrove area) will affect fisheries. Some Pacific nations are better placed than others to deal with this.

Vanuatu has undertaken a number of adaptation activities in response, including:

- Structured monitoring of coastal fish habitats (reefs, seagrass, mangroves) commenced in 2015/16
- National Fisheries Policy 2016–2031 (ecosystem-based approach to coastal fisheries management)
- Trial of solar dryers for improved post-harvest fish preservation in north Efate and Santo
- New freshwater pond aquaculture for tilapia in villages
- Transfer fishing effort to target nearshore pelagic species using fish attracting devices (FADs); mostly local ‘Vatuika’ (‘Fish and Wealth’) design; 30 FADS installed/replaced since 2014

Papua New Guinea Treaty Villages

There are 13 Treaty Villages in the South Fly District of Papua New Guinea, where the low human development index is second only to the Congo. These villages are only 4 km from the northern Torres Strait Islands (Saibai and Boigu), and are highly exposed to climate variability and change.

Challenges for Treaty Villages include: water contamination, salinity intrusion, lack of sanitation, increasing demand/competition for natural resources (due to population growth), flooding and inundation during extreme sea level events, declining fisheries due to fish poaching, habitat loss and overfishing, high human disease prevalence (TB, malaria, cholera), isolation and lack of income opportunities – all serious cross-cutting issues that cannot be dealt with in isolation of climate change or each other.

A Community Ranger program is building a resilience platform for these villages with community-based and community-led activities to improve food security, water, health, livelihoods and well-being.

Outreach

The Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) program developed *The Pacific Adventures of the Climate Crab*, an animation and communication resource toolkit to raise awareness of the science and impacts of El Niño and La Niña to encourage Pacific Islanders to take early action in preparing for these extreme climate events.

The resource was developed in close consultation with in-country stakeholders, and its success as a community-level information tool demonstrates the importance of getting in the room and talking to people when developing content to facilitate outreach of the science.

The animation and toolkit are available on the Pacific Climate Change Science website at www.pacificclimatechangescience.org.

References/more information

- Johnson JE, Basel B (2017) Vulnerability Assessment & Local Early Action Planning (VA-LEAP): Community-based Assessments on Rendova Island, Solomon Islands. Report to the Pacific-American Climate Fund (PACAM), USAID Program, March 2017.
- Johnson JE, Waterhouse J, Devlin, MJ, Hooper E (2016) Marine Ecosystem Assessment: North Efate, Vanuatu. Report to the Pacific Community (SPC), Noumea, New Caledonia, and Agence Francaise de Developpement, Paris, France. Vanuatu RESCCUE project.
- Johnson, JE, Welch DJ (2016) Climate change impacts and adaptation actions in North Efate, Vanuatu. Report to the Pacific Community (SPC), Noumea, New Caledonia, and Agence Francaise de Developpement, Paris, France. Vanuatu RESCCUE project.
- Pacific Climate Change Science – www.pacificclimatechangescience.org

Work being done in or relevant to Torres Strait fisheries and climate change

Australian Fisheries Management Authority

Ian Butler

AFMA's has a three-phase approach for adapting Commonwealth fisheries management to climate change.

1. Now

Industry perspectives – AFMA recently completed a survey of fishers in south-eastern Australia (Lakes Entrance) and found that climate change was not perceived as a major issue, even though the region is a climate change 'hot spot'. More important issues were economics, quotas, fishing costs and competition.

Non-recovering undercaught species – a collaboration between AFMA, Fishwell Consulting, CSIRO, the South East Trawl Fishing Industry Association and the Department of Agriculture and Water Resources is investigating the causes of undercaught total allowable catches (TACs) and non-recovering species in the Southern and Eastern Scalefish and Shark Fisheries.

Updated modelling – a CSIRO-led project involving AFMA, the University of Tasmania, the University of British Columbia and the Fisheries Research and Development Corporation is underway to update existing models to account for decadal and regional variation. The project will provide analyses of species sensitivity to climate change impacts and provide a set of recommendations based on findings.

2. 2018–20: Adaptation project

The objectives of AFMA's adaptation project are to:

- Determine how well the existing Commonwealth fisheries management framework copes with climate change impacts (i.e. risk assessment)
- Develop methodology and approach for AFMA (and other fisheries) to adapt the regulatory environment to climate change impacts.
- Develop strategies and priorities to account for the effects of climate change in management of fisheries.

This project does not directly apply to Torres Strait, but can fit in with some effort.

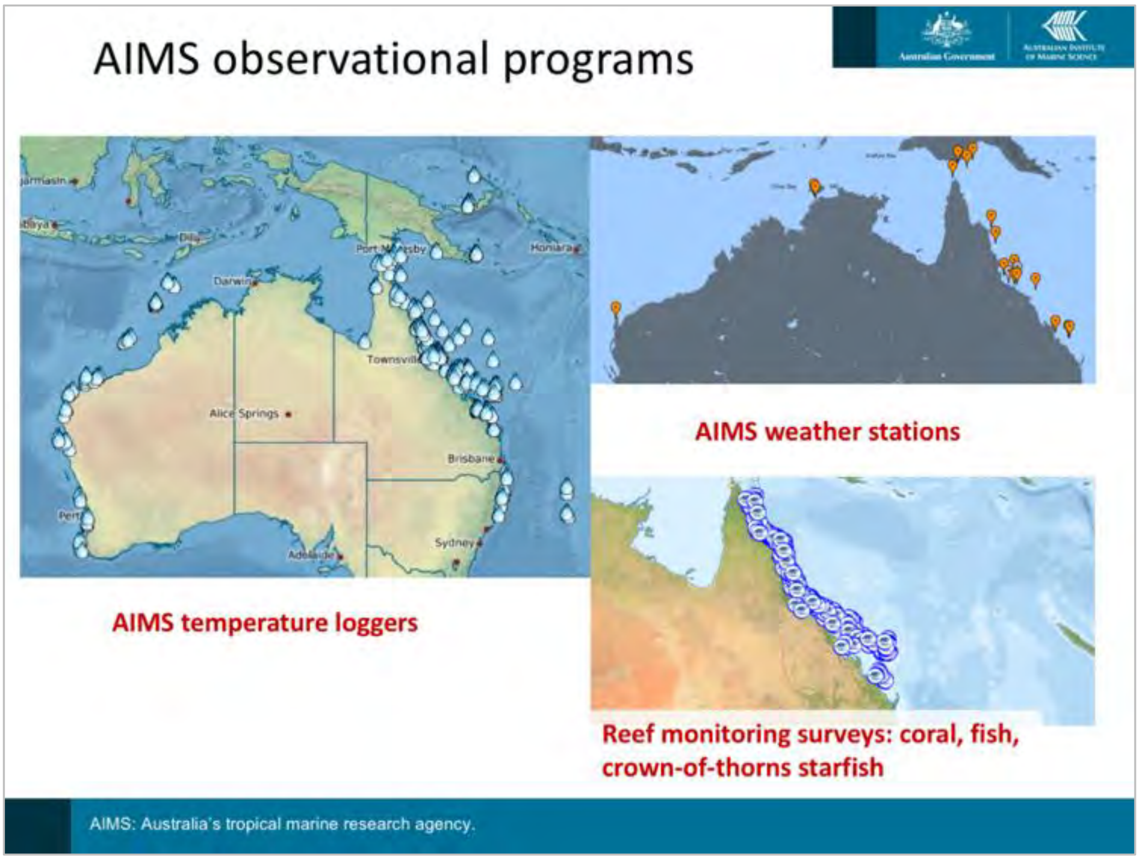
3. 2020+: Implementation

Flexible management is likely to be a key for future fisheries management with features such as a one-fishery approach (flexible management techniques with fewer boundaries) and mobile boundaries (e.g. Southern Bluefin tuna). Another feature is integration of forecasting of optimal fishing conditions.

Australian Institute of Marine Science

Craig Steinberg

One of AIMS's strengths is in its observational programs, which includes temperature loggers, weather stations and surveys of coral, fish and crown-of-thorns starfish.



Modelling currents, sea surface temperatures and sea-level anomalies allows analysis of marine heatwaves and coral bleaching events. Some results to come out of this work:

- The 2016 bleaching event on the Great Barrier Reef was the most severe on record and heat anomalies persisted to the following winter
- Micro-climates created by small scale upwelling can create persistent thermal refugia for coral from a variety of oceanographic processes
- The Gulf of Papua current can reverse, and the current is predicted to intensify in winter in the future. The fate of larvae will be dependent on these changes.

An environmental data gateway has been developed to bring together existing near-realtime data from many sources – IMOS, eReefs, NOAA, AIMS – into one location. The gateway is at http://eatlas.org.au/gbr-gateway-temp.

CSIRO

Eva Plaganyi

There is a long history of fisheries research in Torres Strait and several long time series of fisheries and habitat information collected as part of scientific surveys.

CSIRO has worked closely with traditional owners in the region for several decades in advancing fisheries science and management in the region, and there is a reasonably good two-way flow of information via workshops and meetings.

Torres Strait tropical rock lobster	• Biological and climate data (CSIRO/AFMA surveys since 1989) • Mapping climate impacts on life history stages (2010 study) • Use of management strategy evaluation (2010–13) • Changes in oceanic currents and larval advection (current Environmental Influences project co-funded by AFMA & CSIRO) • Model projections under future climate change (current project that links also with AFMA decadal projections project)
Bêche de mer	• Mapping climate impacts on life history stages (2011 study) • Examples of the use of management strategy evaluation to test the performance of alternative marine monitoring and management strategies to detect and respond to ecological changes caused by climate change (2009–11, part of RUSS project)

There are gaps in some of the physical and oceanographic models that are needed to couple with the biological population dynamics for species of interest in order to reliably make predictions of impacts under climate change for fisheries and ecosystems (e.g. need to resolve tides in the region).

Management strategy evaluation as a risk management tool

Climate-smart strategies build resilience to multiple stresses. Management strategy evaluation (MSE) has been and continues to be used as one effective risk assessment method for road-testing the ‘climate-smartness’ of management strategies. This involves:

- Using climate risk assessment as an input to dynamic models
- Using a reference set of models (ensemble rather than single model) to capture key uncertainties
- Demonstration of use of MSE to test the performance (and adaptability),especially in the face of uncertainty, of alternative harvest strategies in meeting fishery management objectives, such as ensuring:
    - low risk of stock depletion (overall and local)
    - high probability of good catch / average profits
    - low risk of changing the multi-species community composition
    - high probability of managing through climate variability and change.

Torres Strait Regional Authority

Andrew Simmonds

Climate change is impacting vulnerable species and habitats in the Torres Strait and Great Barrier Reef.

Seagrass meadows to date have not shown a negative response to climate change as trends in biomass and species diversity remain consistently high across the region. Seagrass could be vulnerable to climate extremes in the future and this would then impact the Torres Strait **dugong** population – currently low risk. Aerial surveys indicate the population is stable. There is a need to maintain five-yearly survey effort.

Isolated locations of **mangroves** on Torres Strait islands have shown local-scale dieback from coastal erosion/sea-level rise.

Hawksbill turtle nesting population in Torres Strait is in severe decline mostly due anthropogenic impacts of overharvest in neighbouring nations and potential overharvest of eggs in Torres Strait and in neighbouring nations.

Northern Great Barrier Reef stock of **green turtles** is likely heading for a steep decline as a result of failing hatchling production at key index sites at Raine Island and Moulter Cay. Targeting of adult females for harvest and overharvest of eggs in some locations in PNG, Solomons and Torres Strait are also primary contributors. Climate change is drastically skewing the sex of marine turtle hatchlings (all species nesting in Torres Strait) to female via the effects of increased temperatures on incubating eggs. This may lead to negative population outcomes once current hatchling cohorts reach maturity. Funding to support ongoing monitoring of vulnerable marine turtle species in Torres Strait is at risk. If monitoring of key nesting index sites were to cease, this would be a bad outcome for these stock as community-based management would cease to have access to population trends.

Impacts on **coral reefs** from broad-scale severe bleaching will likely have an impact on supporting habitat for commercial fish species. A fisheries management response may be necessary in the future if harvest levels decline. However, there is a lack of information in Torres Strait fisheries regarding amount and value of catches which limits certainty in accurate management responses. There may be refugia for corals at the north-eastern corner of the Torres Strait where waters remain cooler and this may need special management arrangements for future conservation.

Certain low-lying islands in Torres Strait are experiencing **sea-level-related coastal erosion**, which TSRA LSMU is monitoring. There are real concerns in these communities.

There is ongoing **water quality** research into the implications of sediment-related pollution originating from the Fly River. Saibai, Dauan and Boigu are most affected, though results are currently inconclusive. Working with JCU TropWater. Future directions may include investigation of common food sources for metal contamination as well as work to determine historical levels of metals in sediment and corals.

NESP Tropical Water Quality Hub

Johanna Johnson

Previous water quality research

- Torres Strait baseline study (1993) – survey of trace metals in marine seafood, seagrass and sediments
- Apte & Day (1998) – first accurate data on trace metal concentrations in waters (Cu, Cd and Ni only)
- Haynes & Kwan (2002) – 28 sediment samples collected in 2000 and analysed for metals
- NERP WQ hazards (2011–13) – hydrodynamic modelling, predictions of water flow, hazard assessment based on previous data

Current relevant Tropical Water Quality Hub projects

Influence of the Fly River on the Torres Strait region (Projects 2.2.1 and 2.2.2)

Runoff from the Fly River in Papua New Guinea influences water quality conditions in the Torres Strait region; however, the extent and frequency of this influence, and the potential ecological impacts, are not well understood. This project builds on previous efforts to determine the spatial extent, temporal patterns and constituent pollutants of Fly River discharge, and assess the vulnerability of ecosystems in the Torres Strait exposed to the discharge.

A related project is using state of the art procedures to determine trace metal concentrations in marine waters and sediments at locations across the Torres Strait. Chemical signatures of mine pollution are being measured in Torres Strait waters and sediments and hotspots of contamination identified. The water quality data generated will allow informed management decisions to be made on how to best address trans-boundary mining related pollution and potential ecological impacts.

Connectivity and inter-dependencies of values in the northeast Australia seascape: Great Barrier Reef, Torres Strait, Coral Sea, Great Sandy (Project 3.3.3)

This project is identifying and assessing the ecological, cultural, social and economic values of four marine jurisdictions – Great Barrier Reef, Torres Strait, Coral Sea, Great Sandy Straits – and characterising the processes and attributes that influence the values and their connectivity at a regional scale. In doing so, the project will deliver a resource that can inform cross-jurisdictional planning and management.

References/more information

- NESP Tropical Water Quality Hub – www.nesptropical.edu.au

Science, data and research priorities

Workshop participants identified six priority areas for research that will help inform fisheries and marine ecosystem management in Torres Strait (and thereby to inform science-based adaptation response).

The following table summarises initial thoughts with regards to these priority areas. It is anticipated that ideas in this table will further refined over time.

Biological understanding	• Limited understanding of species responses to combinations of changing environmental variables (e.g. bêche-de-mer) (lab, desktop, field) • Seagrass sensitivities
Monitoring	• Tidal gauges – to analyse and add • Drifters – inform on complexity • Integrated Marine Observing System • Moorings (upwellings) – strings of loggers • Himawari satellite information – 1 picture/10 minutes • Turbidity using Secchi discs (cheap and easy)
Population modelling	• Coupling with high-resolution current/climate • Follow similar approaches to those used for corals, crown-of-thorns starfish • Additional models for species (e.g. turtles, dugongs) at appropriate spatial scales • Coral trout correlations with coral abundance or habitat
Climate modelling	• Downscaling of projections for Torres Strait and in particular, tides • Produce regional rainfall projections from CMIP5 models selected for skill/low biases (and maybe CCAM model runs)
Adaptation responses/ communities	• Communication • Community consultation regarding adaptation • Industry and traditional owner advice/experience with regard to fishing behaviour • Management of fisheries – parallel AFMA projects, fishery by fishery; adaptation
Fly River	• Plume prediction • Metals/health risks

Science-based information products and services

Existing information and tools

While additional science will help inform management decisions in the Torres Strait, there is a great deal of information and a number of communication products and decision support tools currently available.

Data collected in the region	• AIMS – in-situ collection (water temperature, weather) – online gateway • BoM – heatwave mapping • AMSA – tide gauges • AFMA – fisheries data • Climate Change in Australia – climate projections • PACCSAP – climate projections for Papua New Guinea and various technical and non-technical climate change communication products and resources • TSRA – reef monitoring, crown-of-thorns starfish monitoring, bleaching, beach profiling • TropWater (James Cook University) – in-situ seagrass surveys • CSIRO – annual habitat surveys (including numbers of pearl oyster, crown-of-thorns starfish and holothurians, and percent cover of standard substratum and biota (including seagrass and algae species) categories
Tools/ programs that make use of the information	• ADWIM (impacts and wellbeing) –> CSIRO • Torres Strait vulnerability assessment • NESP ESCC Hub (www.nespclimate.com.au)

The challenge lies in identifying which information is most useful and delivering it to the people that need it in ways that they can use it.

Communication and outreach ideas

It was agreed that a useful communication and outreach model is needed to develop information resources for the communities and stakeholder groups to provide information that can be easily understood and delivered to stakeholders. A number of ideas for ways this might occur were identified at the workshop.

As is the case with the ideas for science, data and research priorities, it is anticipated that these ideas will be refined over time as follow-up to the workshop.

Support	• Outreach specialist in climate supporting TSRA in disseminating information
Engagement/ outreach activities	• TSRA staff discussing the outcomes of this workshop in fisheries working group meetings and canvasing interest in engagement • More targeted outreach effort to discuss key climate change messages in Torres Strait communities • Building local climate change capacity -> drive local adaptation plans -> climate champion -> who wants to be involved in the communities • Annual event (pre-season gathering of key stakeholders) to provide timely climate information relevant to local communities/the fishery sector
Communication/ knowledge brokering products	• Workshop report • Climate change themed ‘comic book’ as a communication resource for local communities • Video – explain the science and communicate traditional knowledge (communities explain what they see)

Appendix 1: Workshop agenda

Technical workshop

CLIMATE CHANGE IN THE TORRES STRAIT: IMPLICATIONS FOR FISHERIES AND MARINE ECOSYSTEMS

Pullman Cairns International, 17 Abbott Street, Cairns
7–8 December 2017

DAY 1: THU 7/12/17 13:00–17:30

Time	Agenda item	Who	Session purpose
13:00	**LUNCH**		
Introduction			
14:00	Welcome	Geoff Gooley (ESCC Hub)	
14:05	Welcome to country	Gudju Gudju	
14:10	Introduction	Geoff Gooley (ESCC Hub)	
Setting the context			
14:20	Overview: Climate change impacts on oceans, fisheries and marine systems	Neil Holbrook (ESCC Hub)	To ensure all workshop participants understand what aspects of climate change impact oceans and marine systems and what the impacts could be (starting with the global 'big picture' and including all aspects of climate change relevant to TS including SLR, coastal hazards, ocean temp extremes, acidification, extreme events, coral bleaching risk)
14:50	Overview: Torres Strait fisheries and marine ecosystems	TSRA/AFMA	To ensure all workshop participants understand the nature and extent of TS fisheries and marine ecosystems, including and key features and related considerations (e.g. social, political, economic).
Current and future climate in the Torres Strait			
15:20	Climate trends and projections for Torres Strait Islands	Jo Brown (ESCC Hub)	To provide an overview of the current climate of the TS, how it has changed and how it could change in the future, drawing on the latest climate change science. This information will provide an important basis for later discussions in the workshop.

Time	Agenda item	Who	Session purpose
15:50	Climate change impacts on key TS resources – ADWIM model	Cass Hunter (CSIRO)	To share outputs from the CSIRO ecosystem goods and services model to show how climate change is likely to impact key marine resources for TS communities.
16:20	Vulnerability of fisheries to climate change – report summary	Jo Johnson (TWQ Hub)	To provide an overview of climate change hazards, vulnerability and risk specific to fisheries and marine ecosystems in the TS.
16:50	Day 1 wrap-up	Geoff Gooley (ESCC Hub)	
17:00	**Close Day 1**		

DAY 2: FRI 8/12/17 9:00–16:30

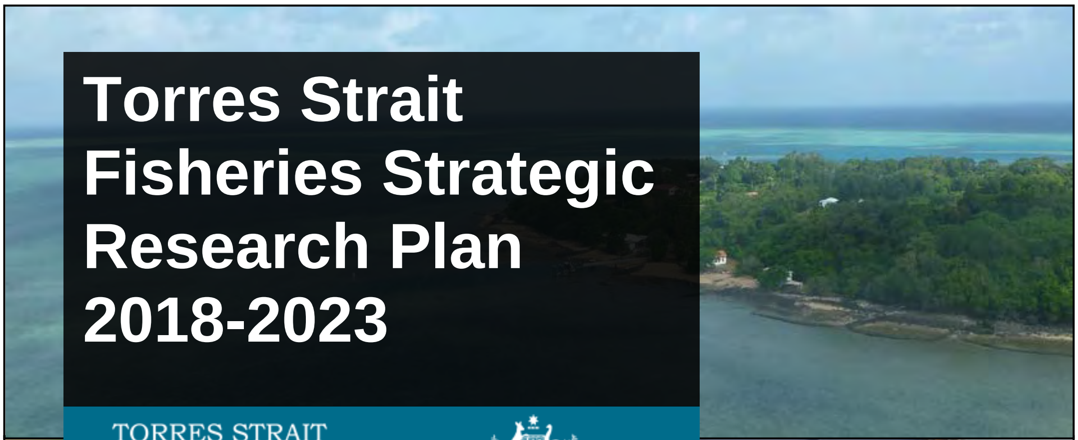
Time	Agenda item	Who	Session purpose
Snapshots: Understanding climate change and impacts in the Torres Strait			
9:00	Issues and impacts Including: • impacts of the last coral bleaching event • decadal scale projection of changes in fisheries stocks under climate change • adaptation of fisheries to climate change	Craig Steinberg (AIMS) Eva Plaganyi (CSIRO) Ian Butler (AFMA) John Rainbird and Andrew Simmonds (TSRA) Jo Johnson (TWQ Hub)	To provide a brief overview of current projects and monitoring activities that are helping us to understand climate change and impacts in the TS, as well as discussion of current issues and impacts. Each presenter will have 15 mins to talk about work from their respective organisations, with time for discussion at the end. Outcomes/findings reported here will feed into the following discussions.
10:40	**Morning tea**		
Looking ahead: what does the future hold for TS fisheries and marine ecosystems?			
11:00	Understanding TS stakeholders	Charles David (TSRA)	To identify TS stakeholder groups and their needs
11:30	Activity: Cascading consequences	Facilitator: John Rainbird (TSRA)	To identify possible consequences of climate change and coincident events in TS. Participants will break into two groups for this activity.
12:30	Discussion: Cascading consequences activity	Facilitator: John Rainbird (TSRA)	To discuss the outcomes of the previous activity. As well as being included in the workshop report, responses will inform post-workshop technical meeting discussions.
13:00	**Lunch**		
Preparing for the future			
13:30	Lessons from the Pacific	Jo Johnson (TWQ Hub) and Mandy Hopkins (ESCC Hub)	To share how communities in the Pacific are using projections/science to drive risk assessments, and how

Time	Agenda item	Who	Session purpose
			this feeds into adaptation planning and associated decision-making
14:00	Identified knowledge gaps and prioritised needs	Facilitator: Geoff Gooley (ESCC Hub)	To learn about some knowledge gaps and needs that have already been identified and prioritised. These will inform the following discussion.
14:20	Small group discussions: Knowledge gaps and knowledge products	Facilitator: Mariana Nahas (TSRA)	To identify knowledge gaps and needs in light of what has been presented at the workshop, and how they may be able to be addressed. What [information] resources/ knowledge products are needed to convey the learnings from this workshop to TS stakeholders (including TOs/local fishers, natural resource managers, other local communities of interest and scientists) and what information do we need from TOs?
15:00	Report back – Knowledge gaps and knowledge products	Facilitator: Mariana Nahas (TSRA)	To record ideas for management responses and information needs. As well as being included in the workshop report, responses will inform post-workshop technical meeting discussions.
15:30	Group discussion: Options for further engagement including priority actions and responsibilities	Facilitators: Geoff Gooley (ESCC Hub), John Rainbird (TSRA)	Emphasis on options for further strategic engagement, collaborative partnerships and delivery
Workshop wrap-up			
16:15	Closing remarks (including next steps)	Geoff Gooley (ESCC Hub), John Rainbird (TSRA)	To provide a brief recap of what has been covered and why, and what the next steps will be.
16:30	**Workshop close**		

Appendix 2: Workshop participants

- Shaun BARCLAY, TSRA (Day 2 only)
- Josephine BROWN, ESCC Hub
- Ian BUTLER, AFMA
- Charles DAVID, TSRA
- Geoff GOOLEY, ESCC Hub
- Rohan HAMDEN, Consultant (Day 1 only)
- Neil HOLBROOK, ESCC Hub
- Mandy HOPKINS, ESCC Hub
- Cass HUNTER, CSIRO
- Johanna JOHNSON, TWQ Hub
- Phil LAYCOCK, GBRMPA
- Mariana NAHAS, TSRA
- Karen PEARCE, ESCC Hub (Day 2 only)
- Eva PLAGANYI, CSIRO
- John RAINBIRD, TSRA
- Andrew SIMMONDS, TSRA
- Selina SOUTE, AFMA (Day 2 only)
- Craig STEINBERG, AIMS

Torres Strait Fisheries Strategic Research Plan 2018-2023



TORRES STRAIT
PZJA
PROTECTED ZONE JOINT AUTHORITY

Australian Government
Australian Fisheries Management Authority

Box 7051, Canberra Business Centre, ACT 2610 / Ph (02) 6225 5555 / Fax (02) 6225 5500 / AFMA Direct 1300 723 621

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Torres Strait Scientific Advisory Committee

The Torres Strait Scientific Advisory Committee (TSSAC) includes members from each of the three main Protected Zone Joint Authority (PZJA) agencies (the Australian Fisheries Management Authority, the Torres Strait Regional Authority and Fisheries Queensland), industry members and scientific research members. TSSAC is responsible for providing advice to the Australian Fisheries Management Authority (AFMA) Executive on the use of AFMA research funds for Torres Strait fisheries research. This Torres Strait research provides critical information to the Minister and the Protected Zone Joint Authority (PZJA) for the management of Torres Strait commercial fisheries.

As part of its role the TSSAC:

- develops research priorities for PZJA fisheries in conjunction with the Resource Assessment Groups (RAGs) (or Management Advisory Committees (MACs) and Working Groups (WG)) and addresses PZJA's management needs and objectives as specified in the *Torres Strait Fisheries Act 1984* (the Act) and this plan;
- reviews and advises (where required) on individual fishery research plans for PZJA managed fisheries;
- advises the AFMA Executive on the allocation of research funds, and provides milestone reports and accounts against the use of funds.
- informs Torres Strait communities of project outcomes.

AFMA provides the TSSAC secretariat duties, including organising meetings and managing research contracts and projects milestones.

The TSSAC relies on the assistance of the various PZJA advisory groups (MACs, RAGs and Working Groups) to develop fishery-specific research plans and priorities based on this Strategic Research Plan (SRP). These groups provide current and up to date scientific and operational advice to the TSSAC as it relates to research proposals and fishery. More information about the advisory groups is provided at section 2.4 below.

The Terms of Reference for the TSSAC is at (Appendix A)

About this plan

This plan specifies the research priorities and strategies that the PZJA intend to pursue in Torres Strait fisheries, and provides background to the processes used to call for, and assess, research proposals.

This SRP has been developed by AFMA in consultation with TSSAC to assist the PZJA to pursue the objectives of the *Torres Strait Fisheries Act 1984* (the Act) through research.

This document sets out the five year strategic plan (2018-2023) for research in Torres Strait fisheries to support a framework for fishery-specific, five-year research plans, and a TSSAC annual research statement.

1. Part one sets out the research planning and priorities, including the current research themes, strategies and possible research activities (Part 1 and Appendix B). It also provides guidance to researchers developing applications for research funding.
2. Part two provides guidance for the TSSAC and PZJA advisory groups when assessing research applications (see Appendix C).

Supporting information for the TSSAC and researchers can be found in appendices and referenced documents, which are useful when developing research applications.

It is intended that the SRP be a living document that responds to a changing environment. In line with this intent, this plan will be reviewed by the TSSAC as needed, but not later than 2022.

Part 1 Research planning and priorities

1.1 Role of five year fishery research plans and link to the TSSAC Strategic Research Plan

The three research themes described in this section are strategic priorities for Torres Strait and provide a basis for advisory forums (RAGs, MACs and working groups) when developing their five-year fishery research plans (see section 2.3.2).

The five year fishery research plans will vary between fisheries depending on the status of the fishery, its information requirements and particular knowledge gaps. Although it is a five year plan, the advisory forums are required to review and update the fishery plan annually so the plan will always have a five year projection.

The TSSAC uses both the strategic priorities in the SRP and the specific priorities within individual fisheries research plans to compile the TSSAC Annual Research Statement (ARS). The ARS is the list of priority research for a given year that researchers will focus on when developing research proposals. The ARS is also the key document for RAGs, MACs and WGs in their prioritisation of research applications for TSSAC funding consideration. All groups including TSSAC and researchers should refer to the 'criteria for assessing research investment' (Appendix C) when developing, assessing and ranking research proposals.

1.2 Torres Strait Fisheries Research Themes, Strategies and Research Activities

The TSSAC has identified three research themes, related strategies and possible research activities (basis for proposals) for the next five years that will help the PZJA to pursue the objectives of the *Torres Strait Fisheries Act 1984* (Appendix A) and improve fisheries management in the Torres Strait.

Researchers are encouraged to use this SRP and the five year fishery plans when considering and planning their proposed research in the Torres Strait, regardless of where they may seek funding. The TSSAC process ensures robust consultation with a broad range of stakeholders regarding funding priorities through the PZJA advisory forums.

Theme 1: Protecting the Torres Strait marine environment for the benefit of Traditional Inhabitants

Aim

Effective management of fishery stocks based on understanding species and their biology and ecological dependencies so it can support Traditional Inhabitant social and economic needs.

Strategy 1a - Fishery stocks, biology and marine environment

Possible research activities under this theme may include:

- Stock assessment and fishery harvest strategies for key commercial species.
- Ecological risk assessments and management strategies for fisheries.
- Minimising marine debris in the Torres Strait.
- Addressing the effects of climate change on Torres Strait fisheries through adaptation pathways for management, the fishing industry and communities.
- Incorporating Traditional Ecological Knowledge into fisheries management.
- Methods for estimating traditional and recreational catch to improve fisheries sustainability.

Strategy 1b – Catch sharing with Papua New Guinea

Possible research activities under this theme may include:

- Status of commercial stocks and catches by all sectors within PNG jurisdiction of the TSPZ.
- Good cross-jurisdictional fisheries management through better monitoring and use of technology.

Theme 2: Social and Economic Benefits

Aim

Increase social and economic benefits to Traditional Inhabitants from Torres Strait Fisheries.

Strategy 2a - Promoting social benefits and economic development in the Torres Strait, including employment opportunities for Traditional Inhabitants

Possible research activities under this theme may include:

- Models for managing/administering Traditional Inhabitant quota
- Understanding what influences participation in commercial fishing by Traditional Inhabitants.
- Understanding the role and contribution of women in fisheries.
- Capacity building for the governance of industry representative bodies
- Methods for valuing social outcomes for participation in Torres Strait fisheries.
- Identifying opportunities and take-up strategies to increase economic benefits from Torres Strait fisheries.

Theme 3: Technology and Innovation

Aim

To have policies and technology that promote economic, environmental and social benefits from the fishing sector.

Strategy 3a – Develop technology to support the management of Torres Strait fisheries.

Possible research activities under this theme may include:

- Electronic reporting and monitoring in the Torres Strait, including for small craft.
- Technologies or systems that support more efficient and effective fisheries management and fishing industry operations.

Part 2 Research management and administration

The PZJA, established under the Act, is responsible for the management of fisheries in the Australian Jurisdiction of the Torres Strait Protected Zone (Figure 1). The PZJA members comprise the Commonwealth and Queensland Ministers responsible for fisheries, and the Chair of the Torres Strait Regional Authority.

Fisheries research findings are critical to the PZJA exercising its functions, and in particular, for monitoring the condition of the Torres Strait fisheries, Good research more broadly assists the PZJA to pursue the legislated objectives. For more information about the PZJA or the PZJA agencies responsible for the day to day management of Torres Strait fisheries see annual reports on the PZJA website (www.pzja.gov.au).

The TSSAC is the only committee that is solely focused on Torres Strait fisheries research, although other committees or agencies (see below) may sometimes fund and manage research projects relevant to Torres Strait fisheries. The different funding sources and management are discussed below.

Research in the Torres Strait comes with a unique set of challenges. The traditional way of life and Torres Strait Island culture are critically important to the communities residing across the many remote islands in the Protected Zone. Consequently, research needs to pay special attention to the social and economic contexts which are unique to the region. This includes consideration of the potential impacts that research may have on Torres Strait communities, both overt through direct interaction with communities and the more subtle emotional or psychological impacts of research activities taking place in and around culturally significant places.

2.1 Research Funding Environment

Torres Strait fisheries operate in a complex management environment with social, economic and cultural objectives being pursued alongside contemporary environmental and fisheries management objectives.

Therefore, the scope of potential fisheries research is necessarily broad. Research ranges from assisting Traditional Inhabitants to pursue their aspirations within local fisheries, undertaking routine science stock assessments and surveys, adaptation to the effects of climate change and ways to improve sustainability of, and economic and social benefits from the Torres Strait fisheries.

2.2 AFMA research funds

The TSSAC primarily funds research through AFMA's annual research contribution (currently at $410 000 annually).

These funds are allocated at the discretion of the AFMA executive, based on recommendations of the TSSAC. The TSSAC considers research proposals based on the priorities set in this SRP and the ARS. When the TSSAC is unable to recommend funding for a project due to funding constraint, it may recommend that researchers go to other funding bodies. Depending on the priority and degree of funding constraint the TSSAC may support the project but ask the researcher to seek co-funding from another body.

Research priorities identified by the TSSAC in its SRP are also intended to implicitly influence other funding agencies in the research they may fund as it relates to Torres Strait fisheries. Equally, the TSSAC should be mindful of research being funded by other bodies, particularly where it may overlap with TSSAC priorities.

It is not possible to meet all Torres Strait research needs through the AFMA funds. Funding constraints are not likely to change and it would be beneficial for the TSSAC to play a greater role in supporting researchers to find other funding opportunities in order to broaden research delivery in the Torres Strait. This could be achieved through improved collaboration among research providers with an interest in the Torres Strait region. AFMA will actively engage in seeking greater collaboration between the TSSAC and other bodies.

2.3 Other funding bodies

Funding for Torres Strait fisheries related projects is sometimes provided by other government agencies or external funding bodies for Torres Strait research. This can take the form of contributions towards AFMA funded TSSAC projects, or be completely funded external to TSSAC and AFMA. In these cases, the funding body will manage the project themselves with little or no TSSAC comment. Information on some of these funding bodies and agencies is provided below. Further information about their role and research programs can be found on the agency websites.

2.3.1 Government Agencies

The Department of Agriculture and Water Resources, along with the Torres Strait Regional Authority and the Queensland Government may provide funding support for certain Torres Strait fisheries projects based on the relevance to their jurisdiction and their current priorities. Sometimes these projects and funds are managed by the TSSAC. TSRA in particular inject significant funds for Torres Strait fisheries research on a regular basis. TSRA funded projects generally have a focus on capacity building and traditional fisheries, or commercial fisheries with an indigenous interest, and generally compliment the TSRA core program work.

2.3.2 The Fisheries Research and Development Corporation (FRDC)

The FRDC is a statutory authority within the portfolio of the Federal Minister for Agriculture and Water Resources, jointly funded by the Australian Government and the commercial fishing The FRDC may fund projects in the Torres Strait if such projects fit within the FRDC’s Research, Development and Extension (RD&E) plan. The FRDC uses Commonwealth, State and Territory research advisory committees at to assess and recommend projects for funding in line with the RD&E Plan.

The Indigenous Reference Group (IRG), FRDC

The IRG is the FRDC’s Indigenous Fishing sub-program advisory partner. The IRG was established by the FRDC in 2012 to assist in working towards a

RD&E plan for indigenous Australians to improve economic, environmental and social benefits to Australia's indigenous people. The current priorities for the IRG, can be found at the FRDC website (www.frdc.com.au) Some of these priorities are highly relevant to Torres Strait fisheries, including;

- Primacy for Indigenous People
- Acknowledgement of Indigenous Cultural Practices
- Self-determination of indigenous rights to use and manage cultural assets and resources
- Economic development opportunities arising from Indigenous peoples cultural assets and associated rights
- Capacity building opportunities for Indigenous people are enhanced.

Human Dimensions Program, FRDC

The FRDC also has a new Human Dimensions Program, focusing on social-science and economic research related to fisheries. Information on this program can also be found on the FRDC website (www.frdc.com.au).

2.3.4 The Commonwealth Scientific and Industrial Research Organisation (CSIRO)

The CSIRO has a long history of contributing funding support for CSIRO-led Torres Strait research. This generally occurs as a co-funding of project managed through the TSSAC.

2.3.6 Collaboration among research providers

There are both formal and informal links between staff from many of these external funding bodies and agencies that contributes to successful funding of research in the Torres Strait. Improved collaboration among research providers may lead to more efficient use of research funds.

AFMA, as a key funding agency for Torres Strait fisheries research, will consult with external research providers and key research stakeholders in an effort to improve collaboration among these groups and transparency about proposed Torres Strait fisheries research.

2.4 MACs, RAGs and Working Groups

MACs, RAGs and WGs are actively involved in the PZJA's research planning process for the Torres Strait.

The roles of these different groups are less distinct than in the AFMA Commonwealth fisheries forums, as the working groups and MAC (there is currently only one MAC operating in Torres Strait) have a very similar function. There are now two RAGs within Torres Strait fisheries. Both Torres Prawn MAC and the hand collectible working group also perform RAG functions (primarily scientific advice).

The collective scientific functions of these groups are to review scientific data and information and provide advice to the PZJA on the status of fish stocks, sub-stocks, species (target and non-target species) and the impact of fishing on the marine environment. This advice assists the Minister and PZJA in the role of managing commercial fishing within PZJA fisheries, particularly in relation to monitoring the condition of the Torres Strait fisheries.

The collective management advisory function is to provide advice on fishery-specific management policies and plans to assists the Minister and PZJA in the role of managing commercial fishing across the PZJA fisheries.

In relation to the TSSAC function, each of these groups will lead the preparation of the rolling five year, fishery-specific research plans which are underpinned by the SRP. See Figure 2 below for a map of roles and responsibilities during the TSSAC funding application process.

Figure 2. Roles and responsibilities of key participants in the PZJA's annual research cycle for Torres Strait fisheries

	AFMA EXECUTIVE *Decides on which research proposals are to funded.*
	↑

AFMA EXECUTIVE

Decides on which research proposals are to funded.

MACs, WGs and RAGs

- Develop and implement individual fisheries five year research plans based on the SRP five year strategic priorities.
- Review project milestones/final reports and provide comments to author/s when requested by TSSAC.
- Advise on management implications of research outcomes.

TSSAC

- Annually reviews fishery research plans.
- Reviews and advises the AFMA Executive (or other funding bodies) on research, monitoring and assessment priorities for PZJA fisheries developed by AFMA Management in conjunction with management advisory committees, resource assessment groups and working groups.
- Develops, maintains and approves TSSAC Five Year Strategic Research Plan.
- Provides advice to other funding bodies (such as FRDC) on priorities for potential funding.
- Manages research contract and milestone reports, assessing them against the evaluation document before payment (AFMA as TSSAC executive officer)
- Assesses final research project outcomes to ensure the research conducted achieved objectives and meaningful outcomes.

External funding bodies

- Applications unable to be funded by TSSAC can be forward to FRDC or other agencies (by the researcher) for consideration.

2.4 Confidentiality of community fishing data and intellectual property

Data collected during research projects can be regarded as confidential to local communities, or non-indigenous fishers. Confidentiality requirements should be considered for all research projects that may generate intellectual property related to traditional knowledge, or contain data, such as fishing grounds or catch data, of individual communities or fisheries. This data should be treated in the same way as commercial in confidence commercial fishing data. Researchers should consider the types of data they will be collecting, and gain prior agreement from each community or relevant stakeholder/s as to how the data will be used for example. only for decision making or to be published in the public domain.

TSSAC's annual research cycle

Table 1. TSSAC funding Cycle

	TSSAC PROCESS
February	Research providers submit pre-proposals for assessment, which meet the scopes provided by TSSAC in November. EOIs submitted are circulated to fisheries managers/ RAGs & MACs for comment; Fisheries Managers, RAGs/MACs identify any additional research priorities for potential FRDC funding.
March	TSSAC meets via teleconference to assess pre-proposals and Management/RAG/MAC comments. Applicants notified of TSSAC comments on their pre-proposals and asked to develop the consultation package (for review by AFMA by end of March) for use during full proposal development.
April	Researchers to complete full proposal (6 weeks total with consultation period)
May	Late May/ early June. TSSAC meet face to face to review full proposals and endorse final applications, or suggest necessary changes before endorsement. Applicants advised of the TSSAC's final evaluation.
June	
July **(START)**	TSSAC confirm the research budget for the new financial year (it doesn't generally change from year to year - $410 000). New contracts and variations for essential research projects prepared and put in place, confirming forward budgets. RAGs, WGs and MACs to identify THEIR PRIORITY RESEARCH NEEDS for funding in the next financial year by updating their *five year rolling fisheries research plan*. This should be framed around strategies in the 5 year strategic research plan. Provide to TSSAC EO by end August.
August	RAGs/MACs submit their five year rolling fishery research plan to the TSSAC

	Executive Officer, currently lisa.cocking@afma.gov.au, by end August.
September	TSSAC EO drafts the TSSAC Annual Research Statement (ARS) with each fisheries priorities for the current year.
October	TSSAC meets (face to face or via teleconference) to finalise the PZJA ARS and agree on priorities for the TSSACs call for applications in November. AFMA develop scopes for the priority research projects and send to TSSAC out of session for consideration.
November	The annual research call opens in November. Scopes sent to researchers seeking pre-proposals.

Appendix A: TSSAC Terms of Reference

Terms Of Reference

i. Identify and document research gaps, needs and priorities for fisheries in the Torres Strait in conjunction with the PZJA advisory groups.
ii. develop, maintain and approve the Torres Strait Five Year Strategic Research Plan. This includes balancing tactical short term needs and strategic needs to identify research gaps and priorities.
iii. review rolling five (5) year research plans for Torres Strait fisheries
iv. provide advice to the AFMA executive on priorities for the allocation of AFMA research funds and potential risks to achieving intended outcomes.
v. Provide advice on effective consultation strategies with communities regarding research projects to ensure engagement throughout the project.
vi. Consider the level of community support for research proposals and advise researchers on any actions needed to improve community consultation before a project is supported.
vii. ensure research outcomes are communicated to community stakeholders.
viii. provide advice to FRDC or other research providers on Torres Strait research priorities for potential funding consideration.
ix. assess research investment and outcomes for the Torres Strait fisheries to measure the extent to which intended sustainability, social and economic needs are being met.
x. provide a forum for expert consideration of scientific issues referred to the TSSSAC by the Torres Strait advisory groups.
xi. provide other advice to the Torres Strait advisory groups on matters consistent with TSSAC functions.
xii. review research / consultancies, stock assessments, and other reports and outputs relevant to Torres Strait fisheries and advise the Torres Strait advisory groups on their technical merit.
xiii. convene Fisheries Assessment workshops as appropriate to review and address assessment needs for Torres Strait fisheries.

Appendix B: Key factors influencing Torres Strait fisheries research needs

In developing this plan and the drivers for research in the Torres Strait, there are a number of factors which have been taken into account. This includes whole of Government policies and objectives relevant to the Torres Strait. These are explained in some detail below.

The Torres Strait Fisheries Act 1984 (the Act)

The PZJA is created under the Act; the legislation used by the Australian and Queensland Governments when managing Torres Strait fisheries.

The Act makes the PZJA responsible for monitoring the condition of the fisheries under its control and formulating policies and plans for their good management. In performing these functions, the Act requires the PZJA to have regard to the rights and obligations conferred on Australia by the Torres Strait Treaty' (https://www.legislation.gov.au/Details/C2016C00677), and in particular, the following management priorities:

(a) to acknowledge and protect the traditional way of life and livelihood of traditional inhabitants, including their rights in relation to traditional fishing;

(b) to protect and preserve the marine environment and indigenous fauna and flora in and in the vicinity of the Protected Zone;

(c) to adopt conservation measures necessary for the conservation of a species in such a way as to minimise any restrictive effects of the measures on traditional fishing;

(d) to administer the provisions of Part 5 of the Torres Strait Treaty (relating to commercial fisheries) so as not to prejudice the achievement of the purposes of Part 4 of the Torres Strait Treaty in regard to traditional fishing;

(e) to manage commercial fisheries for optimum utilisation;

(f) to share the allowable catch of relevant Protected Zone commercial fisheries with Papua New Guinea in accordance with the Torres Strait Treaty;

(g) to have regard, in developing and implementing licensing policy, to the desirability of promoting economic development in the Torres Strait area and employment opportunities for traditional inhabitants.

Australian Government priorities

The Australian Government has identified priorities for research that are significant in shaping fisheries research effort and its reporting, namely:

- Global trends
- National Research Priorities
- Rural Research and Development Priorities

Global Trends

The five major trends that are expected to influence primary industries globally during the next 20 years, as identified by the Rural Industries Research and Development Corporation in its report *Rural Industry Futures – Megatrends impacting Australian agriculture over the coming twenty years*, include:

A hungrier world: Population growth will drive demand for food and fibre

A bumpier ride: Globalisation, climate change and environmental change will reshape the risk profile for agriculture

A wealthier world: A new middle class will increase food consumption, diversify diets and eat more protein

Transformative technologies: Advances in digital technology, genetic science and synthetics will change the way food and fibre products are made and transported

Choosy customers: Information-empowered customers of the future will have expectations for health, provenance, sustainability and ethics

National RD&E Strategy for Fishing and Aquaculture

The National Fishing and Aquaculture RD&E Strategy 2015-20 provides direction to improve the focus, efficiency and effectiveness of RD&E to support Australia's fishing and aquaculture industry.

The identified goals and key strategies are:

- Australia's fisheries and aquaculture sectors are managed, and acknowledged, to be ecologically sustainable.
- Security of access and resource allocation.
- Maximising benefits and value from fisheries and aquaculture resources.
- Streamlining governance and regulatory systems.
- Maintain the health of habitats and environments upon which fisheries and aquaculture rely.
- Aquatic animal health, and biosecurity (inclusive of pests) Aquaplan 2015-2019.

FRDC Research Development and Extension Plan 2015-20

The FRDC's RD&E Plan 2015-20[1] is focused on maximising impacts by concentrating on knowledge development around three national priorities:

1. Ensuring that Australian fishing and aquaculture products are sustainable and acknowledged to be so.
2. Improving productivity and profitability of fishing and aquaculture.
3. Developing new and emerging aquaculture growth opportunities.

[1] http://frdc.com.au/research/Documents/FRDC_RDE-Plan_2015-20.pdf

Appendix C: Criteria for assessing research investment in Torres Strait fisheries

The TSSAC will apply these criteria in assessing and ranking research proposals. Researchers should use the criteria as a guide when developing research applications and RAGs, MACs and WGs should also use these criteria when assessing proposals.

	Strongly disagree -------------------------→ strongly agree											Notes
Attractiveness	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**N/A**	
1. Is there a priority need for the research (does it align with the Torres Strait Strategic Research Plan and Annual Research statement)?												
2. Is/are the end-user/s identified?												
3. Do the outcomes have relevance and are they appropriate to the end-users?												
4. Do the outputs contribute towards outcomes and are they measureable?												
5. Does the proposal actively engage Traditional Inhabitants and Torres Strait Islanders in the research?												
6. Are there employment opportunities for Traditional Inhabitants and Torres Strait Islanders?												
7. Does the research contribute to the knowledge that underpins ecosystem based fisheries management (EBFM) to improve the quality of decisions made?												

8. Does the project involve capacity development for Communities? If so, TSSAC to discuss if there is funding from other agencies such as the IRG or TSRA that could support this project.												
Feasibility												
9. Does the applicant and their team / resources have the capacity to produce the outputs?												
10. Is the budget appropriate to meet the outputs and outcomes?												
11. Does the proposal outline a coherent strategy surrounding data collection, analysis, and storage?												
12. Does the proposal include appropriate plans (for example, adoption, communication and/or commercialisation plans) to ensure that the full potential of the research is realised through adoption of research outputs by end-users?												
13. Are the methods scientifically sound, well described and consistent with the projects objectives?												

14. Research will be most effective when there is effective engagement with fishery stakeholders, particularly Traditional Inhabitants of the Torres Strait, and where the research has widespread stakeholder support (refer to procedural framework for undertaking research in the Torres Strait and the TSSAC research proposal application). Does the project identify the key stakeholders and how they will be engaged regarding the project in a culturally appropriate way?												

Torres Strait fisheries research themes, strategies and research activities

<table>
<tr><th colspan="2">Theme 1: Protecting the Torres Strait marine environment for the benefit of Traditional Inhabitants</th></tr>
<tr><td colspan="2">Aim
Effective management of fishery stocks based on understanding species and their biology and ecological dependencies so it can support Traditional Inhabitant social and economic needs.</td></tr>
<tr><td>Strategy 1a - Fishery stocks, biology and marine environment</td><td>Possible research activities under this theme may include:
a. Stock assessment and fishery harvest strategies for key commercial species.
b. Ecological risk assessments and management strategies for fisheries.
c. Minimising marine debris in the Torres Strait.
d. Addressing the effects of climate change on Torres Strait fisheries through adaptation pathways for management, the fishing industry and communities.
e. Incorporating Traditional Ecological Knowledge into fisheries management.
f. Methods for estimating traditional and recreational catch to improve fisheries sustainability.</td></tr>
<tr><td>Strategy 1b – Catch sharing with Papua New Guinea</td><td>Possible research activities under this theme may include:
a. Status of commercial stocks and catches by all sectors within PNG jurisdiction of the TSPZ.
b. Good cross-jurisdictional fisheries management through better monitoring and use of technology.</td></tr>
<tr><th colspan="2">Theme 2: Social and Economic Benefits</th></tr>
<tr><td colspan="2">Aim
Increase social and economic benefits to Traditional Inhabitants from Torres Strait Fisheries.</td></tr>
<tr><td>Strategy 2a - Promoting social benefits and economic development in the Torres Strait, including employment opportunities for Traditional Inhabitants</td><td>Possible research activities under this theme may include:
a. Models for managing/administering Traditional Inhabitant quota
b. Understanding what influences participation in commercial fishing by Traditional Inhabitants.
c. Understanding the role and contribution of women in fisheries.
d. Capacity building for the governance of industry representative bodies
e. Methods for valuing social outcomes for participation in Torres Strait fisheries.
f. Identifying opportunities and take-up strategies to increase economic benefits from Torres Strait fisheries.</td></tr>
</table>

Theme 3: Technology and Innovation	
Aim To have policies and technology that promote economic, environmental and social benefits from the fishing sector.	
Strategy 3a – Develop technology to support the management of Torres Strait fisheries.	Possible research activities under this theme may include: a. Electronic reporting and monitoring in the Torres Strait, including for small craft. b. Technologies or systems that support more efficient and effective fisheries management and fishing industry operations.

TSSAC annual research cycle

	TSSAC Process
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August	RAGs/MACs submit their five year rolling fishery research plan to the TSSAC Executive Officer, currently lisa.cocking@afma.gov.au, by end August.
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November	The annual research call opens in November. Scopes sent to researchers seeking pre-proposals.

Development of a tier Harvest Strategy approach for Torres Strait tropical rock lobster (TRL)

Éva Plagányi, Roy Deng, Robert Campbell, Darren Dennis, Trevor Hutton

CSIRO Oceans and Atmosphere

Working Paper for TRLRAG December 2016

Summary

The amount and quality of data and surveys available to inform assessments of the Torres Strait tropical rock lobster (TRL) stock has varied over time, and stakeholders have requested flexibility to increase or decrease the frequency and intensity of fishery-independent surveys in future. To accommodate potential changes in the amount of monitoring information available and number and timing of surveys, and hence changes in the associated level of confidence in the scientific advice for decision-making, a hierarchical tier system is proposed. Tier systems broadly aim to reduce the risk when data are poorer, and ideally aim for risk equivalency such that different tiers have the same risk of the stock falling below the limit reference point. This is achieved by adjusting catch limits upwards or downwards based on the available data and assessment type, with the adjustment factors referred to as buffers or discount rates. A four Tier system is proposed for TRL, where Tier 1 represents the highest quality of information (as was collected during 2005-2008, 2014) and Tier 4 the lowest. The top three tiers all include applying a stock assessment every three years, and each tier has its own empirical Harvest Control Rule (eHCR) based on available inputs, but discount factors are applied to the Recommended Biological Catch (RBC) from Tiers 1, 3 and 4. This is because these tiers are assessed relative to the current/base Tier 2, with any upward move to the data-rich Tier 1 involving a bonus in the form of a positive discount, and a move down the tiers incurring a penalty in the form of a negative discount. A preliminary suggested framework is as shown in Table 1 below.

Table 1. Summary of proposed tier system for TRL (penalty or bonus relative to Tier 2 – current approach).

Tier level	Information requirements	eHCR	Penalty or bonus discount factor applied to RBC
1	Catch, Midyear survey, Preseason survey, CPUE_TIB, CPUE_TVH	Based on all indices with weightings and rule as specified in App. 2.	5%
2	Catch, Preseason survey, CPUE_TIB, CPUE_TVH	Based on all indices with weightings and rule as specified in App. 1.	-
3	Catch, CPUE_TIB, CPUE_TVH	Based on CPUE indices and average catch as specified in App. 3.	-20%
4	Only for assessment	Fixed catch = 360t	-

Introduction

The amount and quality of data and surveys available to inform assessments of the Torres Strait tropical rock lobster (TRL) stock has varied over time, and stakeholders have requested flexibility to increase or decrease the frequency and intensity of fishery-independent surveys in future. It is generally accepted that as monitoring, management and costs increase for a fishery, the risk associated with being overfished declines (Sainsbury 2005). Risk is often defined as the probability of a resource falling below the limit reference point, and is related to the stock's productivity and amount of catch taken from it (Dichmont et al. 2015). The Australian Commonwealth Harvest Policy (HSP) defines risk equivalency based on the criterion that the stock stays above the limit biomass level at least 90% of the time (DAFF 2007; Rayns 2007). Traditional owners in Torres Strait are generally highly risk averse also because of the local cultural and socio-economic importance of TRL. Here we additionally consider the risk of a fishery closure based on the harvest strategy rules currently under development. The trade-offs between managing a fishery in a biologically and economically optimal way whilst minimising management costs is referred to as the risk-cost-catch frontier (Dowling et al. 2013; Little et al. 2014).

To accommodate potential changes in the amount of monitoring information available, and hence changes in the associated level of confidence in the scientific advice for decision-making, a hierarchical tier system is proposed. Tier systems broadly aim to reduce the risk when data are poorer, and ideally aim for risk equivalency such that different tiers have the same risk of the stock falling below the limit reference point. This is achieved by adjusting catch limits upwards or downwards based on the available data and assessment type, with the adjustment factors referred to as buffers or discount rates. Examples of tier systems that have been formally implemented include Australia's Southern and Eastern Scalefish and Shark Fishery (SESSF), the USA Federal system and ICES (Dichmont et al. 2015; Fulton et al. 2016; Punt et al. 2012). However these systems are designed to accommodate a suite of different species with different data and assessment methods that are applied to individual species which are then assigned to a tier. Existing tier systems involve an element of expert judgement as to choice of discount rates applied to different tiers, although it is recognised that Management Strategy Evaluation (MSE) testing (Rademeyer et al. 2007; Smith et al. 1999) can be used to quantify discount rates that would meet the aim of achieving risk equivalency. For the SESSF, each individual tier has been tested using Management Strategy Evaluation (MSE), and recently MSE was used to evaluate the tier system in an ecosystem context using Atlantis (Fulton et al. 2016). The analyses suggested that neither the SESSF or USA systems achieved complete risk equivalency and highlighted that achieving risk equivalency depends partly on the definition of risk as performance metrics may differ (Fulton et al. 2016). In another Australian example, Plaganyi et al. (2015) applied an MSE approach to simulation test alternative rotational zone strategies for the multispecies Queensland East Coast Sea Cucumber (bêche de mer) fishery. They demonstrated that for the same risk level (based on risk of depletion below a limit reference point), the average annual catch could be greater with increasing length of the rotation cycle.

The TRL case differs from the SESSF because it is intended for application to a single stock to account for potential monitoring data changes over time, and hence support stakeholders in making decisions regarding the level of monitoring (and amount and timing of surveys). The TRL case also differs from other fisheries such as SESSF as TRL harvests a short-lived species largely dependent on an ever-changing environment which means that data from recruitment surveys (and mid-year surveys) are actually very informative. These concepts have been discussed at several previous TRLRAG meetings using the example as shown in Fig. 1.

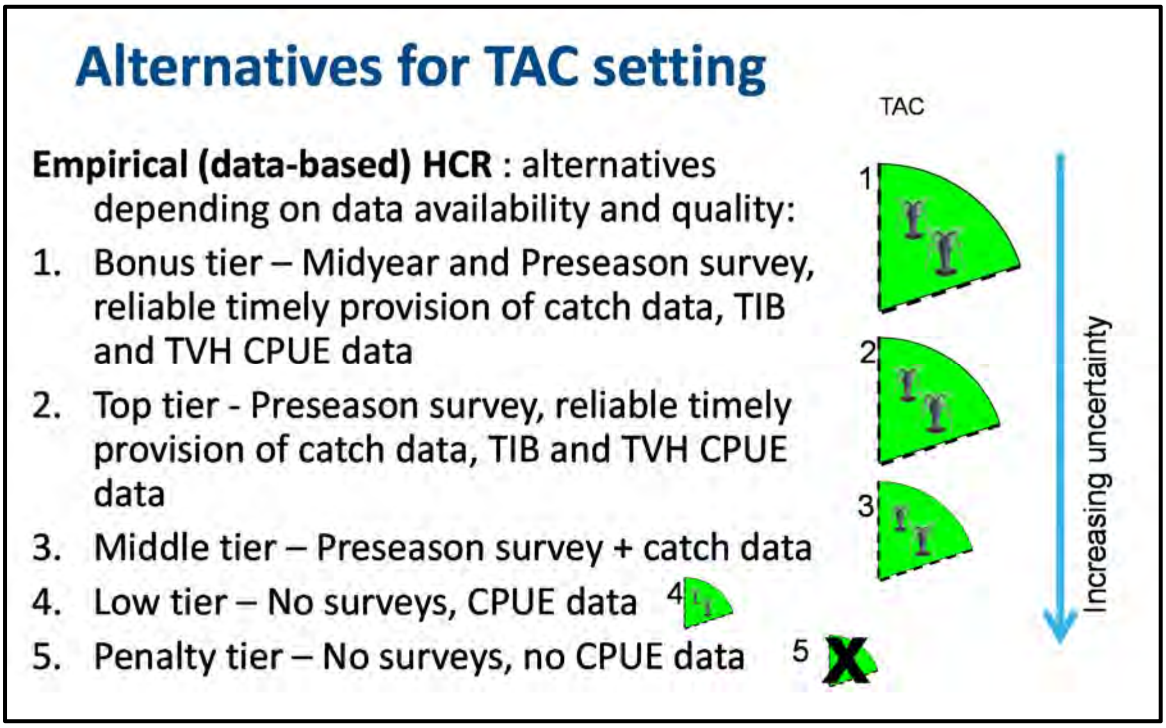

Fig. 1. Preliminary tier-based framework for TRL presented at previous meetings. The framework presented in this document has dropped number 3, with number 4 in the above relabelled Tier 3 and the "penalty tier" as Tier 4.

This paper summarises a preliminary approach for developing a tier system for TRL that uses MSE testing to inform choice of discount rates consistent with the aim of achieving risk equivalency across tiers. Applying a more precautionary approach to harvest control rules for which data and/or assessments are more uncertain is consistent with the Commonwealth Fisheries Harvest Strategy Policy 2007 (HSP) (DAFF 2007). This acknowledges higher risk associated with having less data to inform an assessment, as well as encouraging data collection that would move the fishery to a higher tier. Maintenance of long-term data sets are also important as each survey's yearly data points true value is greater than its fractional individual value, as even though this is a short lived species dependent on environmental fluctuations a trend in any time series is valuable in terms of additional information. Moreover, Dennis et al. (2015) showed that including one or more fishery-independent surveys returned a positive net present value over a 20 year timeframe even when randomly varying biomass using the historical range estimated from stock assessments, and accounting for increasing survey costs, lower gross margins, and lower lobster prices.

A four Tier system is proposed as follows, where Tier 1 represents the highest quality of information (as was collected during 2005-2008, 2014) and Tier 4 the lowest. The top three tiers all include applying a stock assessment every three years, and each tier has its own empirical Harvest Control Rule (eHCR) based on available inputs, but discount factors are applied to the Recommended Biological Catch (RBC) from Tiers 1, 3 and 4. This is because these tiers are assessed relative to the current/base Tier 2, with any upward move to the data-rich Tier 1 involving a bonus in the form of a positive discount, and a move down the tiers incurring a penalty in the form of a negative discount.

Tier 1 (Bonus Tier): Monitoring information: Total catch (TIB, TVH,PNG), Midyear survey (1+ and 2+ relative abundance), Preseason survey (0+, 1+ relative abundance), CPUE standardised indices of abundance from TIB and TVH sectors (2+ index).

Tier 2 (Current Tier): Monitoring information: Total catch (TIB, TVH,PNG), Preseason survey (0+, 1+ relative abundance), CPUE standardised indices of abundance from TIB and TVH sectors (2+ index).

Tier 3 (Penalty Tier): Monitoring information: Total catch (TIB, TVH,PNG), CPUE standardised indices of abundance from TIB and TVH sectors (2+ index).

Tier 4 (Lowest Tier): No monitoring information

Empirical Harvest Control Rules for different tiers

Here we commence with a review of Tier 2 because this is the current situation and is used as the base level for comparison with the other tiers. Next we review Tier 4 because this is based on work presented previously, followed by Tier 1 and finally Tier 3.

Tier 2 eHCR

The current Tier 2 eHCR being considered for adoption by the TRLRAG outputs a RBC based on the slopes of the regression lines fitted to the Preseason survey and CPUE indices, with different weightings applied to the different data sources (70% Preseason 1+; 10% Preseason 0+; 10% CPUE_TIB; 10% CPUE_TVH) (Fig. 2), and the overall resultant trend multiplied by the average of the last 5 years' catch (Appendix 1). This eHCR implies that if the performance of the fishery is improving then the RBC will increase while if the performance of the fishery is decreasing then the RBC will also decrease. Over the long-term this eHCR should maintain the stock around the target biomass level.

Different weightings are applied to the four abundance indices included in the relative performance statistic used in the eHCR, based on extensive testing to compare performance of alternative weightings and also on considerations of the information content and reliability of each series, as well as a preference expressed by the stakeholders to use a portfolio approach in determining the RBC. The Preseason 1+ index is the most reliable and direct in terms of indexing the biomass of lobsters that will be available to be caught in the next fishing season, and hence this index is assigned the highest weighting of 70%. The Preseason 0+ index provides an early indication of the following year's recruitment, whereas the CPUE indices reflect the abundance of the large 2+ lobsters, the survivors of which will migrate out of the Torres Strait to spawning grounds to the East, and hence they index spawning biomass which is an important consideration in terms of ensuring the future sustainability of the stock. Each of these three secondary indices (Survey 0+ and CPUE (TIB and TVH)) are assigned a weighting of 10% in the eHCR formula.

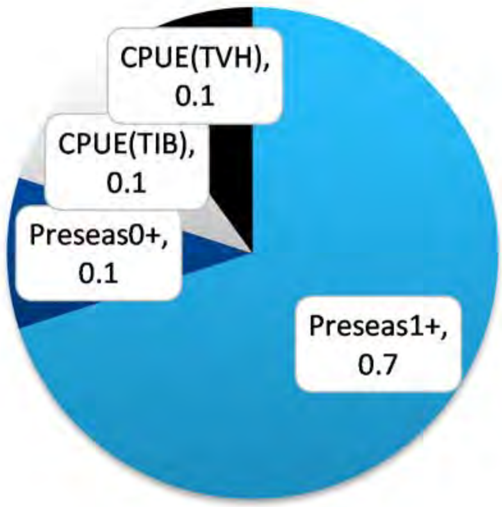

Fig. 2. Tier 2 eHCR weightings selected by TRLRAG.

Tier 4 rule:

MSE testing was also used to highlight the comparison with a constant catch strategy (with catch set at 680t or alternatively, the average of the past 10 years' catch). Results highlighted that such a constant catch strategy poses an unacceptably high risk to the resource and importantly a substantially higher risk of invoking a closure of the fishery in the future, compared to the adaptive Tier 2 eHCR, which adjusts catches in line with stock fluctuations. It is worth noting that previous TAC estimates were as low as 470 t; hence a constant catch may result in overfishing by 200 t in low stock years. Simulations suggest that to achieve the same level of risk as the adaptive Tier 2 eHCR, the constant catch would need to be set at a low total of 360t, which is approximately half the average catch that could be achieved using an adaptive eHCR. Hence the Tier 4 rule would simply be to set the RBC = 360t.

Tier 1 eHCR

For Tier 1, it is possible to expand the eHCR to include data inputs from a Midyear survey. MSE testing has been done to compare the performance of a range of alternative candidate Tier 1 eHCRs. The alternative weightings for consideration by the TRLRAG are as shown in Fig. 3, and summarised in Appendix 2. All of the options correspond to a similar level of risk to the resource, and the overall risk to the resource is similar to the Tier 2 level except for option Mid1 which had slightly higher risk. The average catch expected when applying this rule is up to 50t greater per year than when using the Tier 2 eHCR.

In addition, a discount factor or bonus *b* can be applied as follows:

Tier 1: $RBC_{DISC} = RBC(1+b/100)$

This was tested by substituting the average catch from Tier 2 in the rule in place of the average for the last 5 years' catch. Results from the application of a discount factor of 10% or 5% (*b*=5 or 10) will be presented at the RAG.

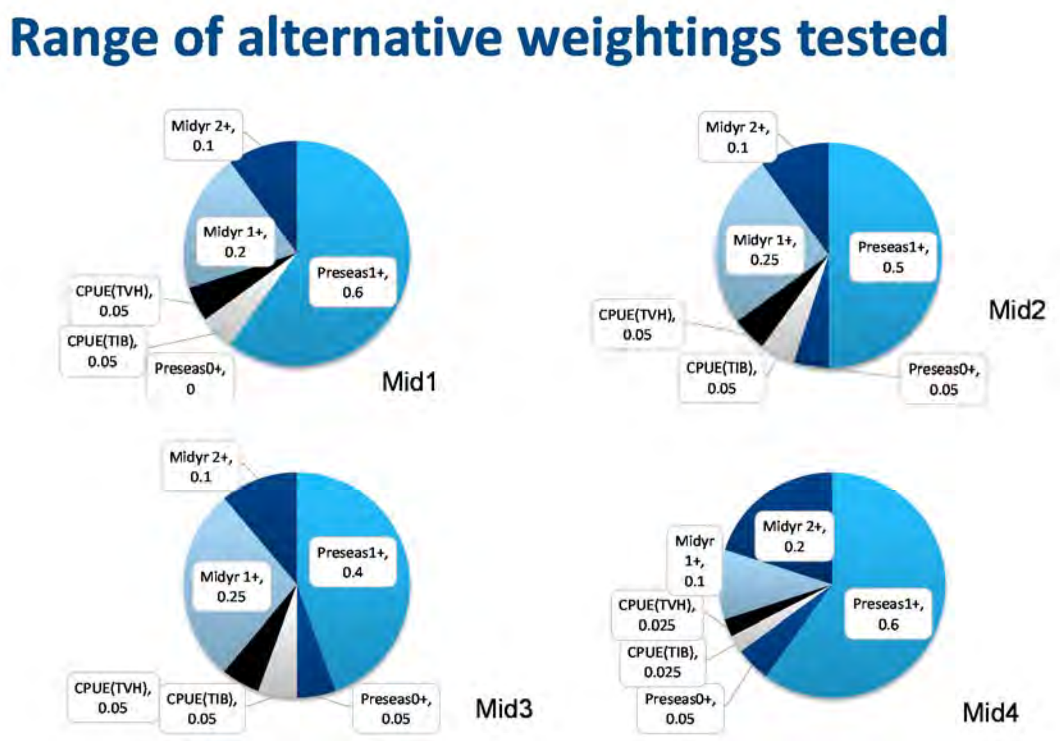

Fig. 3. Alternative Tier 1 eHCR weightings when including information from a midyear survey

Tier 3 eHCR

For Tier 3, the eHCR needs to be based on only the two CPUE input series, with equal weight assigned to each input, as shown in Fig. 4 and summarised in Appendix 3. If a discount factor is applied consistently to a eHCR that uses the average of the last five years' catch, this results in the catch ramping down substantially over time (full results available in electronic Appendix). Hence an alternative eHCR was tested which uses instead the average catch from the Tier 2 testing, and adjusts this upwards or downwards based on the CPUE trends (see Appendix 3) before applying a penalty *p* of a 10% or 20% reduction in the RBC as follows:

Tier 3: $RBC_{DISC} = RBC(1-p/100)$

Results from application of a discount factor of -10% or - 20% (*p*=10 or 20) will be presented at the RAG. In addition, given the considerable uncertainty in the reliability of CPUE as an index of abundance (because of e.g. changes in catchability or fishing efficiency) an additional sensitivity test was run (assuming a 10% future increase in catchability and 20% increase in sigma) to evaluate the additional risk and inform choice of an appropriate penalty to achieve risk equivalency.

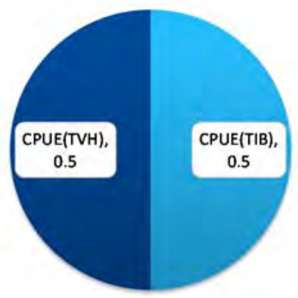

Fig. 4. Tier 3 eHCR weightings

CONCLUSIONS

A preliminary summary of the findings is shown in Fig. 5 and the full set of MSE results is available on request in an electronic Appendix, and a more detailed description of the methods is being prepared in a report that will be finalised once feedback from the TRL RAG is obtained. Broadly preliminary results are as summarise in Table 1.

This summary paper outlines the motivation for adopting a tier approach and some suggestions for a framework that could be used, but any further work will depend on detailed discussion and feedback from the TRLRAG.

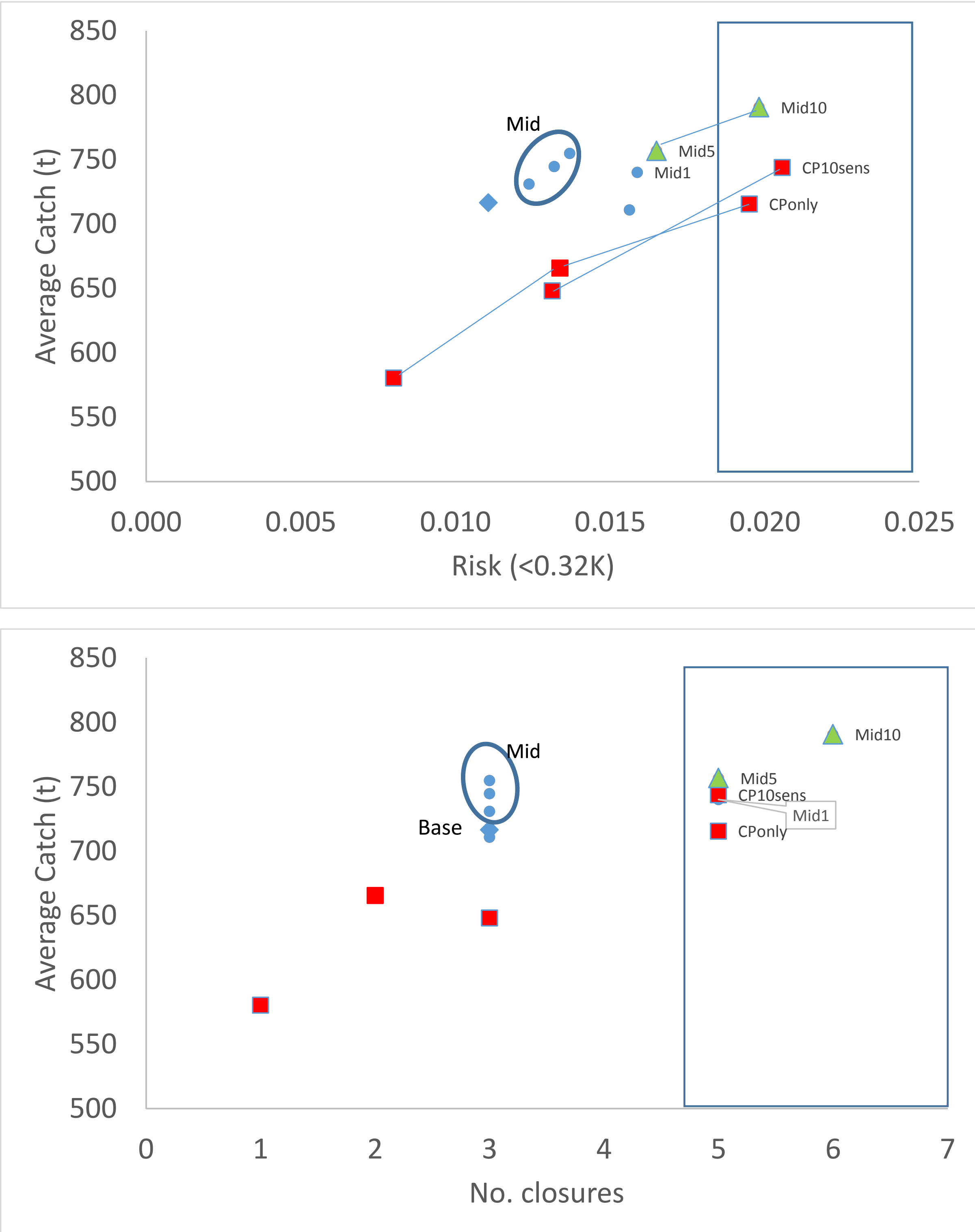

Fig. 5. Trade-off plot showing average catch (t) versus risk for a number of alternative harvest control rule variants across tiers 1-3, to illustrate the higher risks associated with some variants, and adjusted versions that aim to achieve risk equivalency across the tiers. The top figure uses as risk criterion the probability of falling below the limit reference point whereas the bottom figure risk definition is based on risk of a fishery closure when evaluated over a 20-year projection period (Blue dots and green triangles are Tier 1 evaluations with green triangles higher discount rates; Red squares are evaluations of Tier 3 sensitivity tests).

Literature cited

DAFF. Commonwealth Fisheries Harvest Strategy Policy Guidelines. Australian Government Department of Agriculture, Fisheries and Forestry; 2007

Dennis, D.; Plaganyi, E.; Van Putten, I.; Hutton, T.; Pascoe, S. Cost benefit of fishery-independent surveys: Are they worth the money? Mar Policy. 58:108-115; 2015

Dichmont, C.M.; Punt, A.E.; Dowling, N.; De Oliveira, J.A.; Little, L.R.; Sporcic, M.; Fulton, E.; Gorton, R.; Klaer, N.; Haddon, M. Is risk consistent across tier-based harvest control rule management systems? A comparison of four case-studies. Fish and Fisheries; 2015

Dowling, N.; Dichmont, C.; Venables, W.; Smith, A.; Smith, D.; Power, D.; Galeano, D. From low-to high-value fisheries: Is it possible to quantify the trade-off between management cost, risk and catch? Marine Policy. 40:41-52; 2013

Fulton, E.A.; Punt, A.E.; Dichmont, C.M.; Gorton, R.; Sporcic, M.; Dowling, N.; Little, L.R.; Haddon, M.; Klaer, N.; Smith, D.C. Developing risk equivalent data-rich and data-limited harvest strategies. Fisheries Research. 183:574-587; 2016

Little, L.R.; Parslow, J.; Fay, G.; Grafton, R.Q.; Smith, A.D.; Punt, A.E.; Tuck, G.N. Environmental derivatives, risk analysis, and conservation management. Conservation Letters. 7:196-207; 2014

Plagányi, É.E.; Skewes, T.; Murphy, N.; Pascual, R.; Fischer, M. Crop rotations in the sea: Increasing returns and reducing risk of collapse in sea cucumber fisheries. Proceedings of the National Academy of Sciences. 112:6760-6765; 2015

Punt, A.E.; Siddeek, M.; Garber-Yonts, B.; Dalton, M.; Rugolo, L.; Stram, D.; Turnock, B.J.; Zheng, J. Evaluating the impact of buffers to account for scientific uncertainty when setting TACs: application to red king crab in Bristol Bay, Alaska. ICES Journal of Marine Science: Journal du Conseil. 69:624-634; 2012

Rademeyer, R.A.; Plagányi, É.E.; Butterworth, D.S. Tips and tricks in designing management procedures. ICES Journal of Marine Science: Journal du Conseil. 64:618-625; 2007

Rayns, N. The Australian government's harvest strategy policy. ICES Journal of Marine Science: Journal du Conseil. 64:596-598; 2007

Sainsbury, K. Cost-effective management of uncertainty in fisheries. Outlook; 2005

Smith, A.; Sainsbury, K.; Stevens, R. Implementing effective fisheries-management systems–management strategy evaluation and the Australian partnership approach. ICES Journal of Marine Science: Journal du Conseil. 56:967-979; 1999

APPENDIX 1 – Tier 2 Harvest Control Rule

The eHCR selected by the TRLRAG (August 2016), from a number of alternative candidates that were evaluated, is a formula that outputs a RBC in December for the following year. This formula is the multiple of the average catch over the last 5 years and a statistic which measures the relative performance of the fishery based on the following 5 data inputs: (1) Preseason recruiting lobster (1+) standardised relative numbers; (2) Preseason recently-settled lobster (0+) standardised relative numbers; (3) CPUE (TIB sector) and (4) standardised CPUE (TVH sector) (using data available up until end of October); and (5) total catch (TIB,TVH,PNG) (using data available up until end of October.

The selected HCR rule is as follows, and uses the preseason survey 1+ and 0+ indices, both CPUE indices, taking natural logarithms of the slopes, an upper catch limit, and using weightings as follows:

$$TAC_{y+1} = \left[0.7\cdot\left(1+s_y^{presurv,1}\right)+0.1\cdot\left[\left(1+s_y^{presurv,0}\right)+\left(1+s_y^{CPUE,TVH}\right)+\left(1+s_y^{CPUE,TIB}\right)\right]\right]\cdot\bar{C}_{y-4,y}$$

or if TAC_{y+1} > 1000t, TAC_{y+1} = 1000.

where

$\bar{C}_{y-4,y}$ is the average achieved catch during the past 5 years, including the current year i.e. from year *y*-4 to year *y*,

$s_y^{presurv,1}$ is the slope of the logarithms of the preseason survey 1+ abundance index, based on the 5 most recent values;

$s_y^{presurv,0}$ is the slope of the logarithms of the preseason survey 0+ abundance index, based on the 5 most recent values;

$s_y^{CPUE,TVH}, s_y^{CPUE,TIB}$ is the slope of the logarithms of the TVH and TIB CPUE abundance index, based on the 5 most recent values;

0.7, 0.1 are tuning parameters

APPENDIX 2 – Tier 1 Harvest Control Rule

The eHCR formula is the multiple of the average catch over the last 5 years and a statistic which measures the relative performance of the fishery based on the following 7 data inputs: (1) Preseason recruiting lobster (1+) standardised relative numbers; (2) Preseason recently-settled lobster (0+) standardised relative numbers; (3) CPUE (TIB sector) and (4) standardised CPUE (TVH sector) (using data available up until end of October); (5) Midyear survey 1+ index; (6) Midyear survey 0+ index, and (7) total catch (TIB,TVH,PNG) (using data available up until end of October.

The general form of the rule is as follows:

$$TAC_{y+1} = \begin{bmatrix} w_1 \cdot \left(1+s_y^{presurv,1}\right) + w_2\left(1+s_y^{presurv,0}\right) + w_3\left(1+s_y^{CPUE,TVH}\right) + w_4\left(1+s_y^{CPUE,TIB}\right) \\ +w_5\left(1+s_y^{Midsurv,1}\right) + w_6\left(1+s_y^{Midsurv,2}\right) \end{bmatrix} \cdot \bar{C}_{y-4,y}$$

or if TAC_{y+1} > 1000t, TAC_{y+1} = 1000.

where

$\bar{C}_{y-4,y}$ is the average achieved catch during the past 5 years, including the current year i.e. from year *y*-4 to year *y*,

$s_y^{presurv,1}$ is the slope of the logarithms of the preseason survey 1+ abundance index, based on the 5 most recent values;

$s_y^{Midsurv,1}$ is the slope of the logarithms of the Midyear survey 1+ abundance index, based on the 5 most recent values;

$s_y^{Midsurv,2}$ is the slope of the logarithms of the Midyear survey 2+ abundance index, based on the 5 most recent values;

$s_y^{presurv,0}$ is the slope of the logarithms of the preseason survey 0+ abundance index, based on the 5 most recent values;

$s_y^{CPUE,TVH}, s_y^{CPUE,TIB}$ is the slope of the logarithms of the TVH and TIB CPUE abundance index, based on the 5 most recent values;

w1,w2,w3,w4,w5,w6 are tuning parameters that assign relative weight respectively to the preseason 1+, preseason 0+ survey trends, CPUE TVH, CPUE TIB trends and the midyear survey 1+ and 2+ trends.

Alternative weights tested:

	Pre1	Pre0	TIB_CPUE	TVH_CPUE	Mid1	Mid2	sum
Base	0.7	0.1	0.1	0.1	0	0	1
Mid1	0.6	0	0.05	0.05	0.2	0.1	1
Mid2	0.5	0.05	0.05	0.05	0.25	0.1	1
Mid3	0.4	0.05	0.05	0.05	0.35	0.1	1
Mid4	0.6	0.05	0.025	0.025	0.1	0.2	1
NoSurv	0	0	0.5	0.5	0	0	1

APPENDIX 3 – Tier 3 Harvest Control Rule

The eHCR suggested doesn't use the average catch over the last 5 years but rather a fixed average catch with the RBC scaled down by a penalty. Hence only the following 2 data inputs are used: (1) CPUE (TIB sector) and (2) standardised CPUE (TVH sector) (using data available up until end of October).

$$TAC_{y+1} = 0.5 \cdot \left[\left(1 + s_y^{CPUE,TVH}\right) + \left(1 + s_y^{CPUE,TIB}\right) \right] \cdot \bar{C}$$

or if TAC_{y+1} > 1000t, TAC_{y+1} = 1000.

where

$\bar{C}$ is a fixed average catch,

$s_y^{CPUE,TVH}, s_y^{CPUE,TIB}$ is the slope of the logarithms of the TVH and TIB CPUE abundance index, based on the 5 most recent values.

APPENDIX 4 – MSE testing results (available on request in electronic pdf)

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
OTHER BUSINESS	**Agenda Item 10** **For Discussion**

RECOMMENDATIONS

1. That the RAG **NOMINATE** any further business for discussion.

TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)	**MEETING 24** **18-19 October 2018**
DATE AND VENUE FOR NEXT MEETING	**Agenda Item 11** **For Decision**

RECOMMENDATIONS

1. That the RAG **NOMINATE** a date and a venue for the next meeting.

BACKGROUND

2. The next meeting is proposed for 11-12 December 2018 on Thursday Island, following the November pre-season survey.