

**TORRES STRAIT TROPICAL ROCK LOBSTER  
RESOURCE ASSESSMENT GROUP (TRLRAG) MEETING #21**

**Tuesday 12 December 2017    9:00AM-5:00PM**

**Wednesday 13 December 2017    9:00AM-12:00PM**

**CAIRNS, NORTHERN FISHERIES CENTRE**

**AGENDA**

1. Preliminaries (Chair)
  - 1.1. Apologies
  - 1.2. Adoption of agenda
  - 1.3. Declaration of interests
  - 1.4. Action items from previous meetings (AFMA)
2. Updates from Members
  - 2.1. Industry and scientific
  - 2.2. Government
  - 2.3. PNG-NFA
  - 2.4. Native Title
3. 2016/17 TRL catch and effort information, including catch data summary by docket book zone for TIB and TVH catch.
4. Catch per unit effort (CPUE) indices for the TIB and TVH sectors
5. Results from the November 2017 pre-season survey (survey indices)
6. TRL larval movement: *Environmental influences on Torres Strait lobster recruitment*
7. Stock assessment update and recommended biological catch (RBC)
8. Stock assessment data rules
9. TRL harvest strategy
10. Other Business
11. Date and venue for next meeting

<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>MEETING No. 21 12-13 December 2017</b>
<b>PRELIMINARIES Opening prayer, acknowledgement of Traditional Owners, welcome and apologies</b>	<b>Agenda Item 1.1 For NOTING</b>

## **RECOMMENDATIONS**

1. That the Working Group **note**:
  - a. an opening prayer;
  - b. an acknowledgement of Traditional Owners;
  - c. the Chairperson's welcome address; and
  - d. apologies received from members unable to attend.

## **BACKGROUND**

2. Apologies have been received from Daniel Takai, Ray Moore
3. Tom Roberts and Samantha Miller from QDAF are attending by video conference

<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>MEETING No. 21 12-13 December 2017</b>
<b>PRELIMINARIES Adoption of agenda</b>	<b>Agenda Item 1.2 For DECISION</b>

## **RECOMMENDATIONS**

1. That the Working Group consider and **ADOPT** the agenda.

## **BACKGROUND**

2. A draft agenda was circulated to members and other participants on 9 November 2017 and 29 November 2017. No comments were received.



Australian Government  
Australian Fisheries Management Authority

### TRLRAG #21 – TUESDAY 12 DECEMBER 2017

Name	Declaration of Interests	Signature





Australian Government

Australian Fisheries Management Authority




<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>Meeting 21 12-13 December 2017</b>
<b>PRELIMINARIES Declarations of interests</b>	<b>Agenda Item No. 1.3 For ACTION</b>

## RECOMMENDATIONS

1. That RAG members:
  - a. **DECLARE** all real or potential conflicts of interest in the Torres Strait Rock Lobster Fishery at the commencement of the meeting;
  - 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 provide the executive officer with a list of declared interests.
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.
7. TRLRAG declarations of interest as at meeting 20 held on 4-5 April 2017 are enclosed.

**TRLRAG Declarations of Interest as at meeting 20 held on 4-5 April 2017**

<b>Name</b>	<b>Position</b>	<b>Declaration of interest</b>
<b>Members</b>		
Ian Knuckey	Chair	Nil. Member of other RAG's and conducts various AFMA research projects
Dean Pease	TRLRAG Executive Officer	Nil
Selina Stoute	AFMA Member	Nil
John Ramsay	TSRA Member	Nil
Samantha Miller, (replaces Tom Roberts)	QDAF member	Nil
Eva Plaganyi	Scientific Member	Project staff for PZJA funded TRL research projects.
Andrew Penney	Independent Scientific Member	Member of other RAG's and research consultant
Aaron Tom	Industry Member	Nil
Mark David	Industry Member	TIB licence holder
Terrence Whap	Industry Member	Nil
Les Pitt	Industry Member	TIB licence holder
Daniel Takai	Industry Member	Pearl Island Seafood, Tanala Seafood and TIB licence holder
Ray Moore	Industry Member	
Brett Arlidge	Industry Member	General Manager MG Kailis Pty Ltd, holder of TVH licences
<b>Observers</b>		
Jerry Stephen	Invited Participant (TSRA Fisheries Portfolio Member)	TIB licence holder
Maluwap Nona	Chairperson Malu Lamar	TIB licence holder
Marianna Nahas	TSRA	Nil
Mark Tonks	CSIRO	Project staff for PZJA funded TRL research projects

Mick Haywood	CSIRO	Project staff for PZJA funded TRL research projects
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<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>MEETING No. 21 12-13 December 2017</b>
<b>PRELIMINARIES Action items from TRLRAG 20 and previous meetings</b>	<b>Agenda Item 1.4 For NOTING</b>

## RECOMMENDATIONS

1. That the Working Group:
  - a. **NOTE** the progress against actions arising from previous meetings, including the 20th meeting of the Tropical Rock Lobster Resource Assessment Group (TRLRAG 20) held on 4-5 April 2017 (**Attachment 1.4a**).
  - b. **NOTE** the final meeting record for TRLRAG 20, which was ratified out of session (**Attachment 1.4b**).

## BACKGROUND

### *Actions arising*

2. Updates are provided on the status of actions arising from TRLRAG 20 and previous meeting.
  - TRLRAG 14 – Thursday Island 25-26 August 2015
  - TRLRAG 15 – Teleconference (combined with TRLWG) 15 December 2015
  - TRLRAG 16 – Teleconference (combined with TRLWG) 11 March 2016
  - TRLRAG 17 – Thursday Island 31 March 2016
  - TRLRAG 18 – Thursday Island 2-3 August 2016

### *Minutes of the previous meeting*

3. The meeting record for TRLRAG 20 was ratified out of session.
4. A draft meeting record was circulated to all TRLRAG members on 5 May 2017 with comments closing on 22 May 2017.
5. Some comments were received from RAG members. Please see the agreed changes that are shown in track changes (**Attachment 1.4c**) and the final meeting record (**Attachment 1.4b**).

No.	Action Item	Agenda	Agency	Due Date	Status
1.	AFMA to review the effectiveness of certain TIB licensing arrangements (in its 2016 licencing review) including: <ul style="list-style-type: none"> <li>TIB licenses should share a common expiry date</li> <li>licences to last for longer than the current 12 month period.</li> </ul>	TRLRAG14 1.3	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 due to be completed 2017.
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 3	AFMA CSIRO	TRLRAG17 2016	Ongoing  AFMA to complete further work.
3.	AFMA prepare information flyer: <ul style="list-style-type: none"> <li>A. docket-book reporting for the TIB sector.</li> <li>B. minimum size limit of lobsters</li> </ul>	TRLRAG14 3 7	AFMA	TRLRAG15 2016	3A Complete/3B Ongoing  The Torres Strait Fish Receiver System and catch disposal record (TDB02) entered into force on 1 December 2017. There are a number of explanatory documents available on the pzja website.  AFMA is developing management arrangement booklets for Torres Strait Fisheries.
4.	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 out-of-session for comment before sending to PNG NFA.	TRLRAG19	AFMA		Ongoing  AFMA has sent a letter to PNG NFA outlining concerns of trawlers retaining TRL.  Next priority is for AFMA to meet with PNG NFA officials to discuss the matter during the Fisheries Bilateral scheduled for February 2018.
5.	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 RNTBC		Ongoing
6.	AFMA and CSIRO to provide a more detailed explanation of each data filtering rule (including statistics about the number of records it corrected by each rule) and provide this to the RAG out of session.	TRLRAG20			Complete Agenda Item 8
7.	AFMA to contact the research applicant (CSIRO) to propose tropical rock lobster to be included as an indicator species for the project 'Decadal scale projection of changes in Australian fisheries stocks under climate change.'	TRLRAG20			Complete

8.	CSIRO to provide further advice on how use of the stock assessment and CONNIE 3 larval transport modelling outputs may improve the understanding of climate change impacts to growth, mortality and recruitment of TRL.	TRLRAG20			Complete Agenda Item 6
9.	AFMA in collaboration with CSIRO and TSRA to put together a list of all climate change projects in the region or that may be relevant to the region more broadly.	TRLRAG20			Complete <b>(Attached)</b>

# Torres Strait Tropical Rock Lobster Resource Assessment Group

Meeting Record 20

4 & 5 April 2017

In-session meeting

Note all meeting papers and record available on  
the PZJA webpage:

[www.pzja.gov.au](http://www.pzja.gov.au)



**Australian Government**

**Australian Fisheries Management Authority**

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## Meeting participants

### Members

Name	Position	Declaration of interest
Ian Knuckey	Chair	Nil Member of other RAG's and conducts various AFMA research projects
Dean Pease	TRLRAG Executive Officer	Nil
Selina Stoute	AFMA Member	Nil
John Ramsay	TSRA Member	Nil
Mariana Nahas	TSRA Member	Nil
Tom Roberts	Queensland Fisheries	Nil
Eva Plaganyi	CSIRO Scientific Member	Project staff for PZJA funded TRL research projects.
Andrew Penney	Independent Scientific Member	Member of other RAG's and research consultant
Maluwap Nona	Chairperson Malu Lamar	TIB licence holder
Aaron Tom	Industry Member	Nil
Mark David	Industry Member	TIB licence holder
Terrence Whap	Industry Member	Nil
Les Pitt	Industry Member	TIB licence holder
Daniel Takai	Industry Member	Pearl Island Seafood, Tanala Seafood and TIB licence holder
Ray Moore	Industry Member	TVH licence holder
Brett Arlidge	Industry Member	General Manager MG Kailis Pty Ltd, holder of TVH licences

## Observers

Name	Position	Declaration of interest
Jerry Stephen	TSRA Deputy Chair TSRA Fisheries Portfolio	TIB licence holder
Ian Butler	AFMA Observer	NIL
Mick Haywood	CSIRO Scientific Observer	Project staff for PZJA funded TRL research projects
Mark Tonks	CSIRO Scientific Observer	Project staff for PZJA funded TRL research projects
Patrick Mills <sup>1</sup>	Chairperson Torres Strait Fishers Association	TIB licence holder

<sup>1</sup> Attended the meeting only on the morning of day two.

## Action items and recommendations

### Action Items

Number	Action
1.	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
2.	AFMA and CSIRO to provide a more detailed explanation of each data filtering rule (including statistics about the number of records it corrected by each rule) and provide this to the RAG out of session.
3.	AFMA to contact the research applicant (CSIRO) to propose tropical rock lobster to be included as an indicator species for the project ' <i>Decadal scale projection of changes in Australian fisheries stocks under climate change.</i> '
4.	CSIRO to provide further advice on how use of the stock assessment and CONNIE 3 larval transport modelling outputs may improve the understanding of climate change impacts to growth, mortality and recruitment of TRL.
5.	AFMA in collaboration with CSIRO and TSRA to put together a list of all climate change projects in the region or that may be relevant to the region more broadly.

## Recommendations

### Recommendations

The **operational objectives** of the Harvest Strategy be revised to place greater emphasis on the importance of the Fishery for traditional way of life and livelihood of traditional inhabitants:

- 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.
  - 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).
- Maintain stocks above the limit biomass level ( $B_{LIM}$ ), or an appropriate proxy, at least 90 per cent of the time.
  - The agreed  $B_{LIM}$  is more precautionary than the default proxy HSP  $B_{LIM}$ .
- Implement rebuilding strategies if the spawning stock biomass is assessed to have fallen below  $B_{LIM}$  in two successive years.

The following decision rules:

#### *eHCR and stock assessment cycle*

- The eHCR is run in November each year to provide a RBC for the following fishing season.
- A stock assessment update is run every three years unless the need for an updated stock assessment is triggered by the eHCR or another applicable decision rule. The three-yearly updated stock assessment will be used to determine the Fishery stock status, evaluate the performance of the eHCR and identify whether any revisions to the eHCR are required.
- If the eHCR needs to be revised, a stock assessment will be conducted annually to estimate the RBC until the revised eHCR is agreed.

#### *Pre-season survey trigger*

- If in any year the pre-season 1+ survey index (average number of age 1 lobsters per survey transect) is 1.25 or lower, it triggers a stock assessment to determine stock status.

#### *Biomass limit reference point triggered*

- If the eHCR limit reference point is triggered in any year, a stock assessment update must be conducted in March the following year. In this case, discussions will be held on preventative measures to reduce the risk of closure.
  - If the stock assessment confirms that the stock is below the biomass limit reference point, it is optional to conduct a mid-season survey to inform the next stock assessment; 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.



## Recommendations

### *Fishery closure rules*

- If stock assessment updates determine the stock to be below the biomass limit reference point in two successive years, the Fishery will be closed to commercial fishing.
  - In this case, discussions will be held on future management arrangements.
  - Management strategy evaluation (MSE) testing of the eHCR has shown that it is extremely unlikely (<1% probability) that the Fishery would be closed under the eHCR.

### *Re-opening the Fishery*

- Following closure of the Fishery, fishery-independent mid-season and pre-season surveys are mandatory to inform annual stock assessments, and the fishery can only be re-opened when a stock assessment determines the stock to be above the biomass limit reference point.

Graphic flowchart representations of alternative possible scenarios under application of the eHCR are provided in **Attachment B** for the following scenarios:

#### Four decision rule scenarios:

- Scenario 1 – eHCR limit not breached. Harvest control rule operates as expected. Stock status, fishery dynamics and RBCs remain within ranges tested by MSE. Updated assessment does not indicate any need for revision of the HCR.
- Scenario 2 – eHCR limit not breached. Harvest control rule operates as expected. Stock status, fishery dynamics and RBCs appear to remain within ranges tested in MSE. However, updated assessment indicates that stock status, stock dynamics or fishery dynamics have moved outside ranges tested in MSE, or that TACs recommended by the HCR are not appropriate given the revised estimate of stock status, indicating that the HCR should be revised.
- Scenario 3 – eHCR limit is breached in one year, stock assessment determines the limit is not breached. Application of the HCR in a particular year results in the limit being triggered, requiring a special assessment update to confirm whether the limit has indeed been breached. However, this assessment update determines that the limit has not been breached. The assessment cycle is reset and application of the eHCR continues.
- Scenario 4 – eHCR limit is breached in two successive years, stock assessment confirms the limit is breached. Application of the HCR in a particular year results in the limit being triggered, requiring a special assessment update to confirm whether the limit has indeed been breached. Special assessment update confirms that the limit has indeed been breached. Application of the HCR the following year results in the limit being triggered for the second successive year, requiring a second rapid assessment update to confirm whether the trigger has been breached a second time. Assessment update confirms that the trigger has been breached again. The commercial fishery is closed until an assessment update confirms that the stock has recovered to above the limit.

## Agenda Item 1 - preliminaries

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### 1.1 & 1.2 Apologies / adoption of agenda / declaration of interest

Apologies were received from Phillip Ketchell (industry member), Ian Liviko (PNG NFA) and Meremi Maina (PNG industry observer).

The RAG adopted the agenda with no changes.

The RAG generally noted that there could be potential conflicts of interest for members and observers when providing information and advice on some agenda items. These conflicts should be tabled by members.

### 1.3 Ratification of RAG #19 meeting record

The RAG noted that the RAG 19 meeting record was ratified out-of-session on 20 February 2017. No comments were received on the draft record.

### 1.4 Action items from previous meetings

The RAG noted progress against action items from previous meetings. The list of action items and progress is provided in **Appendix A**.

## Agenda Item 2 - updates

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### Industry

The RAG noted the updates provide by industry members that:

- Fishers from Darnley Island have had lower than average catches since the start of the 2017 fishing season.
- Fishers from Mabuiag Island have reported catches to be lower than expected and similar to the 2016 fishing season. Mabuiag fishers report that sand incursions persist on the nearby reefs and it is thought that the sand is causing lower catches of TRL. A higher number of Mabuiag fishers participated in lamp fishing during December and January and as a result a higher number of live TRL were landed. The AFMA member noted TIB and TVH fishers have reported that some areas around Mabuiag previously inundated by sand are recovering to seagrass and reef habitat.
- The Queensland East Coast Fishery had its best start ever for a fishing season, 97 t of the 195 t TAC was caught in the first three months of fishing (January to March 2017).
- The Torres Strait Fishery hookah opening started well with catch rates above expected, based on the TAC of 495 t. However, catch rates have now dropped and are at a level consistent with a 495 t TAC. Fishing in PNG has been consistent with the Torres Strait. Some industry members noted that return of the south-easterly trade winds may improve fishing conditions.
- The price at the start of the year (during the Chinese New Year and Lantern Festival) was strong. The price is currently at its lowest point in the year (Tomb-Sweeping Day)

4 April 2017). The price is likely to return to normal (approx. average price \$40-\$50 per kilogram) by May.

## AFMA

The RAG noted the update provided by the AFMA member that:

- The introduction of a mandatory fish receiver system (also known as catch disposal record) for Torres Strait fisheries is being considered by the PZJA. If agreed, the system will require buyers and processors to record the species and amount of product they purchase. The TRL Working Group supported the introduction of a mandatory fish receiver system at its meeting on 4-5 April 2016.
- Research funding is almost fully committed for the next two financial years and as a result there will be no call for new research proposals in 2017/18. The Torres Strait research budget is due to be underspent by \$80,000 for 2016/17 and it is forecast to be underspent by \$20,000 in 2017/18. Funding is committed to conducting a TRL pre-season survey in 2017/18 and 2018/19.
  - The RAG noted advice from CSIRO that the stock assessment is funded on a three-year cycle and that in every 3<sup>rd</sup> year the cost of running the assessment is slightly higher because more work is undertaken to review and update stock assessment model.

## QDAF

The RAG noted the update from the QDAF member:

- The Queensland East Coast Fishery had an exceptional start to the fishing season, the catch (97 t in 3 months) is the highest ever recorded for the first 3 months of fishing (January to March).
  - CSIRO noted that it will be presenting preliminary results of the Coral Sea gyre advection modelling at Agenda Item 7 and it may be at least part of the explanation for higher catches of TRL on the East Coast.
- The QLD fisheries green paper (policy to guide sustainable fishing) public consultation period has closed. Taking into account consultation outcomes a 'Sustainable fishing Strategy' has been developed and with the Government for consideration.

## TSRA

The RAG noted the update from the TSRA member that TSRA is continuing to pursue the roadmap to 100 per cent ownership of commercial fisheries by Traditional Inhabitants through the PZJA process. The member noted the recent increase of TIB catch (Agenda Item 1.2, Attachment A) supports the growing capacity to transition to 100 per cent ownership.

## Native title

The RAG noted the update from the Chairperson of Malu Lamar that Malu Lamar RNTBC has contracted two Queensland Council lawyers to provide an independent report on transitioning to 100 per cent ownership of Torres Strait commercial fishing rights by Traditional Inhabitants. The final report is due by the end of April 2017.

## Agenda Item 3 – updated fishery assessment

The RAG noted an update on the TRL stock assessment presented by the scientific member based on the paper titled '*Torres Strait rock lobster (TRL) fishery surveys and stock assessment. AFMA Project 2016/0822*':

The scientific member noted that:

- The RAG accepted the 2016 updated Fishery stock assessment and recommended an RBC of 495 t for the 2016/17 fishing season at meeting no. 19 on 13 December 2016.
- At RAG 19, CSIRO noted some final checks of the stock assessment would be undertaken in early 2017 with updated data.
- CSIRO finalised the Fishery stock assessment with the updated data and the RBC remained unchanged at 495 t.

The RAG noted advice from the scientific member that:

- There was an initial key-punching error in the 2014 reported total catch used. The 2014 total catch was corrected from 572.6 t to 682.4 t.
- There is uncertainty in the PNG reported catch for 2016 and one industry member has reported that the PNG catch of 127 t used in the assessment was possibly under reported.
- If PNG caught an additional 100 t in 2016 the fishing mortality rate (F) would increase from approximately 0.10 to 0.15 (F = 0.15 is the target fishing mortality rate). This level of increase would not have a significant impact on the stock sustainability.

The RAG noted advice from the scientific member about the pre-season survey:

- As previously agreed by the RAG, the fishery-independent survey reduced its number of survey sites 2015 (78 sites) and 2016 (74 sites), down from 144 historically to reduce survey costs.
- When using the reduced number of sites, the survey results follow the same trend as the full-scale survey, although they are slightly more uncertain (larger error bars). The reduced number of survey sites still gives a reliable index of abundance and is considered to optimise cost-benefits for the Fishery.

The RAG noted advice from the representative of Malu Lamar that traditional names should be used to describe research areas. This would also assist stakeholders in understanding the nature and extent of survey sites underpinning TRL research.

1. The RAG **AGREED** that Malu Lamar RNTBC is to provide AFMA with the map of traditional boundaries, regional and reef names for each of the Torres Strait Island nations and for CSIRO to examine possible revised naming conventions for survey sites.

The RAG noted that the 2017 RBC derived from the assessment was 495 t compared to 624 t from the eHCR. The reason for the difference was explained:

- The stock assessment model integrates all available information into a single framework to output a RBC. The information includes pre-season survey data, CPUE data for TIB and TVH sectors, and size frequency; the model RBC is not averaged in the same way as for the eHCR.
- The eHCR on the other hand uses averages from the last four years of four of the data inputs, weighted as follows:
  - 1+ TRL indices (70% weighting);
  - 0+ TRL indices (10% weighting);
  - TIB standardised CPUE (10% weighting); and
  - TVH standardised CPUE (10% weighting).

It was also noted that the two-year projection of RBC from the 2015 assessment (719 t) was higher than the RBC from the current assessment. The reason for this was explained:

- the 2015 pre-season survey 0+ (recently settled TRL) index of abundance used in the 2-year projection was relatively high but there is a higher level of uncertainty using the 0+ index compared to the 1+ index, due to the small size and cryptic behaviour of 0+ TRL and a range of factors affecting mortality in the intervening period. Therefore the forecast RBC based on the 0+ indices is less reliable than using the 1+ indices which estimates the abundance of TRL recruiting into the Fishery that will be of fishable size.

The RAG noted the updated data summary for the commercial catch-at-age data detailed in the paper titled '*Summary of Torres Strait and QLD East Coast lobster commercial catch monitoring by MG Kailis Pty Ltd 2001-2017*'. The RAG noted:

- The collection of commercial catch-at-age data from M.G Kailis Pty. Ltd. is cost-effective and provides important information on the size distribution of commercially caught TRL for the Torres Strait and East Coast fisheries.
- The TSRA member noted that a fishery independent observer program may be useful for collecting Torres Strait fishery information such as catch at age. It was noted however that:
  - There may be data other than catch-at-age information, which would be more valuable for an observer program to collect.

- If an observer program or another data collection program is developed it will need to be spatially extensive and overlap with current data collection programs to confirm that the data are representative and compatible with historical data.

The member for TSRA questioned whether recreational and traditional catch of TRL should be taken into account in the fishery stock assessment. Scientific members advised that:

- there needs to be a time series of data or an estimate of historical catch to indicate if catch has increased or decreased over time;
- if recreational and traditional catch has remained constant over time then it may not be worthwhile including in the assessment because it is unlikely to adjust the RBC estimate;
- it is important to understand if catches are a lot bigger than assumed as that could impact the stock assessment; and,
- recreational and traditional catch data are often expensive to collect because this requires surveys to be conducted periodically, therefore it may not be affordable to collect this information.

## **Agenda Item 4 – finalisation of the harvest strategy**

The RAG noted an update from the AFMA member as detailed in the paper titled '*Torres Strait Tropical Rock Lobster Fishery Working Draft Harvest Strategy*' and the scientific member as detailed in the presentation titled '*Summary of empirical Harvest Control Rule for the Torres Strait tropical rock lobster (TRL) fishery.*'

### **4.1 – Summary of agreed Harvest Strategy to date**

- The draft TRL Fishery Harvest Strategy was considered by the RAG at meeting no. 18 and 19 (2-3 August 2016 and 13 December 2016 respectively). The process for finalising this is for the RAG to agree to the final draft Harvest Strategy and the draft final report to be sent to the TRL Working Group and Protected Zone Joint Authority (PZJA) to be agreed.
- The RAG agreed eHCR fits a regression line to the logarithm of last five years of fishery indicator data to determine if the stock size is trending up or down. The indicators used are the pre-season survey 1+ indices (70% weighting), 0+ indices (10% weighting), TIB standardised CPUE (10% weighting) and TVH standardised CPUE (10% weighting). The logarithm is used to reduce the variability in the data and as a result there is also a reduction in the inter-annual variability in the RBC.
- In response to an industry request to consider the simple option of a fixed TAC, it was noted that a Fishery TAC (Australian and PNG inclusive) set as a constant catch would need to be set at 360 t annually to allow for the necessary precaution in years when the stock size may be low. If a constant TAC was set at 360 t the Fishery total

catch would be much lower in the long term due to forgone catch in years of high stock abundance.

## 4.2 – Operational objectives of the Harvest Strategy

The RAG discussed and provided advice on the objectives of the Harvest Strategy. The RAG **RECOMMENDED** the operational objectives of the Harvest Strategy be revised to place emphasis on the importance of the Fishery for traditional way of life and livelihood of traditional inhabitants:

- 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.
  - 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).
- Maintain stocks above the limit biomass level ( $B_{LIM}$ ), or an appropriate proxy, at least 90 per cent of the time.
  - The agreed  $B_{LIM}$  is more precautionary than the default proxy HSP  $B_{LIM}$
- Implement rebuilding strategies, if the spawning stock biomass is assessed to fall below  $B_{LIM}$  in two successive years.

## 4.3 – Harvest Strategy Decision Rules

The RAG discussed and provided advice on the Fishery Harvest Strategy decision rules, including the necessary timing of fishery monitoring and assessment and the various scenarios that may occur under the Harvest Strategy.

One industry member and two observers suggested that if the Fishery is facing closure there should be a ban on hookah diving or the Fishery should be closed to the TVH sector.

The RAG **RECOMMENDED** the following decision rules:

### *eHCR and stock assessment cycle*

- The eHCR is run in November each year to provide a RBC for the following fishing season.
- A stock assessment update is run every three years unless the need for an updated stock assessment is triggered by the eHCR or another applicable decision rule. The three-yearly updated stock assessment will be used to determine the Fishery stock status, evaluate the performance of the eHCR and identify if any revisions to the eHCR are required.
- If the eHCR needs to be revised, a stock assessment will be conducted annually to estimate the RBC until the revised eHCR is agreed.

### *Pre-season survey trigger*

- If in any year, the pre-season 1+ survey index (average number of age 1 lobsters per survey transect) is 1.25 or lower it triggers a stock assessment to determine stock status.

### *Biomass limit reference point triggered*

- If the eHCR limit reference point is triggered in any year, a stock assessment update must be conducted in March the following year.
  - In this case, discussions will be held on preventative measures to reduce the risk of closure.
  - If the stock assessment confirms that the stock is below the biomass limit reference point, it is optional to conduct a mid-season survey to inform the next stock assessment; the pre-season survey must continue annually.

### *Fishery closure rules*

- If stock assessment updates determine the stock to be below the biomass limit reference point in two successive years, the Fishery will be closed to commercial fishing.
  - In this case, a stock assessment must be conducted in December (of the second year).
  - Discussions will be held on future management arrangements.
  - It should be noted that management strategy evaluation (MSE) testing of the eHCR has shown that it is extremely unlikely (<1% probability) that the Fishery would be closed under the eHCR.

### *Re-opening the Fishery*

- Following closure of the Fishery, fishery-independent mid-season and pre-season surveys are mandatory to inform annual stock assessments, and the fishery can only be re-opened when a stock assessment determines the stock to be above the biomass limit reference point.

Based on the above rules, the independent scientific member provided flowcharts depicting various alternative possible scenarios that may occur under application of the eHCR.

**Scenario 1** – eHCR limit not breached. Harvest control rule operates as expected. Stock status, fishery dynamics and recommended TACs remain within ranges tested by MSE. Updated 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 B, Figure 1**.

**Scenario 2** – eHCR limit not breached. Harvest control rule operates as expected. Stock status, fishery dynamics and recommended TACs appear to remain within ranges tested in MSE. However, updated assessment indicates that stock status, stock dynamics or fishery dynamics have moved outside ranges tested in MSE; or that TACs recommended by the



HCR are not appropriate given the revised estimate of stock status; indicating that the HCR 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 B, Figure 2**.

**Scenario 3**– eHCR limit is breached in one year, stock assessment determines limit is not breached. Application of the HCR in a particular year results in the limit being triggered, requiring a special assessment update to confirm whether the limit has indeed been breached. However, 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.
- A graphic representation of Scenario 3 is provided in **Attachment B, Figure 3**.

**Scenario 4** – eHCR limit is breached in two successive years, stock assessment confirms limit is breached. Application of the eHCR in a particular year results in the limit being triggered, requiring a special assessment update to confirm whether the limit has indeed been breached. Special assessment update confirms that the limit has indeed been breached. Application of the HCR the following year results in the limit being triggered for the second successive year, requiring a second rapid assessment update to confirm whether the trigger has been breached a second time. Assessment update confirms that the trigger has been breached again. 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 B, Figure 4**.

## Agenda item 5 – data rules

The RAG noted proposed data rules for the TRL Fishery as detailed in the paper titled '*Separating TIB, TVH and Processor catch records from Docket-Book Data*.' The RAG noted the significant work that had been undertaken to develop the rules and considered having an agreed procedure for filtering the docket book (TDB01) data was a high priority.

For clarity and to enable the RAG to properly assess the data rules, the RAG **AGREED** that AFMA and CSIRO should provide a more detailed explanation of each rule (including

statistics about the number of records it corrected by each rule) and provide it to the RAG out of session.

## Agenda item 6 – climate change

The RAG noted presentations from AFMA, TSRA and CSIRO about ongoing and planned climate change research for the region and Australia more broadly. The purpose of the discussion was to improve the RAG's understanding on climate change research initiatives and information relevant to the fishery.

### AFMA

The AFMA observer noted that AFMA is involved with two funding applications for projects relating to climate change titled:

- 1) *'Adaptation of Commonwealth fisheries management to climate change.'*
  - This project proposes to use the findings of previous research that identifies how fisheries may be impacted by climate change to adapt or generate management strategies for Commonwealth fisheries that will be resilient to the predicted changes.
  - The project is not specifically related to the Torres Strait; however the findings and outcomes may be useful for adapting the management strategies of Torres Strait fisheries.
- 2) *'Decadal scale projection of changes in Australian fisheries stocks under climate change.'*
  - This project will evaluate species and fisheries vulnerability to climate change using ecosystem modelling for the oceans around continental Australia.
  - The species selected will be based on the vulnerability assessment and with consideration of geographic coverage, economic value and known abundance and distribution trends.
  - The RAG **AGREED** that AFMA should contact the research applicant (CSIRO) to propose that tropical rock lobster be included as an indicator species for the project.
  - The scientific member noted there had been some preliminary discussions with the principal investigator to include tropical rock lobster; however the Torres Strait lobster stock is not included in other ecosystem models (for example Ecopath, Ecosim and Atlantis). A supporting project may need to be developed for the inclusion of TRL into the modelling.

### TSRA

The TSRA member provided an update as detailed in the paper *'Update on TSRA climate change projects – marine focus'* (**Attachment C**).

- TSRA and AIMS established marine monitoring stations at Masig, Maize Kauri (Bramble Cay) and Tuesday Island that monitor meteorological parameters and ocean temperature and salinity.
- A number of temperature data loggers have been deployed off islands across the Torres Strait, the data are monitored by AIMS and it is incorporated into the coral reef bleaching risk assessment.
- In 2016 aerial and in-water surveys were conducted to assess the extent of the mass coral reef bleaching event. A number of permanent reef monitoring sites have been established.
- The Torres Strait Regional Adaptation and Resilience Plan was developed to address climate change risks and build resilience.
- TSRA will be facilitating a workshop on 7-8 June 2017 in Cairns to evaluate the shipping risks in the Torres Strait and the potential impacts to fisheries.

## CSIRO

The CSIRO observer provided an update as detailed in the presentation titled '*Climate influences in Torres Strait and the TRL Fishery.*'

- Since 1970 the sea surface temperature in the Coral Sea has consistently been above the long term average (data from 1900 to 2017).
- The El Nino event from 2015/16 was more intense than previous events in recent history. The impacts to the Fishery include increased mortality of cage-held lobsters and increasing coral mortality that may result in a reduction of suitable habitat. The influences on the larval phases of TRL are poorly understood.
- Updated oceanographic larval transport models (CONNIE 3) show that El Nino Southern Oscillation (ENSO) cycles may impact the delivery of TRL larvae to the Torres Strait. The models can be used to estimate how larval dispersal is impacted by climate change.
- Preliminary modelling indicates a strengthening of the Coral Sea gyre during El Nino events.
- Seabed habitat monitoring as part of the TRL fishery independent surveys identified:
  - seagrass habitat declined up to 2001 and has since increased;
  - increase in sand habitat in the north-west region (Mabuiag), supported by fisher observations; and
  - decrease in live coral cover and an increase in bleached coral.

The independent scientific member noted that CONNIE 3 which models oceanographic conditions in the Coral Sea is likely to be useful to predict how TRL larvae would be

transported from PNG to the Torres Strait and how climate change may impact larval transport and recruitment.

The scientific member noted that the biggest climate change risk that is likely to affect TRL and should be accounted for in the stock assessment model is likely to be changes to sea temperature and its influence on growth and mortality of TRL. The member noted the assessment could be updated using information from climate projections and higher resolution projections from CONNIE 3 to identify the possible impacts of climate change.

The RAG **AGREED** that CSIRO should provide further advice on how updating the stock assessment with CONNIE 3 modelling outputs may improve the understanding of climate change impacts to growth, mortality and recruitment of TRL.

The RAG **AGREED** for AFMA in collaboration with CSIRO and TSRA to put together a list of all climate change projects in the region or that may be relevant to the region more broadly.

## **Agenda item 7 – other business**

The Chair noted that due to time constraints the following agenda items will need to be discussed at the next meeting:

- Agenda item 6 *‘options for supporting industry run TRL surveys’* (paper sent to RAG out of session)
- Agenda item 8 *‘future work – developing a tiered approach for the harvest control rule.’*

The next meeting was agreed for December 2017.

# Torres Strait Tropical Rock Lobster Resource Assessment Group

Meeting Record 20

4 & 5 April 2017

In-session meeting

Note all meeting papers and record available on  
the PZJA webpage:

[www.pzja.gov.au](http://www.pzja.gov.au)



Australian Government

Australian Fisheries Management Authority

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## Meeting participants

### Members

Name	Position	Declaration of interest
Ian Knuckey	Chair	Nil Member of other RAG's and conducts various AFMA research projects
Dean Pease	TRLRAG Executive Officer	Nil
Selina Stoute	AFMA Member	Nil
John Ramsay	TSRA Member	Nil
Mariana Nahas	TSRA Member	Nil
Tom Roberts	Queensland Fisheries	Nil
Eva Plaganyi	CSIRO Scientific Member	Project staff for PZJA funded TRL research projects.
Andrew Penney	Independent Scientific Member	Member of other RAG's and research consultant
Maluwap Nona	Chairperson Malu Lamar	TIB licence holder
Aaron Tom	Industry Member	Nil
Mark David	Industry Member	TIB licence holder
Terrence Whap	Industry Member	Nil
Les Pitt	Industry Member	TIB licence holder
Daniel Takai	Industry Member	Pearl Island Seafood, Tanala Seafood and TIB licence holder
Ray Moore	Industry Member	TVH licence holder
Brett Arlidge	Industry Member	General Manager MG Kailis Pty Ltd, holder of TVH licences

## Observers

Name	Position	Declaration of interest
Jerry Stephen	TSRA Deputy Chair TSRA Fisheries Portfolio	TIB licence holder
Ian Butler	AFMA Observer	NIL
Mick Haywood	CSIRO Scientific Observer	Project staff for PZJA funded TRL research projects
Mark Tonks	CSIRO Scientific Observer	Project staff for PZJA funded TRL research projects
Patrick Mills <sup>1</sup>	Chairperson Torres Strait Fishers Association	TIB licence holder

<sup>1</sup> Attended the meeting only on the morning of day two.

## Action items and recommendations

### Action Items

Number	Action
1.	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
2.	AFMA and CSIRO to provide a more detailed explanation of each data filtering rule (including statistics about the number of records it corrected by each rule) and provide this to the RAG out of session.
3.	AFMA to contact the research applicant (CSIRO) to propose tropical rock lobster to be included as an indicator species for the project ' <i>Decadal scale projection of changes in Australian fisheries stocks under climate change.</i> '
4.	CSIRO to provide further advice on how use of the stock assessment and CONNIE 3 larval transport modelling outputs may improve the understanding of climate change impacts to growth, mortality and recruitment of TRL.
5.	AFMA in collaboration with CSIRO and TSRA to put together a list of all climate change projects in the region or that may be relevant to the region more broadly.



## Recommendations

### Recommendations

The **operational objectives** of the Harvest Strategy be revised to place greater emphasis on the importance of the Fishery for traditional way of life and livelihood of traditional inhabitants:

- 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.
  - 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).
- Maintain stocks above the limit biomass level ( $B_{LIM}$ ), or an appropriate proxy, at least 90 per cent of the time.
  - The agreed  $B_{LIM}$  is more precautionary than the default proxy HSP  $B_{LIM}$ .
- Implement rebuilding strategies if the spawning stock biomass is assessed to have fallen below  $B_{LIM}$  in two successive years.

The following decision rules:

#### *eHCR and stock assessment cycle*

- The eHCR is run in November each year to provide a RBC for the following fishing season.
- A stock assessment update is run every three years unless the need for an updated stock assessment is triggered by the eHCR or another applicable decision rule. The three-yearly updated stock assessment will be used to determine the Fishery stock status, evaluate the performance of the eHCR and identify whether any revisions to the eHCR are required.
- If the eHCR needs to be revised, a stock assessment will be conducted annually to estimate the RBC until the revised eHCR is agreed.

#### *Pre-season survey trigger*

- If in any year the pre-season 1+ survey index (average number of age 1 lobsters per survey transect) is 1.25 or lower, it triggers a stock assessment to determine stock status.

#### *Biomass limit reference point triggered*

- If the eHCR limit reference point is triggered in any year, a stock assessment update must be conducted in March the following year. In this case, discussions will be held on preventative measures to reduce the risk of closure.
  - If the stock assessment confirms that the stock is below the biomass limit reference point, it is optional to conduct a mid-season survey to inform the next stock assessment; 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.

## Recommendations

### *Fishery closure rules*

- If stock assessment updates determine the stock to be below the biomass limit reference point in two successive years, the Fishery will be closed to commercial fishing.
  - In this case, discussions will be held on future management arrangements.
  - Management strategy evaluation (MSE) testing of the eHCR has shown that it is extremely unlikely (<1% probability) that the Fishery would be closed under the eHCR.

### *Re-opening the Fishery*

- Following closure of the Fishery, fishery-independent mid-season and pre-season surveys are mandatory to inform annual stock assessments, and the fishery can only be re-opened when a stock assessment determines the stock to be above the biomass limit reference point.

Graphic flowchart representations of alternative possible scenarios under application of the eHCR are provided in **Attachment B** for the following scenarios:

#### Four decision rule scenarios:

- Scenario 1 – eHCR limit not breached. Harvest control rule operates as expected. Stock status, fishery dynamics and RBCs remain within ranges tested by MSE. Updated assessment does not indicate any need for revision of the HCR.
- Scenario 2 – eHCR limit not breached. Harvest control rule operates as expected. Stock status, fishery dynamics and RBCs appear to remain within ranges tested in MSE. However, updated assessment indicates that stock status, stock dynamics or fishery dynamics have moved outside ranges tested in MSE, or that TACs recommended by the HCR are not appropriate given the revised estimate of stock status, indicating that the HCR should be revised.
- Scenario 3 – eHCR limit is breached in one year, stock assessment determines the limit is not breached. Application of the HCR in a particular year results in the limit being triggered, requiring a special assessment update to confirm whether the limit has indeed been breached. However, this assessment update determines that the limit has not been breached. The assessment cycle is reset and application of the eHCR continues.
- Scenario 4 – eHCR limit is breached in two successive years, stock assessment confirms the limit is breached. Application of the HCR in a particular year results in the limit being triggered, requiring a special assessment update to confirm whether the limit has indeed been breached. Special assessment update confirms that the limit has indeed been breached. Application of the HCR the following year results in the limit being triggered for the second successive year, requiring a second rapid assessment update to confirm whether the trigger has been breached a second time. Assessment update confirms that the trigger has been breached again. The commercial fishery is closed until an assessment update confirms that the stock has recovered to above the limit.

## Agenda Item 1 - preliminaries

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### 1.1 & 1.2 Apologies / adoption of agenda / declaration of interest

Apologies were received from Phillip Ketchell (industry member), Ian Liviko (PNG NFA) and Meremi Maina (PNG industry observer).

The RAG adopted the agenda with no changes.

The RAG generally noted that there could be potential conflicts of interest for members and observers when providing information and advice on some agenda items. These conflicts should be tabled by members.

### 1.3 Ratification of RAG #19 meeting record

The RAG noted that the RAG 19 meeting record was ratified out-of-session on 20 February 2017. No comments were received on the draft record.

### 1.4 Action items from previous meetings

The RAG noted progress against action items from previous meetings. The list of action items and progress is provided in **Appendix A**.

## Agenda Item 2 - updates

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### Industry

The RAG noted the updates provide by industry members that:

- Fishers from Darnley Island have had lower than average catches since the start of the 2017 fishing season.
- Fishers from Mabuiag Island have reported catches to be lower than expected and similar to the 2016 fishing season. Mabuiag fishers report that sand incursions persist on the nearby reefs and it is thought that the sand is causing lower catches of TRL. A higher number of Mabuiag fishers participated in lamp fishing during December and January and as a result a higher number of live TRL were landed. The AFMA member noted TIB and TVH fishers have reported that some areas around Mabuiag previously inundated by sand are recovering to seagrass and reef habitat.
- The Queensland East Coast Fishery had its best start ever for a fishing season, 97 t of the 195 t TAC was caught in the first three months of fishing (January to March 2017).
- The Torres Strait Fishery hookah opening started well with catch rates above expected, based on the TAC of 495 t. However, catch rates have now dropped and are at a level consistent with a 495 t TAC. Fishing in PNG has been consistent with the Torres Strait. Some industry members noted that return of the south-easterly trade winds may improve fishing conditions.
- The price at the start of the year (during the Chinese New Year and Lantern Festival) was strong. The price is currently at its lowest point in the year (Tomb-Sweeping Day)

4 April 2017). The price is likely to return to normal (approx. average price \$40-\$50 per kilogram) by May.

## AFMA

The RAG noted the update provided by the AFMA member that:

- The introduction of a mandatory fish receiver system (also known as catch disposal record) for Torres Strait fisheries is being considered by the PZJA. If agreed, the system will require buyers and processors to record the species and amount of product they purchase. The TRL Working Group supported the introduction of a mandatory fish receiver system at its meeting on 4-5 April 2016.
- Research funding is almost fully committed for the next two financial years and as a result there will be no call for new research proposals in 2017/18. The Torres Strait research budget is due to be underspent by \$80,000 for 2016/17 and it is forecast to be underspent by \$20,000 in 2017/18. Funding is committed to conducting a TRL pre-season survey in 2017/18 and 2018/19.
  - The RAG noted advice from CSIRO that the stock assessment is funded on a three-year cycle and that in every 3<sup>rd</sup> year the cost of running the assessment is slightly higher because more work is undertaken to review and update stock assessment model.

## QDAF

The RAG noted the update from the QDAF member:

- The Queensland East Coast Fishery had an exceptional start to the fishing season, the catch (97 t in 3 months) is the highest ever recorded for the first 3 months of fishing (January to March).
  - CSIRO noted that it will be presenting preliminary results of the Coral Sea gyre advection modelling at Agenda Item 7 and it may be at least part of the explanation for higher catches of TRL on the East Coast.
- The QLD fisheries green paper (policy to guide sustainable fishing) public consultation period has closed. Taking into account consultation outcomes a 'Sustainable fishing Strategy' has been developed and with the Government for consideration.

## TSRA

The RAG noted the update from the TSRA member that TSRA is continuing to pursue the roadmap to 100 per cent ownership of commercial fisheries by Traditional Inhabitants through the PZJA process. The member noted the recent increase of TIB catch (Agenda Item 1.2, Attachment A) supports the growing capacity to transition to 100 per cent ownership.

## Native title

The RAG noted the update from the Chairperson of Malu Lamar that Malu Lamar RNTBC has contracted two Queensland Council lawyers to provide an independent report on transitioning to 100 per cent ownership of Torres Strait commercial fishing rights by Traditional Inhabitants. The final report is due by the end of April 2017.

## Agenda Item 3 – updated fishery assessment

The RAG noted an update on the TRL stock assessment presented by the scientific member based on the paper titled '*Torres Strait rock lobster (TRL) fishery surveys and stock assessment. AFMA Project 2016/0822*':

The scientific member noted that:

- The RAG accepted the 2016 updated Fishery stock assessment and recommended an RBC of 495 t for the 2016/17 fishing season at meeting no. 19 on 13 December 2016.
- At RAG 19, CSIRO noted some final checks of the stock assessment would be undertaken in early 2017 with updated data.
- CSIRO finalised the Fishery stock assessment with the updated data and the RBC remained unchanged at 495 t.

The RAG noted advice from the scientific member that:

- There was an initial key-punching error in the 2014 reported total catch used. The 2014 total catch was corrected from 572.6 t to 682.4 t.
- There is uncertainty in the PNG reported catch for 2016 and one industry member has reported that the PNG catch of 127 t used in the assessment was possibly under reported.
- If PNG caught an additional 100 t in 2016 the fishing mortality rate (F) would increase from approximately 0.10 to 0.15 (F = 0.15 is the target fishing mortality rate). This level of increase would not have a significant impact on the stock sustainability.

The RAG noted advice from the scientific member about the pre-season survey:

- As previously agreed by the RAG, the fishery-independent survey reduced its number of survey sites 2015 (78 sites) and 2016 (74 sites), down from 144 historically to reduce survey costs.
- When using the reduced number of sites, the survey results follow the same trend as the full-scale survey, although they are slightly more uncertain (larger error bars). The reduced number of survey sites still gives a reliable index of abundance and is considered to optimise cost-benefits for the Fishery.

The RAG noted advice from the representative of Malu Lamar that traditional names should be used to describe research areas. This would also assist stakeholders in understanding the nature and extent of survey sites underpinning TRL research.

1. The RAG **AGREED** that Malu Lamar RNTBC is to provide AFMA with the map of traditional boundaries, regional and reef names for each of the Torres Strait Island nations and for CSIRO to examine possible revised naming conventions for survey sites.

The RAG noted that the 2017 RBC derived from the assessment was 495 t compared to 624 t from the eHCR. The reason for the difference was explained:

- The stock assessment model integrates all available information into a single framework to output a RBC. The information includes pre-season survey data, CPUE data for TIB and TVH sectors, and size frequency; the model RBC is not averaged in the same way as for the eHCR.
- The eHCR on the other hand uses averages from the last four years of four of the data inputs, weighted as follows:
  - 1+ TRL indices (70% weighting);
  - 0+ TRL indices (10% weighting);
  - TIB standardised CPUE (10% weighting); and
  - TVH standardised CPUE (10% weighting).

It was also noted that the two-year projection of RBC from the 2015 assessment (719 t) was higher than the RBC from the current assessment. The reason for this was explained:

- the 2015 pre-season survey 0+ (recently settled TRL) index of abundance used in the 2-year projection was relatively high but there is a higher level of uncertainty using the 0+ index compared to the 1+ index, due to the small size and cryptic behaviour of 0+ TRL and a range of factors affecting mortality in the intervening period. Therefore the forecast RBC based on the 0+ indices is less reliable than using the 1+ indices which estimates the abundance of TRL recruiting into the Fishery that will be of fishable size.

The RAG noted the updated data summary for the commercial catch-at-age data detailed in the paper titled '*Summary of Torres Strait and QLD East Coast lobster commercial catch monitoring by MG Kailis Pty Ltd 2001-2017*'. The RAG noted:

- The collection of commercial catch-at-age data from M.G Kailis Pty. Ltd. is cost-effective and provides important information on the size distribution of commercially caught TRL for the Torres Strait and East Coast fisheries.
- The TSRA member noted that a fishery independent observer program may be useful for collecting Torres Strait fishery information such as catch at age. It was noted however that:
  - There may be data other than catch-at-age information, which would be more valuable for an observer program to collect.

- If an observer program or another data collection program is developed it will need to be spatially extensive and overlap with current data collection programs to confirm that the data are representative and compatible with historical data.

The member for TSRA questioned whether recreational and traditional catch of TRL should be taken into account in the fishery stock assessment. Scientific members advised that:

- there needs to be a time series of data or an estimate of historical catch to indicate if catch has increased or decreased over time;
- if recreational and traditional catch has remained constant over time then it may not be worthwhile including in the assessment because it is unlikely to adjust the RBC estimate;
- it is important to understand if catches are a lot bigger than assumed as that could impact the stock assessment; and,
- recreational and traditional catch data are often expensive to collect because this requires surveys to be conducted periodically, therefore it may not be affordable to collect this information.

## **Agenda Item 4 – finalisation of the harvest strategy**

The RAG noted an update from the AFMA member as detailed in the paper titled '*Torres Strait Tropical Rock Lobster Fishery Working Draft Harvest Strategy*' and the scientific member as detailed in the presentation titled '*Summary of empirical Harvest Control Rule for the Torres Strait tropical rock lobster (TRL) fishery.*'

### **4.1 – Summary of agreed Harvest Strategy to date**

- The draft TRL Fishery Harvest Strategy was considered by the RAG at meeting no. 18 and 19 (2-3 August 2016 and 13 December 2016 respectively). The process for finalising this is for the RAG to agree to the final draft Harvest Strategy and the draft final report to be sent to the TRL Working Group and Protected Zone Joint Authority (PZJA) to be agreed.
- The RAG agreed eHCR fits a regression line to the logarithm of last five years of fishery indicator data to determine if the stock size is trending up or down. The indicators used are the pre-season survey 1+ indices (70% weighting), 0+ indices (10% weighting), TIB standardised CPUE (10% weighting) and TVH standardised CPUE (10% weighting). The logarithm is used to reduce the variability in the data and as a result there is also a reduction in the inter-annual variability in the RBC.
- In response to an industry request to consider the simple option of a fixed TAC, it was noted that a Fishery TAC (Australian and PNG inclusive) set as a constant catch would need to be set at 360 t annually to allow for the necessary precaution in years when the stock size may be low. If a constant TAC was set at 360 t the Fishery total



catch would be much lower in the long term due to forgone catch in years of high stock abundance.

## 4.2 – Operational objectives of the Harvest Strategy

The RAG discussed and provided advice on the objectives of the Harvest Strategy. The RAG **RECOMMENDED** the operational objectives of the Harvest Strategy be revised to place emphasis on the importance of the Fishery for traditional way of life and livelihood of traditional inhabitants:

- 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.
  - 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).
- Maintain stocks above the limit biomass level ( $B_{LIM}$ ), or an appropriate proxy, at least 90 per cent of the time.
  - The agreed  $B_{LIM}$  is more precautionary than the default proxy HSP  $B_{LIM}$
- Implement rebuilding strategies, if the spawning stock biomass is assessed to fall below  $B_{LIM}$  in two successive years.

## 4.3 – Harvest Strategy Decision Rules

The RAG discussed and provided advice on the Fishery Harvest Strategy decision rules, including the necessary timing of fishery monitoring and assessment and the various scenarios that may occur under the Harvest Strategy.

One industry member and two observers suggested that if the Fishery is facing closure there should be a ban on hookah diving or the Fishery should be closed to the TVH sector.

The RAG **RECOMMENDED** the following decision rules:

### *eHCR and stock assessment cycle*

- The eHCR is run in November each year to provide a RBC for the following fishing season.
- A stock assessment update is run every three years unless the need for an updated stock assessment is triggered by the eHCR or another applicable decision rule. The three-yearly updated stock assessment will be used to determine the Fishery stock status, evaluate the performance of the eHCR and identify if any revisions to the eHCR are required.
- If the eHCR needs to be revised, a stock assessment will be conducted annually to estimate the RBC until the revised eHCR is agreed.



### *Pre-season survey trigger*

- If in any year, the pre-season 1+ survey index (average number of age 1 lobsters per survey transect) is 1.25 or lower it triggers a stock assessment to determine stock status.

### *Biomass limit reference point triggered*

- If the eHCR limit reference point is triggered in any year, a stock assessment update must be conducted in March the following year.
  - In this case, discussions will be held on preventative measures to reduce the risk of closure.
  - If the stock assessment confirms that the stock is below the biomass limit reference point, it is optional to conduct a mid-season survey to inform the next stock assessment; the pre-season survey must continue annually.

### *Fishery closure rules*

- If stock assessment updates determine the stock to be below the biomass limit reference point in two successive years, the Fishery will be closed to commercial fishing.
  - In this case, a stock assessment must be conducted in December (of the second year).
  - Discussions will be held on future management arrangements.
  - It should be noted that management strategy evaluation (MSE) testing of the eHCR has shown that it is extremely unlikely (<1% probability) that the Fishery would be closed under the eHCR.

### *Re-opening the Fishery*

- Following closure of the Fishery, fishery-independent mid-season and pre-season surveys are mandatory to inform annual stock assessments, and the fishery can only be re-opened when a stock assessment determines the stock to be above the biomass limit reference point.

Based on the above rules, the independent scientific member provided flowcharts depicting various alternative possible scenarios that may occur under application of the eHCR.

**Scenario 1** – eHCR limit not breached. Harvest control rule operates as expected. Stock status, fishery dynamics and recommended TACs remain within ranges tested by MSE. Updated 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 B, Figure 1**.

**Scenario 2** – eHCR limit not breached. Harvest control rule operates as expected. Stock status, fishery dynamics and recommended TACs appear to remain within ranges tested in MSE. However, updated assessment indicates that stock status, stock dynamics or fishery dynamics have moved outside ranges tested in MSE; or that TACs recommended by the

HCR are not appropriate given the revised estimate of stock status; indicating that the HCR 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 B, Figure 2**.

**Scenario 3**– eHCR limit is breached in one year, stock assessment determines limit is not breached. Application of the HCR in a particular year results in the limit being triggered, requiring a special assessment update to confirm whether the limit has indeed been breached. However, 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.
- A graphic representation of Scenario 3 is provided in **Attachment B, Figure 3**.

**Scenario 4** – eHCR limit is breached in two successive years, stock assessment confirms limit is breached. Application of the eHCR in a particular year results in the limit being triggered, requiring a special assessment update to confirm whether the limit has indeed been breached. Special assessment update confirms that the limit has indeed been breached. Application of the HCR the following year results in the limit being triggered for the second successive year, requiring a second rapid assessment update to confirm whether the trigger has been breached a second time. Assessment update confirms that the trigger has been breached again. 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 B, Figure 4**.

## Agenda item 5 – data rules

The RAG noted proposed data rules for the TRL Fishery as detailed in the paper titled '*Separating TIB, TVH and Processor catch records from Docket-Book Data*.' The RAG noted the significant work that had been undertaken to develop the rules and considered having an agreed procedure for filtering the docket book (TDB01) data was a high priority.

For clarity and to enable the RAG to properly assess the data rules, the RAG **AGREED** that AFMA and CSIRO should provide a more detailed explanation of each rule (including

statistics about the number of records it corrected by each rule) and provide it to the RAG out of session.

## Agenda item 6 – climate change

The RAG noted presentations from AFMA, TSRA and CSIRO about ongoing and planned climate change research for the region and Australia more broadly. The purpose of the discussion was to improve the RAG's understanding on climate change research initiatives and information relevant to the fishery.

### AFMA

The AFMA observer noted that AFMA is involved with two funding applications for projects relating to climate change titled:

- 1) *'Adaptation of Commonwealth fisheries management to climate change.'*
  - This project proposes to use the findings of previous research that identifies how fisheries may be impacted by climate change to adapt or generate management strategies for Commonwealth fisheries that will be resilient to the predicted changes.
  - The project is not specifically related to the Torres Strait; however the findings and outcomes may be useful for adapting the management strategies of Torres Strait fisheries.
- 2) *'Decadal scale projection of changes in Australian fisheries stocks under climate change.'*
  - This project will evaluate species and fisheries vulnerability to climate change using ecosystem modelling for the oceans around continental Australia.
  - The species selected will be based on the vulnerability assessment and with consideration of geographic coverage, economic value and known abundance and distribution trends.
  - The RAG **AGREED** that AFMA should contact the research applicant (CSIRO) to propose that tropical rock lobster be included as an indicator species for the project.
  - The scientific member noted there had been some preliminary discussions with the principal investigator to include tropical rock lobster; however the Torres Strait lobster stock is not included in other ecosystem models (for example Ecopath, Ecosim and Atlantis). A supporting project may need to be developed for the inclusion of TRL into the modelling.

### TSRA

The TSRA member provided an update as detailed in the paper *'Update on TSRA climate change projects – marine focus'* (**Attachment C**).

- TSRA and AIMS established marine monitoring stations at Masig, Maize Kauri (Bramble Cay) and Tuesday Island that monitor meteorological parameters and ocean temperature and salinity.
- A number of temperature data loggers have been deployed off islands across the Torres Strait, the data are monitored by AIMS and it is incorporated into the coral reef bleaching risk assessment.
- In 2016 aerial and in-water surveys were conducted to assess the extent of the mass coral reef bleaching event. A number of permanent reef monitoring sites have been established.
- The Torres Strait Regional Adaptation and Resilience Plan was developed to address climate change risks and build resilience.
- TSRA will be facilitating a workshop on 7-8 June 2017 in Cairns to evaluate the shipping risks in the Torres Strait and the potential impacts to fisheries.

## CSIRO

The CSIRO observer provided an update as detailed in the presentation titled '*Climate influences in Torres Strait and the TRL Fishery.*'

- Since 1970 the sea surface temperature in the Coral Sea has consistently been above the long term average (data from 1900 to 2017).
- The El Nino event from 2015/16 was more intense than previous events in recent history. The impacts to the Fishery include increased mortality of cage-held lobsters and increasing coral mortality that may result in a reduction of suitable habitat. The influences on the larval phases of TRL are poorly understood.
- Updated oceanographic larval transport models (CONNIE 3) show that El Nino Southern Oscillation (ENSO) cycles may impact the delivery of TRL larvae to the Torres Strait. The models can be used to estimate how larval dispersal is impacted by climate change.
- Preliminary modelling indicates a strengthening of the Coral Sea gyre during El Nino events.
- Seabed habitat monitoring as part of the TRL fishery independent surveys identified:
  - seagrass habitat declined up to 2001 and has since increased;
  - increase in sand habitat in the north-west region (Mabuiag), supported by fisher observations; and
  - decrease in live coral cover and an increase in bleached coral.

The independent scientific member noted that CONNIE 3 which models oceanographic conditions in the Coral Sea is likely to be useful to predict how TRL larvae would be

transported from PNG to the Torres Strait and how climate change may impact larval transport and recruitment.

The scientific member noted that the biggest climate change risk that is likely to affect TRL and should be accounted for in the stock assessment model is likely to be changes to sea temperature and its influence on growth and mortality of TRL. The member noted the assessment could be updated using information from climate projections and higher resolution projections from CONNIE 3 to identify the possible impacts of climate change.

The RAG **AGREED** that CSIRO should provide further advice on how updating the stock assessment with CONNIE 3 modelling outputs may improve the understanding of climate change impacts to growth, mortality and recruitment of TRL.

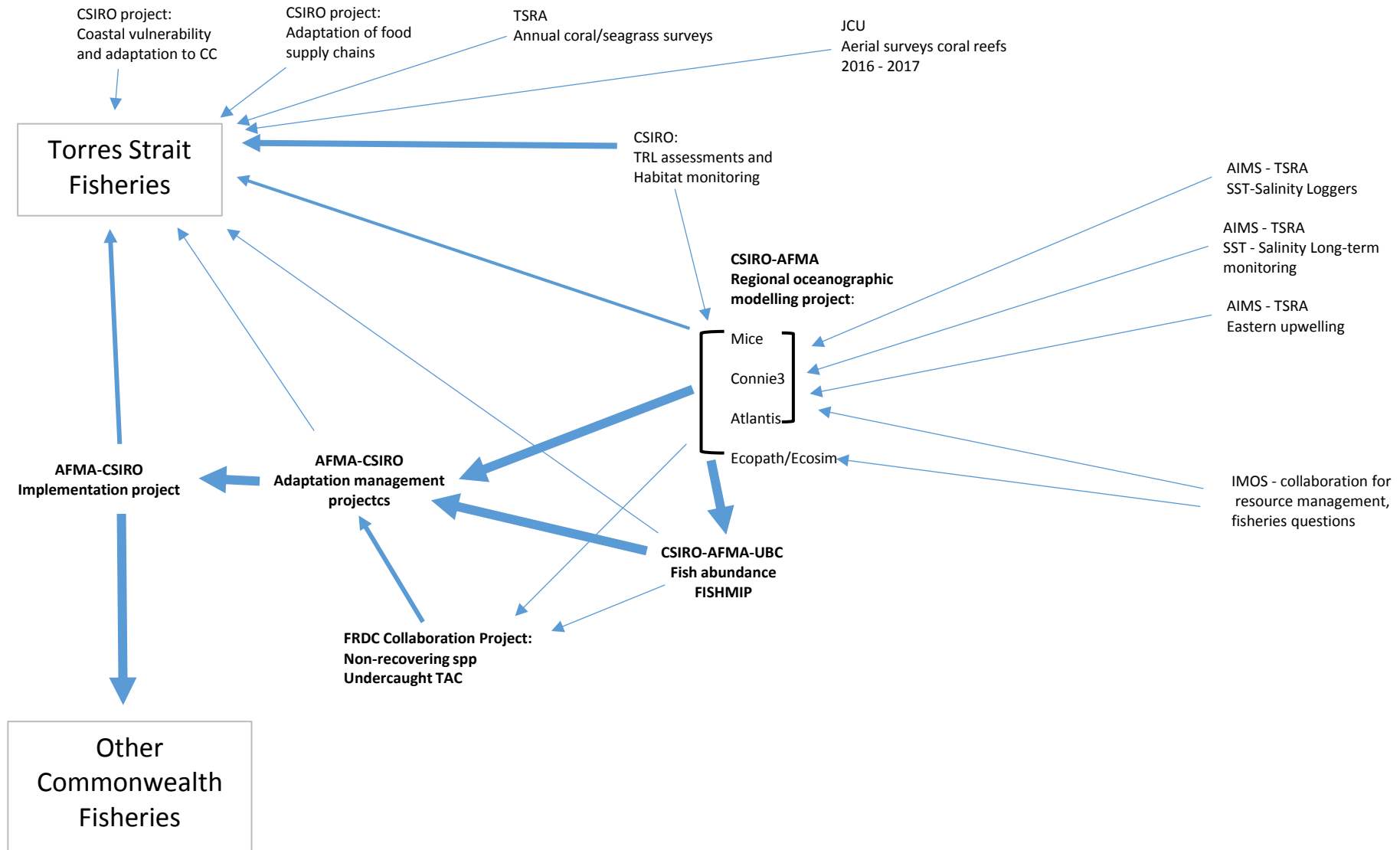
The RAG **AGREED** for AFMA in collaboration with CSIRO and TSRA to put together a list of all climate change projects in the region or that may be relevant to the region more broadly.

## **Agenda item 7 – other business**

The Chair noted that due to time constraints the following agenda items will need to be discussed at the next meeting:

- Agenda item 6 *'options for supporting industry run TRL surveys'* (paper sent to RAG out of session)
- Agenda item 8 *'future work – developing a tiered approach for the harvest control rule.'*

The next meeting was agreed for December 2017.



## Climate Change – Torres Strait – moving forward

(updated 5 May 2017, I Butler)

A variety of organisations are carrying out climate change work in Australia, some of which applies to the Torres Strait region. This is a brief outline of these organisations and what applies to this region.

### AFMA

AFMA have a number of (joint) projects at various stages of progress regarding climate change. Parts of these projects apply to the Torres Strait.

#### Adaptation of Commonwealth fisheries management to climate change (Funded FRDC) – AFMA PI, Funded

- 1: How well does existing Commonwealth fisheries management framework cope with climate change impacts (i.e. Risk Assessment)
- 2: Develop methodology and approach for AFMA (and other fisheries) to adapt regulatory environment to climate change impacts
- 3: Develop strategies and priorities to account for effects of climate change in management of fisheries

#### Decadal scale projection of changes in Australian fisheries stocks under climate change (Submitted FRDC) – AFMA CI, likely funding

- 1: Update fisheries climate/ecosystem models with latest information (e.g. Atlantis, Ecopath with Ecosim, FISHMIP, Connie, MICE)
- 2: Run ecosystem projections out to 2050 at 5-10 year intervals
- 3: Where possible, examine species level projections
- 4: Provide advice on likely impacts to stocks (input into Adaptation project)

#### Non-recovering stocks and undercaught TACs (Submitted FRDC)- AFMA CI, likely funded

1. Develop understanding of why some stocks are not recovering despite no fishing
2. Explain reasons behind undercaught TACs

#### Implementation of what we have learned to fisheries management (early Proposal) – AFMA PI? (concept only)

1. Address risks identified in adaptation project
2. Implement strategies learned from adaptation project

## TSRA

AIMS Long term monitoring stations (Masig, Maizab Kaur, Tuesday Island)

- Monitor SST and salinity

AIMS Data loggers at various islands across region (Regional bleach risk assessments)

Bleaching surveys carried out in 2016 – aerial surveys

NESP Earth Systems Hub (Climate change Geoff Gooley) – case study, climate change in TS

NESP water quality impacts from Fly River, including hydrodynamic models for TS (CSIRO modelling indicates increased rainfall to Fly catchment as a result of CC)

Climate change risks from storms to shipping (collaboration with AMSA, MSQ)

Annual surveys of coral reefs and seagrass beds

**CSIRO** – update of various oceanographic/biological models and projects, some of which are connected with FRDC decadal modelling application.

Connie3 – Early Austral-Asian, recent Coral Sea and GBR Modelling apply to TI

Atlantis – biophysical model, oceanographic as well as economic and social parameters

MICE – Models of Intermediate Complexity for Ecosystem assessments

Ecopath with Ecosim (EwE) – biophysical model applied to certain areas (eg Gulf Carpentaria – overlap with TS?)

TRL assessment, habitat monitoring

Coastal community vulnerability assessments (food) and adaptation options

Minimising instability of food supply chains with climate change

**University of British Columbia (UBC)** – use of models to project fish abundance with changing climate over decades (part of CSIRO FRDC project for decadal modelling) (Key modeller - William Cheung)

FISHMIP models

## JCU (ARC Centre of Excellence Coral Reef Research)

Aerial surveys of coral reefs, 2016 -2017(incl TS) (Terry Hughes, JCU)



**Integrated Marine Observing System (IMOS) – Australian Ocean Data Network AODN)**

Wide range of monitoring/tagging/sampling equipment at various locations around Australia and linked with many organisations/networks around the world.

Interest in engagement with fisheries (natural resource management)

What are important fisheries questions to support stock assessments/management?

What can IMOS do to help to find solutions?

<b>TROPICAL ROCK LOBSTER</b>	<b>MEETING No. 21</b>
<b>RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>12-13 December 2017</b>
<b>FISHERY UPDATES</b>	<b>Agenda Item 2.1</b>
<b>Industry and scientific update</b>	<b>For DISCUSSION</b>

## RECOMMENDATIONS

1. That the RAG:
  - a. **NOTE** updates provided by industry and scientific members;
  - b. **DISCUSS** strategic issues, including economic, fishing and research trends relevant to the management the TRL Fishery.

## 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.

<b>TROPICAL ROCK LOBSTER</b>	<b>MEETING No. 21</b>
<b>RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>12-13 December 2017</b>
<b>FISHERY UPDATES</b>	<b>Agenda Item 2.2</b>
<b>Government agencies update</b>	<b>For NOTING</b>

## RECOMMENDATIONS

1. That the Working Group:
  - a. **NOTE** the written and verbal update provided by AFMA; and
  - b. **NOTE** a verbal update will be provided by the QDAF and TSRA;

## AFMA UPDATES

### *Fish receiver system (FRS)*

2. A mandatory FRS for all the Torres Strait Fisheries (excluding the Torres Strait Prawn Fishery) will commence on 1 December 2017. The FRS will replace the current voluntary Torres Strait Seafood Buyers and Processors Docket Book system. The FRS makes mandatory the reporting total landed weight by species by Fish Receivers. The Catch Disposal Record also provides field to report effort information however it will remain voluntary to provide this information. A copy of the CDR is provided at **Attachment A**.

### *TRL draft quota management plan*

3. The TRLWG met on 25-26 July to consider the outcomes of the public consultation process on the draft quota management plan for TRL Fishery. The TRLWG Industry Members, including those with Transferable Vessel Holder (TVH) interest, supported setting aside further development of the draft plan until the Traditional Inhabitant sector has developed preferred options for managing their quota allocation.
4. In light of what was learnt from the TSRA Maori study tour New Zealand, in July and concerns raised about the draft plan through the public consultation, the TSRA Fisheries Portfolio Member and the Malu Lamar (Torres Strait Islander) Corporation RNTBC (Malu Lamar) Chairperson did not support any further discussion on the draft plan until the Traditional Inhabitant Boat (TIB) sector and native holders more broadly, first meet to consider how their quota entitlements might be managed in order to meet their aspirations from the Fishery.
5. The TSRA Fisheries Portfolio member advised the TRLWG that the TSRA Board would develop a work plan for leading further consultation with the TIB sector and Malu Lamar.
6. Outcomes of the consultation will be tabled with the PZJA together with advice from the TRLWG and TSRA's proposal to conduct further consultation on the TIB allocation.

### *Torres Strait legislative amendments*

7. Following PZJA and further Ministerial approval, AFMA is progressing draft amendments to the *Torres Strait Fisheries Act 1984* and *Torres Strait Fisheries Regulations 1985*. The amendments will provide immediate improvements to the efficiency and effectiveness of fisheries administration in the Torres Strait. Relevantly to the RAG it is proposed that the Act be amended to ensure clear power to introduce mandatory daily logbook reporting by TIB licence holders. AFMA expects to commence work on the amendments next year and anticipates it may take up to two years to finalise.



**Australian Government**  
**Australian Fisheries**  
**Management Authority**

**Torres Strait**  
**PZJA**  
Protected Zone  
Joint Authority

**TORRES STRAIT FISHERIES**  
**CATCH DISPOSAL**  
**RECORD**

**TDB02**



Business Name

# AREAS FOR TORRES STRAIT CATCH DISPOSAL RECORD



Edition Date:  
September 2017

Use area where most catch was taken

# Torres Strait Fisheries Catch Disposal Record TDB02

## GENERAL INFORMATION

### About this Catch Disposal Record

- This TDB02 Catch Disposal Record is designed to record verified landed information about fish catches - it does not replace any requirement for fishers to complete daily catch and effort logbooks.
- Information supplied on this Catch Disposal Record will be used for fisheries management purposes. AFMA may release data on specific returns in connection with the investigation and prosecution of offences against the *Torres Strait Fisheries Act 1984* and associated legislation or under a court order.
- All fields **must** be completed in part A of the form, fields in part B are not mandatory.

### Who must complete this Catch Disposal Record?

- The licensed Torres Strait Fish Receiver (the Receiver) or their Registered Authorised Agent must complete the Catch Disposal Record.
  - a Registered Authorised Agent is a person who has been nominated by the licensed Torres Strait Fish Receiver to complete the TDB02 on their behalf. The Receiver must complete and lodge with AFMA the appropriate nomination form. **Note:** *all further references in this Catch Disposal Record to Receiver/s should be taken to also be a reference to a Registered Authorised Agent as prescribed by AFMA’s Registered Authorised Agent Nomination process.*
  - the fish receiver (or agent) signing the CDR form must be a different person to fisher signing the fishing licence details.
- The Receiver must accurately determine the weight of the fish and complete the Catch Disposal Record for every consignment of fish received.

### When must this Catch Disposal Record be completed?

- This Catch Disposal Record must be completed by the Receiver immediately upon receipt of the fish and before the fish are placed with any other fish that are not part of the consignment.
- Retaining the Catch Disposal Record – the Receiver must retain this Catch Disposal Record. Once completed the Receiver must keep this book for a minimum period of five years and make it available to any authorised officer on request.

### Where and how must the forms be submitted?

- **White copy** – the Receiver must forward the white original copy to AFMA within 3 calendar days of the fish being received. Where the premises at which the fish were received was a boat, the Receiver must forward the white original copy to AFMA within 3 business days of that boat returning to port.
- **Pink Copy** – the holder of the Torres Strait commercial fishing licence (the Fisher) who is disposing of the fish retains the pink copy.
- **Green copy** – must remain in this book and be held by the Receiver.

**Note:** As each page of this Catch Disposal Record is numbered, any spoiled or incorrectly completed forms must be clearly marked ‘cancelled’ and returned to AFMA.

If you have any queries about completing this Catch Disposal Record please contact AFMA Direct on 1300 723 621.

**FAILURE TO SUPPLY AN ACCURATE AND FULLY COMPLETED CATCH DISPOSAL RECORD FOR ALL FISH RECEIVED IS A BREACH OF THE LICENCE CONDITIONS OF YOUR FISH RECEIVER LICENCE. BREACH OF ANY LICENCE CONDITION(S) IS AN OFFENCE UNDER THE TORRES STRAIT FISHERIES ACT 1984 AND PENALTIES APPLY.**

## INSTRUCTIONS FOR FISH RECEIVERS

You **must** provide details for **PART A** for each consignment of fish as follows:

**• Has a TDB02 been completed for this fish by another Receiver? No Not Sure**

- If you know another receiver has completed a TDB02 for this consignment of fish then you do not need to complete a TDB02.
- If you know another TDB02 has not been completed then circle NO and continue completing this form as required.
- If you don't know if another form has been completed then circle Not Sure and continue completing this form as required.

**• Fishing Licence Holder Name** – enter the name of the person who holds the licence that is nominated to the boat from which the fish were caught. Enter their name as it appears on the fishing licence.

**• Fishing Licence Number** – enter the fishing licence number of the fishing licence that is nominated to the boat from which the fish were caught. Enter the number as it appears on their fishing licence.

**• Fisher Type** – circle one of the three options provided (TIB, TVH, or Sunset).

**• Boat Symbol** - enter the boat symbol that appears on the fishing licence nominated to the boat from which the fish were caught.

**• Fisher/or Agent Name** - enter the name of the person signing as the fisher/or agent.

**• Signature of Fisher/ or Agent** – Where fish are received directly from a fisher or their agent, the fishing licence holder (or agent) must sign the CDR form to verify their licence details.

**• Date** – Enter the date Fisher signed.

**• Fish Receiver** – enter the name of the Fish Receiver name as it appears on your Fish Receiver Licence.

**• Fish Receiver Licence Number** – enter your Fish Receiver Licence number.

**• Fish Receiver Address** – enter the address of the premise the fish were received.

**• Species** – species codes are shown on the cardboard page divider in this logbook. Enter either the species code or name of each species in the consignment.

**• Processing Code** – processing codes are shown on the cardboard page divider in this logbook. Where processing has occurred please indicate the nature of the processing (e.g. gutted and blanched, dried, headed and gutted, etc.).

**• Weight (kg)** – Weight must be determined by accurate scales

- Where the fish have not been processed in any way, enter the accurate weight in kilograms of all the whole fish received of each individual species.
- Where the fish have been processed prior to receiving, record the accurate processed weight in kilograms of all the fish received of each individual species.
- Where only part of the catch of a species is processed, record the processed and unprocessed components of the species on separate rows.
- Do not record processed and unprocessed forms in the same row.

**• Fish Number** – Enter the number of fish for records of live Fin Fish only.

**• Signature of Receiver** – The Receiver or their Registered Authorised Agent must sign this part to certify accurate completion of the Catch Disposal Record.

**• Printed name** of Receiver – enter the name of the Receiver or Registered Authorised Agent who signed this form.

**• Date** – Enter the date on which this form was completed.

The following information **may** also be completed in **PART B**. These fields are not mandatory:

**• Number of Fishers** – enter the number of fishers who participated in the fishing trip for which the Catch Disposal Record relates.

**• Number of Days** – enter the duration of the fishing trip for which the Catch Disposal Record relates.

**• Area Fished** – enter the area where the fish were taken using the map shown at the start of this logbook. Enter more than one area if the fishing trip for which the Catch Disposal Record relates if applicable.

**• Start Date** – enter the start date of the fishing trip for which the Catch Disposal Record relates.

**• End Date** – enter the end date of the fishing trip for which the Catch Disposal Record relates.

**• Logbook Type** – record the logbook type that was completed. For example catches of tropical rock lobster may have been recorded in their Tropical Rock Lobster Daily Fishing Log TRL04.

**• Logbook Number and Page Number this catch relates to** – Record detail if this catch has also been entered into a daily fishing logbook. Please enter N/A (Not applicable) if this catch has not previously been entered in a daily fishing logbook.

**• Fishing Method** – tick (✓) the fishing method used to take the fish for the fishing trip for which the Catch Disposal Record relates. Tick (✓) more than one fishing method if applicable.

If you have any queries about completing this Catch Disposal Record please contact AFMA Direct on 1300 723 621.



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Has a TDB02 been completed for this fish by another Receiver?  
If you are certain the answer is yes - do not complete another TDB02 for the same fish (Circle one) **NO** NOT SURE

Fisher Details					
Fishing Licence Holder Name	Geoff Trout		Fishing Licence Number	3579	
Fisher Type (Circle One)	TIB	TVH	Sunset	Boat Symbol	FTVW
Signature of Fisher /or agent:	Geoff Trout		Printed name of Fisher /or agent and Date:	Geoff Trout 9 / 08 / 2017	

Fish Receiver Name	Island Seafoods	Fish Receiver Licence Number	2468
Fish Receiver Address	Lot 987 Thursday Island QLD 4875		

Species (see code list)	Processing Code (see code list)	Weight (kg)	Fish Number (live finfish only)
SNM	W	200	
SNM	GG	45	
TCG	L		72
TOTAL		245	72

Signature of Receiver /or Agent: I certify that the information provided on this form is a true and accurate record.	<i>Bob Smith</i>	Printed Name of Receiver and Date:	Bob Smith 9 / 08 / 2017
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Fishing Effort and Area					
Number of Fishers	2		Number of Days	3	
Area Fished	16		Start and End Dates	8/8/17 to 9/8/17	
Has the catch been recorded on a daily fishing logbook? (Circle one) Yes No					
Logbook Type	TSF01		Logbook Number(s)	234	Page Number(s) 34, 35, 36
Fishing Method (tick the fishing methods used)					
Hookah (MDH)		Handline (LHL)	✓	Drop Line (LDL)	✓
Free Dive (MDF)		Rod and Reel (LRR)		Other	
Lamp Fishing (MLF)		Troll (LTL)		(Specify)	



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Has a TDB02 been completed for this fish by another Receiver? (Circle one) **NO** NOT SURE

Fisher Details			
Fishing Licence Holder Name	Rob Kayar	Fishing Licence Number	4573
Fisher Type (Circle One)	TIB TVH Sunset	Boat Symbol	TRAWQ9999
Signature of Fisher /or agent:	Rob Kayar	Printed name of Fisher /or agent and Date:	Rob Kayar 9 / 08 / 2017

Fish Receiver Name	Island Lobster	Fish Receiver Licence Number	1234
Fish Receiver Address	Lot 987 Thursday Island QLD 4875		

Species (see code list)	Processing Code (see code list)	Weight (kg)	Fish Number (live finfish only)
T0B	W	78	
T0B	T	23	
T0B	L	223	
TOTAL		324	

Signature of Receiver /or Agent: I certify that the information provided on this form is a true and accurate record.	<i>John Smith</i>	Printed Name of Receiver and Date:	John Smith 9 / 08 / 2017
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Fishing Effort and Area					
Number of Fishers	2		Number of Days	2	
Area Fished	10		Start and End Dates	8/8/17 to 9/8/17	
Has the catch been recorded on a daily fishing logbook? (Circle one)      Yes      No					
Logbook Type			Logbook Number(s)	N/A	Page Number(s)      N/A
Fishing Method (tick the fishing methods used)					
Hookah (MDH)	<input checked="" type="checkbox"/>	Handline (LHL)	<input type="checkbox"/>	Drop Line (LDL)	<input type="checkbox"/>
Free Dive (MDF)	<input type="checkbox"/>	Rod and Reel (LRR)	<input type="checkbox"/>	Other	<input type="checkbox"/>
Lamp Fishing (MLF)	<input type="checkbox"/>	Troll (LTL)	<input type="checkbox"/>	(Specify)	<input type="checkbox"/>

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# Torres Strait Fisheries Catch Disposal Record TDB02

Has a TDB02 been completed for this fish by another receiver? (Circle one)

NO	NOT SURE
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**PART A MANDATORY**

Fisher Details					
Fishing Licence Holder Name				Fishing Licence Number	
Fisher Type (Circle One)	TIB	TVH	Sunset	Boat Symbol	
Signature of Fisher /or agent:				Printed name of Fisher /or agent and Date:	/ /

Receiver Details			
Fish Receiver Name		Fish Receiver Licence Number	
Fish Receiver Address			

Details of Catch			
Species <small>(see code list)</small>	Processing Code <small>(see code list)</small>	Weight <small>(kg)</small>	Fish Number <small>(live finfish only)</small>
TOTAL			

Signature of Receiver /or Agent: I certify that the information provided on this form is a true and accurate record.	Printed Name of Receiver and Date:	/ /
---	---------------------------------------	-----

## PART B VOLUNTARY

Fishing Effort and Area					
Number of Fishers			Number of Days		
Area Fished			Start and End Dates		
Has the catch been recorded on a daily fishing logbook? (Circle one)      Yes      No					
Logbook Type			Logbook Number(s)		Page Number(s)
Fishing Method (tick the fishing methods used)					
Hookah (MDH)	<input type="checkbox"/>	Handline (LHL)	<input type="checkbox"/>	Drop Line (LDL)	<input type="checkbox"/>
Free Dive (MDF)	<input type="checkbox"/>	Rod and Reel (LRR)	<input type="checkbox"/>	Other	
Lamp Fishing (MLF)	<input type="checkbox"/>	Troll (LTL)	<input type="checkbox"/>	(Specify)	

<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>MEETING No. 21 12-13 December 2017</b>
<b>FISHERY UPDATES PNG National Fisheries Authority update</b>	<b>Agenda Item 2.3 For NOTING</b>

## **RECOMMENDATIONS**

1. That the RAG **NOTE** the update provided by the PNG National Fisheries Authority.

## **BACKGROUND**

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

<b>TROPICAL ROCK LOBSTER</b>	<b>MEETING No. 21</b>
<b>RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>12-13 December 2017</b>
<b>FISHERY UPDATES</b>	<b>Agenda Item 2.4</b>
<b>Native Title update</b>	<b>For NOTING</b>

## RECOMMENDATIONS

1. That the RAG **NOTE** any updates on Native Title matters from members, including the representative from 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 the management of Torres Strait fisheries.
4. AFMA has extended an invitation to Malu Lamar to attend all PZJA consultative forums as an observer and is investigating longer term arrangements for representation in consultation with PZJA agencies.

<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>MEETING No. 21 12-13 December 2017</b>
<b>2016/17 Catch Summary</b>	<b>Agenda Item 3 FOR NOTING</b>

## RECOMMENDATIONS

1. That the RAG **NOTE** the 2016/17 tropical rock lobster catch information to be provided by CSIRO.

## KEY ISSUES

2. The 2016/17 notional global total allowable catch (TAC), PNG and Australia inclusive, was set at 495 tonnes. The combined PNG and Australia catch was 368.4 tonnes.
  - a. Australian catch was 255.4 tonnes. The TIB sector caught 106.4 tonnes and the TVH sector caught 149.0 tonnes.
  - b. The 2016/17 PNG catch was 113 tonnes.
3. Note that there was zero reported catch of TRL by PNG trawlers, because PNG NFA did not issue exemptions to allow trawlers to retain TRL in 2016/17.
4. The Australia catch summary by sector and docket book zone is provided in **Attachment A**.

**Table 1.** Torres Strait Tropical Rock Lobster Fishery catch and total allowable catch for the years 2013 to 2017.

Year	TIB Catch (t)	TVH Catch (t)	PNG Catch (t)	Total Catch (t)	Global TAC (t)	Catch as % of TAC
2013	146.1	361.7	108.3	616.1	871	71%
2014	204.6	273.2	261.2	739.0	616	120%
2015	196.3	152.7	235.7	584.7	769	76%
2016	266.1	243.7	248.0	757.8	796	95%
2017	106.4	149.0	113.0	368.4	495	74%

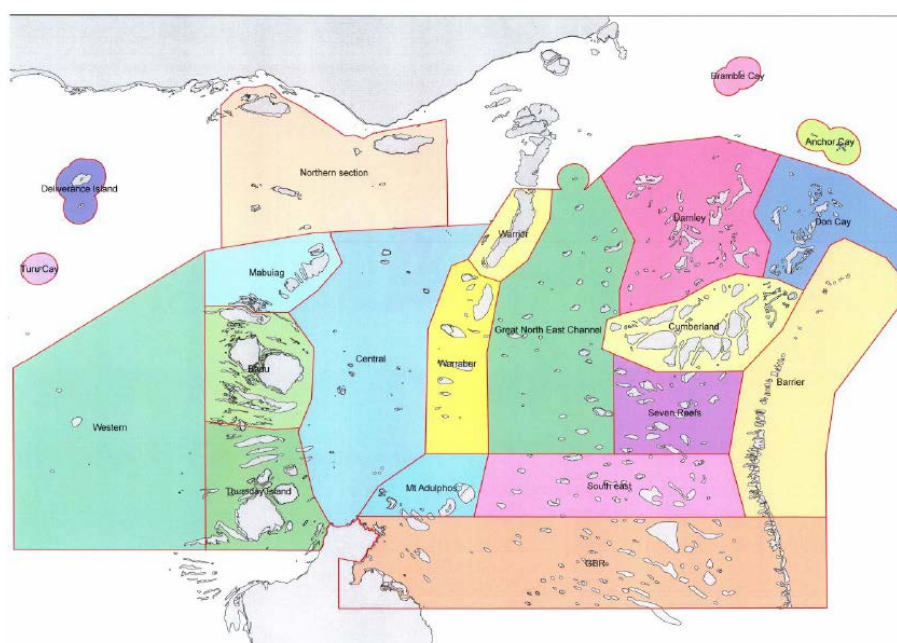
\*Catch is whole weight

### Number of active vessels 2017

- Number of active TIB's (primary and tenders) 2017: No vessel symbols recorded in Docketbook, though 248 distinct Seller Names
- Number of active TVH (primary and tenders) 2017: 10 primary vessels (by name), 34 tenders

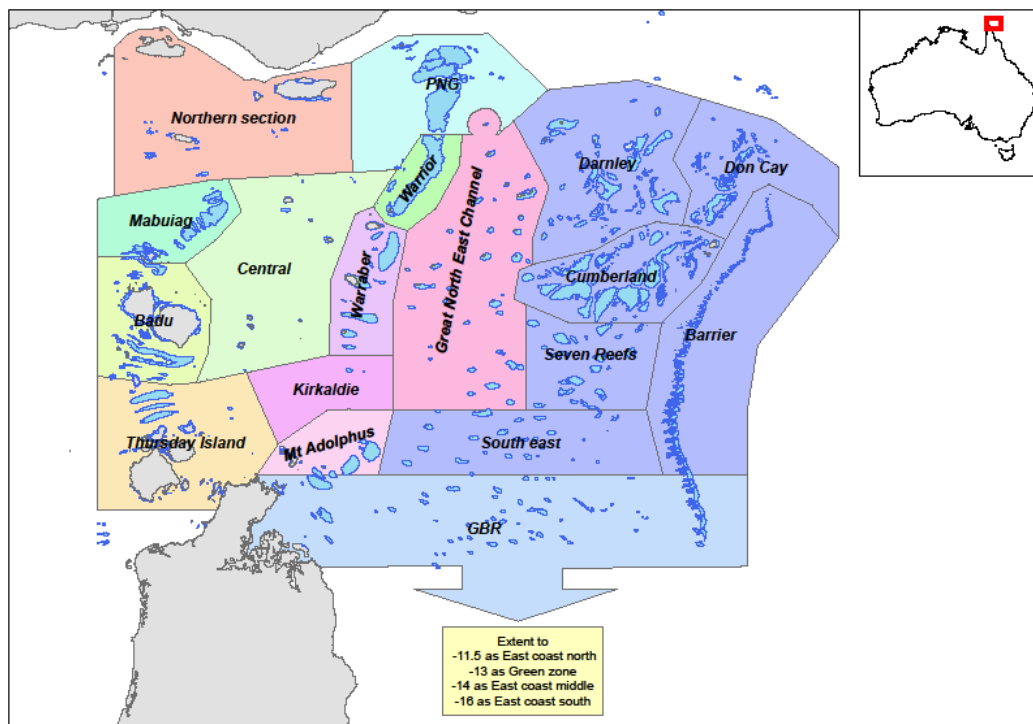
**Table 2.** Torres Strait Tropical Rock Lobster Fishery TIB sector catch by zone for 2017 (refer to map of TIB zones below).

TIB Area	Area Name	TIB Catch (Kgs)	TIB Area	Area Name	TIB Catch (Kg)
0	Unknown	12,325	11	Warrior	959
1	Turu Cay	2,220	12	Warraber	1,906
2	Deliverance Island	0	13	Mt Adolphos	722
3	Northern Section	383	14	Great NE Channel	3036
4	Bramble Cay	347	15	South East	0
5	Anchor Cay	0	16	Darnley	118
6	Western	0	17	Cumberland	62
7	Mabuiag	307	18	Seven Reefs	0
8	Badu	14,771	19	Don Cay	10
9	Thursday Island	63,119	20	Barrier	0
10	Central	6,071	21	GBR	0



**Table 3.** Torres Strait Tropical Rock Lobster Fishery TVH sector catch by zone for 2017 (refer to map<sup>63</sup> of TVH zones below).

TVH Area	Area Name	TVH Catch (Kgs)	TVH Area	Area Name	TVH Catch (Kgs)
0	Unknown	108	10	Northern section	51,226
1	Badu	489	11	Seven Reefs	183
2			12	South East	130
3	Central	4,572	13	Thursday Island	2,691
4	Cumberland	2,307	14	Warraber	29,646
5	Darnley	423	15	Warrior	28,109
6	Don Cay	0	16	Western	0
7	Great NE Channel	0	17	Kirkaldie	20,499
8	Mabuiag	7436	18	PNG	430
9	Mt Adolphos	799	19	GBR	0



# Estimation of Total Annual Effort in the Torres Strait Rock Lobster Fishery - 2017 Update

Robert Campbell

CSIRO Oceans and Atmosphere Flagship

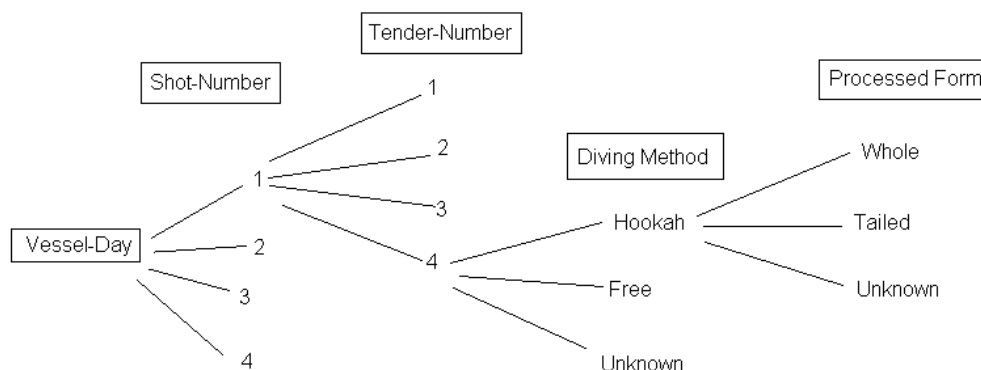
December 2017

## 1. TVH Fishery

### 1.1 Data Summary

Catch and effort data for the TVH sector of the Torres Strait rock lobster fishery is recorded in the TRL04 Logbook. 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 (also known as a tender-set). Between 2004 and 2017 there are a total of 38,274 TVH records or tender-sets.

Figure 1. Structure of the TVH data



The distribution of these 38,274 records by year and month are given in Table 1. It is apparent that there has been little if any effort during October and January since 2004.

Effort is recorded as “Hours-Fished” which records the duration of the fishing trip for each tender-set. The distribution of hours fished for all records is shown in Figure 2. Unfortunately the fishing effort has not been completed for all tender-sets (c.f. Figure 3), with the number of hours fished recorded for only 35,871 (93.7%) of the 38,274 records. The number of recorded hours fished was between 0.15 hours and 96 hours, though the majority were less than 12 hours. Of the 337 records where the hours fished was greater than 12, most (315) recorded 24 hours which was assumed to be a day’s fishing. All records where the hours-fished was greater than 12 hours were considered suspect due to possible recording errors and as such only those records where the hours-fished was 12 hours or less were included in the analysis. A further two records where effort was less than 0.5 hours were also excluded. This left a total of 35,534 records (92.8% of all tender-sets) having a recorded effort between 0.5 and 12 hours for further analysis.



Table 1. Number of TVH tender-sets by year and month.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2004	24	607	712	571	662	761	729	633	395	0	0	106	5200
2005	13	662	615	543	519	538	552	533	323	0	0	4	4302
2006	0	409	436	361	286	206	349	289	92	0	0	0	2428
2007	0	288	427	446	542	489	402	184	91	0	0	0	2869
2008	0	133	222	113	161	96	159	175	152	0	0	0	1211
2009	0	148	227	174	201	200	125	163	70	0	0	0	1308
2010	0	255	333	302	324	292	309	294	253	0	6	0	2368
2011	0	286	384	371	322	380	356	310	261	0	0	0	2670
2012	0	166	344	371	311	336	318	264	201	0	0	0	2311
2013	0	461	383	414	424	324	374	385	243	0	0	0	3008
2014	0	357	404	297	433	408	445	274	291	0	1	0	2910
2015	0	419	408	441	355	313	253	357	137	0	0	0	2683
2016	12	500	444	315	379	349	323	191	141	0	0	9	2663
2017	7	397	254	322	383	310	292	277	101	0	0	0	2343
Total	56	5,088	5,593	5,041	5,302	5,002	4,986	4,329	2,751	0	7	119	38,274

Figure 2. Distribution of effort for the 38,274 TVH records between 2004 and 2017.

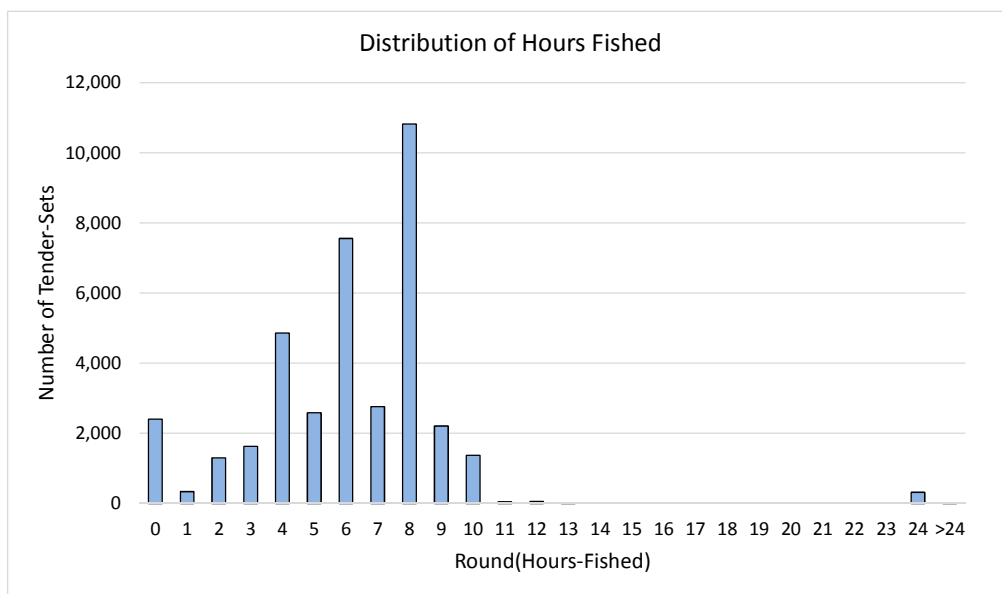


Figure 3. The total number of TVH catch records each year and the number of records for which the corresponding effort data is available. The percentage of records for which no effort is recorded is also shown (right hand axis).

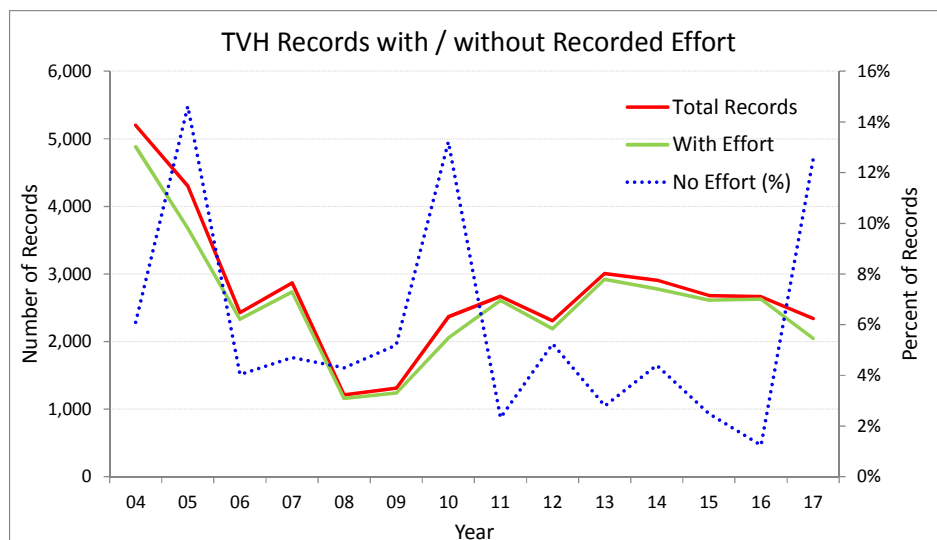
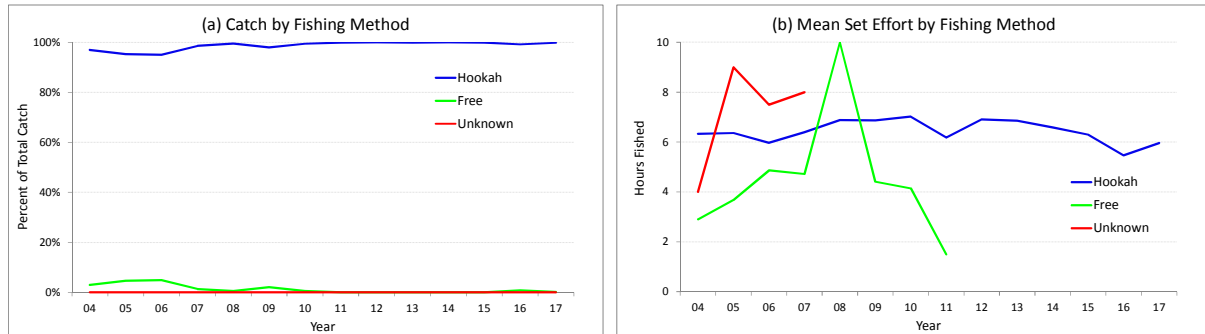


Figure 4. (a) The percent of total TVH catch each year caught by each fishing method, and (b) the mean number of hours fished per tender-set for each fishing method.



Finally, the percent of total TVH catch each year caught by each fishing method, and the mean number of hours fished per tender-set for each fishing method are shown in Figure 4.

### 1.2 Estimate of Annual Effort

Given the above data preparation and filtering the following process was adopted for estimating the total annual effort:

1. First, an annual listing of the number of TVH records against the number of hours fished was prepared (c.f. Table 2a, Figure 5). Records listed against zero hours fished pertain to those where the effort was either not recorded or was outside the 0.5 to 12 hour band used. The total number of tender-sets for each year is also shown in this table.
2. For those records where the hours-fished was recorded the total number of hours fished for these tender-sets was totalled. This result is shown as the Total Hours in Table 2b.
3. To account for those records where the hours-fished was not recorded, the total calculated in the previous section was adjusted as follows:

$$Total\ Hours\ (Adj) = Total\ Hours * \frac{\sum_{i=0}^{12} NumberRecords_i}{\sum_{i=1}^{12} NumberRecords_i}$$

This assumes that the distribution of hours -fished for those records where effort was not recorded is similar to the distribution of hours -fished for those records where effort was recorded. Again, for each year this result is shown as the Total Hours -Adj in Table 2b.

Table 2. Annual listing of (a) the number of TVH records against the number of hours fished. – rounded to the nearest integer, and (b) unadjusted and adjusted total number of hours fished.

(a)																
Hours-Fished	04	05	06	07	08	09	10	11	12	13	14	15	16	17	Total	
0	320	631	99	138	52	68	435	205	180	88	129	68	33	294	2,740	
1	61	48	37	14	15	10	10	21	5	15	21	23	32	26	338	
2	188	135	102	76	24	22	36	88	40	54	75	94	183	184	1,301	
3	396	286	198	100	34	66	34	58	44	87	64	73	117	70	1,627	
4	607	598	354	424	129	92	215	610	263	341	201	245	525	251	4,855	
5	399	231	255	282	86	120	94	145	73	170	124	457	97	53	2,586	
6	727	482	445	587	128	180	389	464	326	420	970	549	1145	749	7,561	
7	422	266	182	199	129	132	126	118	187	324	329	195	118	36	2,763	
8	1622	1293	596	638	375	378	677	728	951	1080	744	747	390	598	10,817	
9	337	251	37	267	143	127	91	70	207	318	129	186	17	32	2,212	
10	69	81	123	144	94	113	261	156	30	111	95	44	5	50	1,376	
11	7	0	0	0	2	0	0	1	4	0	24	1	1	0	40	
12	45	0	0	0	0	0	0	6	1	0	5	1	0	0	58	
Total Tender-Sets	5,200	4,302	2,428	2,869	1,211	1,308	2,368	2,670	2,311	3,008	2,910	2,683	2,663	2,343	38,274	
0.5 to 12 hours	4,880	3,671	2,329	2,731	1,159	1,240	1,933	2,465	2,131	2,920	2,781	2,615	2,630	2,049	35,534	
(b)																
Total Hours	30,627	22,829	13,775	17,403	7,996	8,484	13,547	15,216	14,721	19,994	18,296	16,464	14,359	12,190	225,899	
Total Hours - Adj	32,636	26,752	14,361	18,282	8,355	8,949	16,595	16,481	15,964	20,597	19,145	16,892	14,539	13,939	243,486	

Figure 5. Estimates of unadjusted and adjusted total number of hours fished and number of tender-sets for the TVH sector each year.

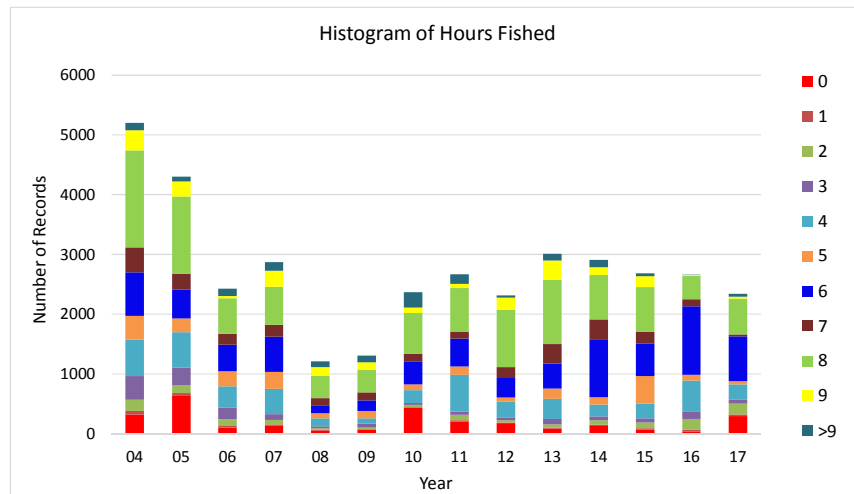
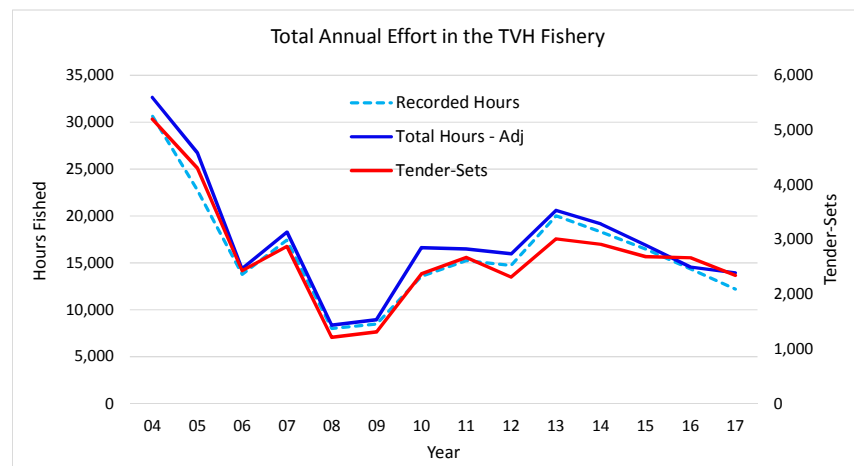


Figure 6. Estimates of TRL04 Logbook recorded and adjusted total number of hours fished and number of tender-sets for the TVH sector each year.



The results of the above process are shown in Figure 6. Note that the final adjusted effort shown for each year (Total Hours-Adj) is only an estimate as it is difficult to know how accurate the recording of this effort is in the logbook (which is understood to relate to the time away from the primary vessel). Nevertheless, the trends in both the annual effort measured in hours fished or number of tender-sets are similar.

## 2. TIB Fishery

### 2.1 Docket-book Coverage

The Buyers and Processors Docket-Book (TDB01), used in the TIB sector of the Torres Strait rock lobster fishery, records the catch sold by fishers (known as sellers on the docket-book) at the end of a fishing trip. However, unlike the logbook for the TVH sector of fishery, which requires catch and effort data to be recorded for individual fishing operations related to each vessel tender, the docket-book requires only aggregate catch and effort data to be recorded at the end of each trip. In particular, the docket-book records the transaction date, the name of the seller together with details of the catch (in weight) and the price obtained. 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.

However, there are a number of issues with the docket-book system which create problems with using this data for estimating the total catch and effort in the TIB fishery. These issues include:

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

Given the duplication of catch information from both the TVH sector and processors which occurs in the docket-book data, several filters are applied to this data to remove these duplicates. Further to these issues, during some years several TIB boats only recorded their catch in the TVH-related logbook (TRL04) and these catch records need to be transferred to the TIB database. Finally, between 2013 and 2016 two processors reported aggregate annual catch data 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 year two data records were added to the Docket-Book data for each processor to account for these additional catches.

## 2.2 TIB Summary

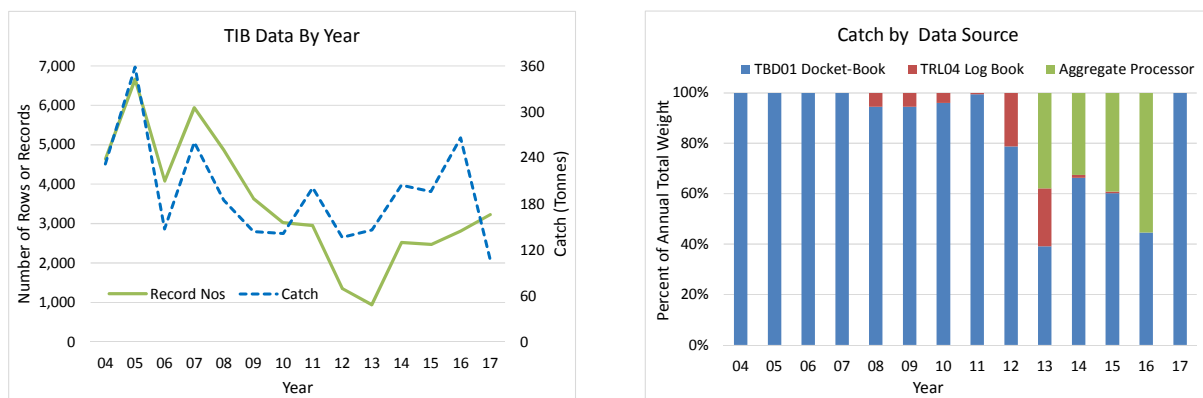
Considerable effort has gone into understanding the nature of both the TDB01 Docket-Book and TRL04 Logbook data so as to identify the catch records that should be assigned to the TIB fishery. A full description of the approach and data-rules used to identify and remove these duplicate records from the Docket-Book data is described in Campbell and Pease (2017). A total of 49,130 catch records have now been attributed to the TIB fishery covering the years 2004 to 2017. A few Docket-Book records (37) having a zero catch of lobsters are not included in this total as it is assumed that other species may have been targeted on these trips.

Table 3. Number of distinct TIB Record Nos by year and the related catch by data source.  
Note, PRC relates to the aggregate catch provided by several processors.

Year	Record Numbers	Catch by Data Source			Total Catch	
		TDB01	TRL04	PRC	(kg)	Tonnes
2004	4,642	232,031	0	0	232,031	232
2005	6,664	358,474	0	0	358,474	358
2006	4,082	146,946	0	0	146,946	147
2007	5,939	260,122	0	0	260,122	260
2008	4,869	174,724	10,223	0	184,947	185
2009	3,635	135,898	7,964	0	143,862	144
2010	3,024	135,517	5,686	0	141,203	141
2011	2,954	200,144	1,025	0	201,168	201
2012	1,352	107,391	29,032	0	136,423	136
2013	940	57,157	33,562	55,411	146,130	146
2014	2,521	135,450	2,456	66,662	204,568	205
2015	2,470	118,066	1,333	76,904	196,303	196
2016	2,810	118,726	0	147,380	266,106	266
2017	3,228	106,356	0	0	106,356	106
Total	49,130	2,287,000	91,283	346,357	2,724,640	2,725

The number of catch records and the associated estimate of the total catch of rock lobsters in the TIB sector each year and by data source is shown in Table 3 and Figure 6. Between 2004 and 2007 all catch is sourced from the TDB01 Docket-Book, and the number of catch records each year varied between 4,082 and 6,664. After this time, and between 2008 and 2015, a portion of the total catch attributed to the TIB sector was recorded in the TRL04 Logbook, and while the total related catch was usually small (<10 tonnes) this catch represented over 20% of the total TIB catch in both 2012 and 2013. Finally, between 2013 and 2016 a significant portion of the total TIB catch (between 33% 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 Docket-Book). Whether or not other catches were also not been recorded in the Docket-Book during these or in other years remains unknown.

Figure 6. Number of TIB data rows, distinct TIB Record Numbers, and associated catch (in tonnes) per year.



### 2.3 Data Preparation

The catch and effort information recorded in the TDB01 Docket-Book is associated with a unique Record-No (i.e. the corresponding record number of the page in either the TDB01 Docket-Book or TRL04 Logbook on which the catch and effort data is recorded). While there are usually multiple catch records associated with a given Record-No (given that the catch is separately recorded by process form and perhaps grade), 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 is likely to be due to mis-recording of the date (and possibly other data fields). Whatever the reason, for the following analysis it was assumed that the multiple records for some vessel, date and seller-names is due to the mis-reporting of the date, and that each Record-No indeed pertains to a separate trip for each seller.

Unlike the TVH data where the measure of effort is hours-fished, the measure of effort recorded in the Docket-Book data is coarser, being days-fished. Furthermore, and as noted above, it has been assumed that each Record-No relates 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 (days fished) associated with each Record-No also pertains to the actual effort expended by that seller in obtaining the recorded catch.

For the TIB attributed catch not-recorded in the Docket-Book there is no corresponding effort information in days fished. However, the TRL04 Logbook allows for fishing effort to be

recorded as the number of hours fished. For the 713 records attributed to the TIB sector the hours fished varied between 1 and 11 with a mode at 6 hours (43% of records). If one considers these fishing efforts correspond to a single day's fishing then one could set the effort equal to one day for all these 713 records. However, a comparison of the annual CPUE (kg/day) between these logbook records with the CPUE for records in the Docket-Book (where days-fished is also 1) indicates that the former are, on average, three times higher. This indicates that the nature of the operations for these larger TIB vessels is substantially different from those of the typical TIB vessel. The example, more than one tender is often associated with each catch Record for the larger vessels recording their catch on the TRL04 Logbook. As such, for the following analysis the effort for these Records was assumed to remain unknown. Similarly, the number of days fished to attribute to the aggregate annual catch data provided by the processors also remains unknown.

#### 2.4 Estimate of Annual Effort

As with the TVH data, in order to account for the under-reporting of effort relating to all trips in the TIB database, the following process was adopted for estimating the total annual effort:

1. First, an annual listing of the number of 48,441 TIB Records included in the TDB01 Docket-Book against the number of days fished was prepared (c.f. Table 5). Note: trips of duration greater than 2-3 days have been recorded and whether these are correct remains uncertain. The associated histogram of the number of days fished is shown in Figure 7.
2. For the 42,860 Records where the days-fished has been recorded the total number of days fished was calculated as follows:

$$Total\ Days = \sum_{i=1}^{16} Number\_Records_i * Days\_Fished_i$$

For each year this result is shown as the Total Days in Table 5b.

3. To account for the 5,581 Docket-Book Records where the days-fished had not been recorded, the total calculated in the previous section was adjusted as follows:

$$Total\ Days\ (Adj1) = Total\ Days * \frac{\sum_{i=0}^{16} Number\_Records_i}{\sum_{i=1}^{16} Number\_Records_i}$$

This assumes that the distribution of days-fished for those Records where effort was not recorded is similar to the distribution of days-fished for those Records where effort was recorded. Again, for each year this result is shown as the Total Days-Adj1 in Table 5b.

4. Finally, to account to the effort associated with those catches which had not been recorded in the TDB01 Docket-Book (i.e. those catches recorded in the TRL04 Logbook or provided in aggregate form for some years by processors), a final estimate of the total number of days fished each year was calculated as follows:

$$Total\ Days\ (Adj2) = Total\ Days(Adj1) * \frac{Total\ TIB\ Catch}{Effort\ Associated\ Catch}$$

where *Effort Associated Catch* relates to the total catch pertaining to the 48,441 Docket-Book Records included in Step 1. Again, this assumes that for catches not recorded in the Docket-Book the relationship between catch and effort is similar to those catches recorded in the Docket-Book. The result is shown as the Total Days-Adj2 in Table 5b.

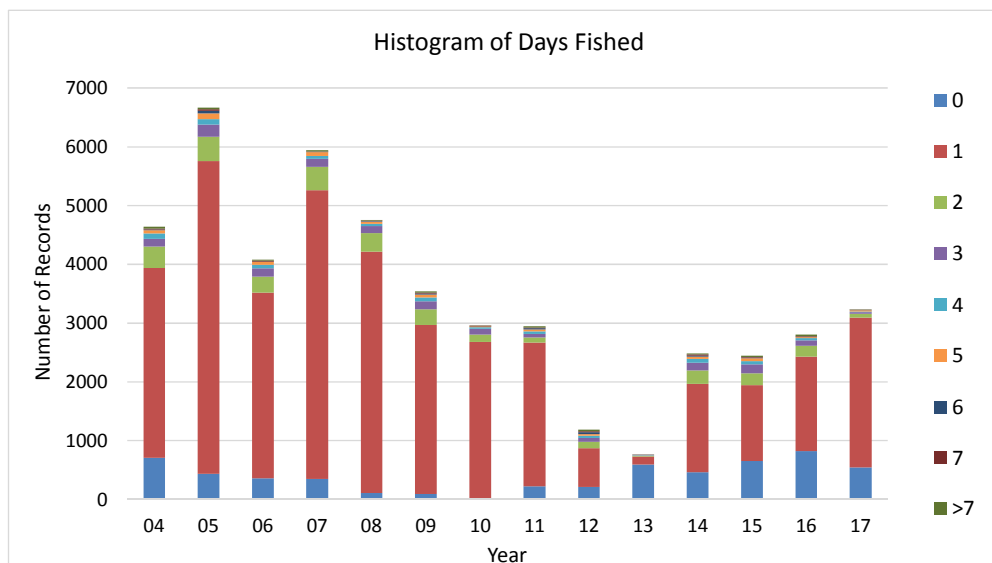
Table 5. (a) Annual listing of the number of Docket-Book Records against the number of days fished. (b). Unadjusted and adjusted total number of days fished each year.

Days-Fished	04	05	06	07	08	09	10	11	12	13	14	15	16	17	Total
0	708	436	363	349	106	92	14	223	210	596	466	654	820	544	5,581
1	3227	5321	3156	4914	4107	2876	2663	2445	661	131	1503	1290	1612	2549	36,455
2	368	417	269	398	320	271	127	86	108	19	222	201	182	64	3,052
3	130	202	145	134	121	134	99	61	64	6	131	150	95	30	1,502
4	91	96	61	48	39	65	30	44	41	6	68	58	35	13	695
5	56	98	52	67	37	52	11	32	25	3	40	49	14	17	553
6	13	41	3	5	8	13	3	23	36	2	12	12	11	4	186
7	13	26	15	6	9	17	11	11	16	0	24	11	10	5	174
8	12	10	9	8	4	5	2	7	10	0	15	8	5	0	95
9	13	5	1	2	0	0	0	3	5	0	6	10	22	2	69
10	2	5	3	3	1	7	1	8	2	0	0	0	0	0	32
11	3	0	0	0	3	5	1	1	7	0	0	0	0	0	20
12	0	5	0	1	0	2	0	0	0	0	0	0	0	0	8
13	4	1	1	2	0	0	0	0	0	0	0	0	0	0	8
14	2	1	1	1	0	0	0	1	0	0	0	0	0	0	6
15	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2
16	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Total Records	4,642	6,664	4,082	5,939	4,755	3,540	2,962	2,945	1,185	763	2,487	2,443	2,806	3,228	48,441

(b)

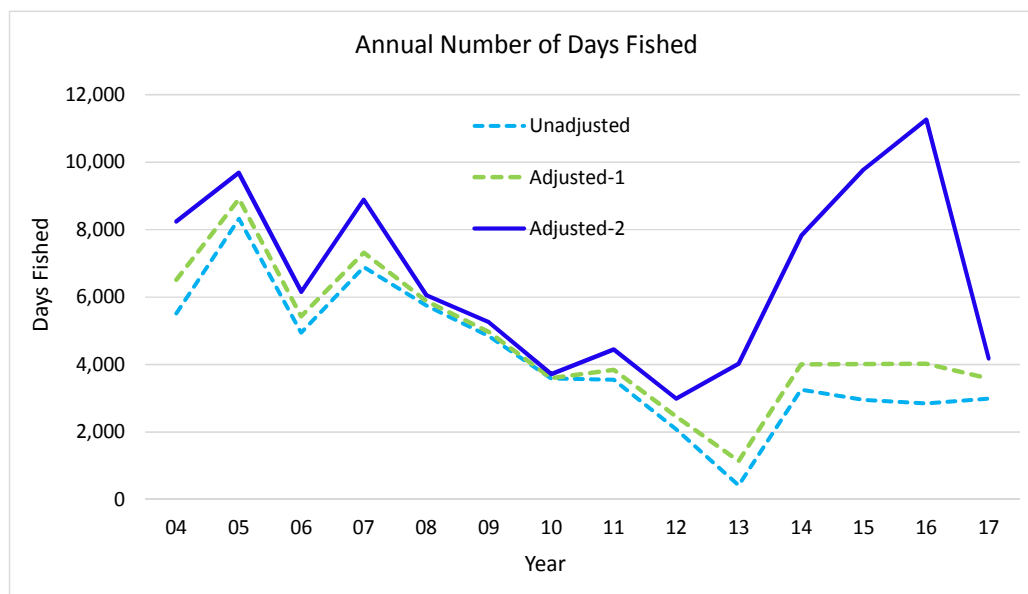
Total Days	5,512	8,325	4,942	6,890	5,637	4,741	3,521	3,539	1,908	238	3,226	2,922	2,845	2,981	57,227
Total Days - Adj1	6,504	8,908	5,424	7,320	5,766	4,868	3,538	3,829	2,319	1,087	3,970	3,990	4,020	3,585	65,127
Associated Catch	232,031	358,474	146,946	260,122	174,724	135,898	135,517	200,144	107,391	57,157	135,450	118,066	118,726	106,356	2,287,002
Total Catch	232,031	358,474	146,946	260,122	184,947	143,862	141,203	201,168	136,423	146,130	204,568	196,303	266,106	106,356	2,724,639
Total Days -Adj2	6,504	8,908	5,424	7,320	6,103	5,153	3,686	3,849	2,946	2,780	5,996	6,634	9,009	3,585	77,897

Figure 7. Histogram of the number of days fished for TIB related records.



The results of the above analyses are shown in Figure 8. Note that the final adjusted effort shown for each year (Total Days-Adj2) is only an estimate and it is difficult to know how accurate this estimate is for each year. For example, the relatively low effort estimate for 2013 is no doubt influenced by the small amount of data available for that year – only 167 Docket-Book records had effort recorded, while the high effort estimate for 2016 is influenced by the high proportion (55%) of the catch provided in aggregate form (again for which no effort information was available). Finally, the time-series of annual effort is premised on the total TIB catch data being adequately captured by various formats (TDB01 Docket-book, TRL04 Logbook, processors) and if this data is not complete given the caveats on the data mentioned previously then this will impact on the annual estimate of total effort.

Figure 8. Estimates of unadjusted and adjusted total number of days fished each year in the TIB sector.



## References

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 21<sup>st</sup> meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12-13 December 2017, Cairns.



## Appendix A. Annual Catch-Per-Unit-Effort

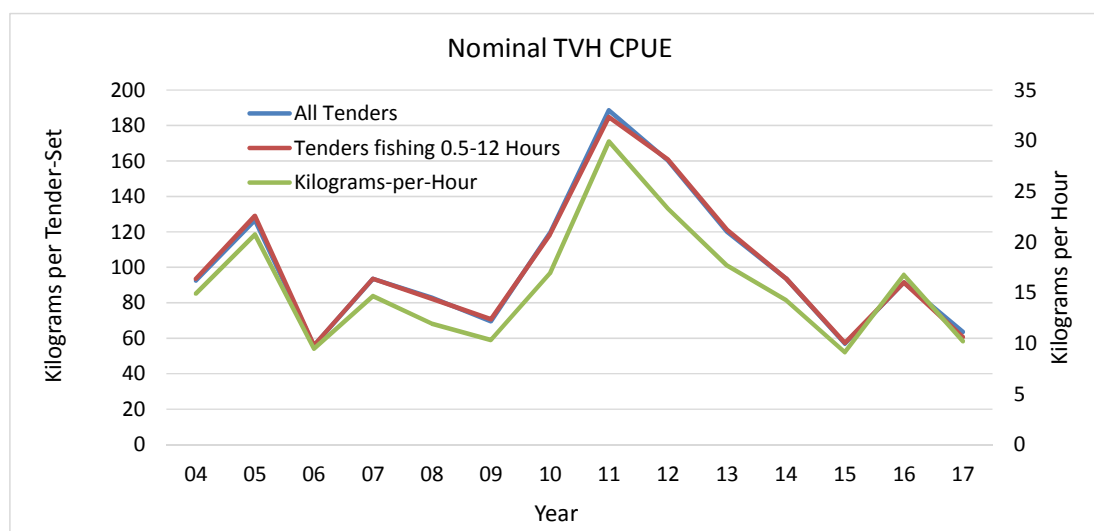
### A. TVH Sector

Effort in the TVH-sector is recorded as hours fished by a tender during each set. As indicated in Table 2 the hours fished for the majority of tender sets (93.2%) are between 0.5 and 12 hours, while the hours fished is not recorded for 6.8% of tender sets. The effort recorded for the remainder of tender sets (<0.5 or >12 hours) is considered not reliable. The annual total number of tender sets, associated catch and corresponding catch-per-unit-effort (CPUE) for (a) all tender-sets and (b) those where effort is between 0.5 and 12 hours is listed in Table A1 while the CPUE for each of the data sets is displayed in Figure A1.

Table A1. (a) Annual total number of tender-sets, associated catch (kilograms) and corresponding CPUE (kilograms per tender-set) for all TVH tender sets, and (b) annual total number of tender-sets, associated hours fished and catch (kilograms) and corresponding CPUE (kilograms per tender-set) and kilograms per hour fished for TVH tender sets where effort is between 0.5 and 12 hours.

Year	(a) All Sets			(b) Sets fishing 0.5-12 Hours				
	N-sets	Catch	CPUE	N-sets	Hours	Catch	CPUE	Kg/hour
04	5,200	481,118	92.5	4,880	30,627	456,700	93.6	14.9
05	4,302	544,977	126.7	3,671	22,829	473,774	129.1	20.8
06	2,428	135,448	55.8	2,329	13,775	130,533	56.0	9.5
07	2,869	268,596	93.6	2,731	17,403	255,468	93.5	14.7
08	1,211	100,438	82.9	1,159	7,996	95,452	82.4	11.9
09	1,308	91,061	69.6	1,240	8,484	87,696	70.7	10.3
10	2,368	282,614	119.3	1,933	13,547	229,162	118.6	16.9
11	2,670	503,533	188.6	2,465	15,216	455,579	184.8	29.9
12	2,311	370,482	160.3	2,131	14,721	342,986	161.0	23.3
13	3,008	361,661	120.2	2,920	19,994	353,786	121.2	17.7
14	2,910	273,186	93.9	2,781	18,296	261,091	93.9	14.3
15	2,683	152,709	56.9	2,615	16,464	150,147	57.4	9.1
16	2,663	243,700	91.5	2,630	14,359	240,919	91.6	16.8
17	2,343	149,048	63.6	2,049	12,190	124,453	60.7	10.2

Figure A1. Annual CPUE (kilograms per tender-set and kilograms per hour) for (a) all TVH tender sets and (b) tender sets where effort is between 0.5 and 12 hours.



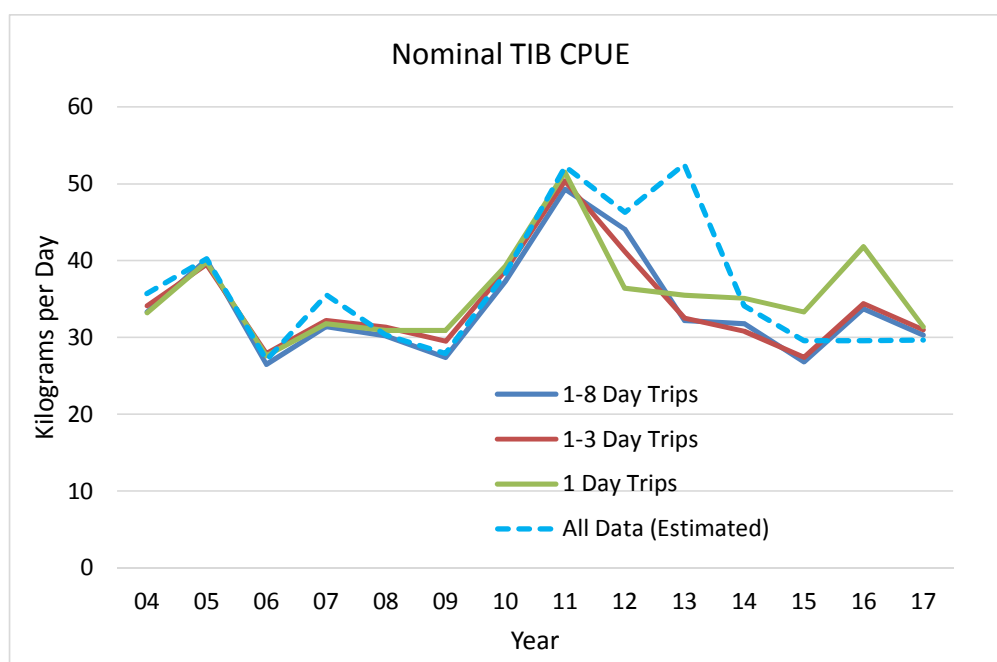
## B. TIB Sector

Effort in the TIB-sector is recorded as the length of each fishing trip in days fished. As indicated in Table 5 fishing trips of up to 16 days have been recorded in the TIB docket-book, though the majority of trips (75.3%) are recorded as having a length of only one day. Whether or not the effort for trips having a long duration is recorded correctly remains unknown. The annual total number of days fished, associated catch and corresponding catch-per-unit-effort (CPUE) for trips having a duration of (a) 1-8 days, (b) 1-3 days and (c) 1 day only is listed in Table A2 while the CPUE (kilograms per day) for each of the data sets is displayed in Figure A2. For comparison, the CPUE associated with the Total Catch and estimated Total Days-Adj2 calculated for all TIB records in Table 5b is also displayed.

Table A2. Annual total number of days fished, associated catch (kilograms) and corresponding catch-per-unit-effort (kilograms per day) for TIB trips having a duration of (a) 1-8 days, (b) 1-3 days and (c) 1 day only. The CPUE in the column All Data relates to that associated with the Total Catch and estimated Total Days-Adj2 calculated for all TIB records in Table 5b.

Year	Year	Trips 1 to 8 days			Trips 1 to 3 days			Trips 1 day only			All Data
		Days	Catch	CPUE	Days	Catch	CPUE	Days	Catch	CPUE	CPUE
04	2004	5,262	175,421	33.3	4,353	148,401	34.1	3,227	107,050	33.2	35.7
05	2005	8,143	326,697	40.1	6,761	267,151	39.5	5,321	211,921	39.8	40.2
06	2006	4,828	127,871	26.5	4,129	115,234	27.9	3,156	87,207	27.6	27.1
07	2007	6,775	212,975	31.4	6,112	196,568	32.2	4,914	156,029	31.8	35.5
08	2008	5,594	168,762	30.2	5,110	159,778	31.3	4,107	126,709	30.9	30.3
09	2009	4,577	125,212	27.4	3,820	112,873	29.5	2,876	88,752	30.9	27.9
10	2010	3,500	130,459	37.3	3,214	124,419	38.7	2,663	104,727	39.3	38.3
11	2011	3,407	167,874	49.3	2,800	141,000	50.4	2,445	125,941	51.5	52.3
12	2012	1,766	77,810	44.1	1,069	44,020	41.2	661	24,063	36.4	46.3
13	2013	238	7,670	32.2	187	6,071	32.5	131	4,656	35.5	52.6
14	2014	3,172	100,773	31.8	2,340	72,013	30.8	1,503	52,826	35.1	34.1
15	2015	2,832	75,914	26.8	2,142	58,596	27.4	1,290	43,011	33.3	29.6
16	2016	2647	89312	33.7	2261	77859	34.4	1612	67427	41.8	29.5
17	2017	2,963	89,818	30.3	2,767	85,723	31.0	2,549	79,995	31.4	29.7

Figure A2. Annual CPUE (kilograms per day) for TIB trips having a duration of (a) 1-8 days, (b) 1-3 days and (c) 1 day only, together with the estimated CPUE for All Data records.



<b>TROPICAL ROCK LOBSTER</b>	<b>MEETING No. 21</b>
<b>RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>12-13 December 2017</b>
<b>Catch per unit effort (CPUE) indices for TIB and TVH sectors</b>	<b>Agenda Item 4</b> <b>For discussion and advice</b>

## RECOMMENDATIONS

1. That the RAG **discuss** and **provide advice** on the Torres Strait Tropical Rock Lobster Fishery catch per unit effort (CPUE) indices for the TIB and TVH sectors to be provided by CSIRO.

## KEY ISSUES

2. Each year as part of the fishery assessment process, CSIRO calculate an annual abundance index for TRL using the TIB docket book (TDB01) data and TVH daily logbook (TRL04) data. This information is used in the integrated stock assessment model and the proposed empirical harvest control rule (eHCR).
3. The RAG is being asked to review the analysis and where relevant provide advice on the findings and/or need for further analysis.
4. CSIRO's analysis will be provided to members before the meeting.

# Use of TIB Docket-Book Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2017 Update

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CSIRO Oceans and Atmosphere Flagship

December 2017

## 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, the Docket-Book required 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 are now integral and equal weighted components of 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, 2014, 2015, 2016).

## 2. Estimation of Total TIB Catch

A copy of the DB01 Docket-Book is shown in Appendix A. The docket-book records the transaction date, the name of the seller together with details of the catch (in weight) and the price obtained. 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 are a number of issues with the Docket-Book system which create problems with using this data for estimating the total catch and effort in the TIB fishery. These issues include:

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

Given the duplication of catch information from both the TVH sector and processors which occurs in the docket-book data, several filters have been developed and applied to this data in an attempt to identify and remove these duplicates. Further to these issues, several large TIB boats for a period of time 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 two processors reported aggregate annual catch data to AFMA as the these catches were also not being recorded in the TDB01 Docket-Book. Each processor reported the catch for tailed and whole lobsters separately, so that for each year 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). A total of 49,130 catch records have now been attributed to the TIB fishery covering the years 2004 to 2017. A few Docket-Book records (37) having a zero catch of lobsters are not included in this total as it is assumed that other species may have been targeted on these trips. Note, 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 Docket-Book 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 catch record (defined by its 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 year, 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 year varied between 4,082 and 6,664. After this time, and between 2008 and 2015, a portion of the total catch attributed to the TIB sector was recorded in the TRL04 Logbook. While the related catch was usually small (<10 tonnes) this catch nevertheless represented over 20% of the total TIB catch in both 2012 and 2013. Finally, between 2013 and 2016 a significant portion of the total TIB catch (between 33% 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 Docket-Book).

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

Year	Records by Data Source			Total Records	Catch by Data Source			Total Catch	
	TDB01	TRL04	PRC		TDB01	TRL04	PRC	(kg)	Tonnes
2004	4642	0	0	4,642	232,031	0	0	232,031	232
2005	6664	0	0	6,664	358,474	0	0	358,474	358
2006	4082	0	0	4,082	146,946	0	0	146,946	147
2007	5939	0	0	5,939	260,122	0	0	260,122	260
2008	4755	114	0	4,869	174,724	10,223	0	184,947	185
2009	3540	95	0	3,635	135,898	7,964	0	143,862	144
2010	2962	62	0	3,024	135,517	5,686	0	141,203	141
2011	2945	9	0	2,954	200,144	1,025	0	201,168	201
2012	1185	167	0	1,352	107,391	29,032	0	136,423	136
2013	763	175	2	940	57,157	33,562	55,411	146,130	146
2014	2487	32	2	2,521	135,450	2,456	66,662	204,568	205
2015	2443	25	2	2,470	118,066	1,333	76,904	196,303	196
2016	2806	0	4	2,810	118,726	0	147,380	266,106	266
2017	3228	0	0	3,228	106,356	0	0	106,356	106
Total	48,441	679	10	49,130	2,287,000	91,283	346,357	2,724,640	2,725

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

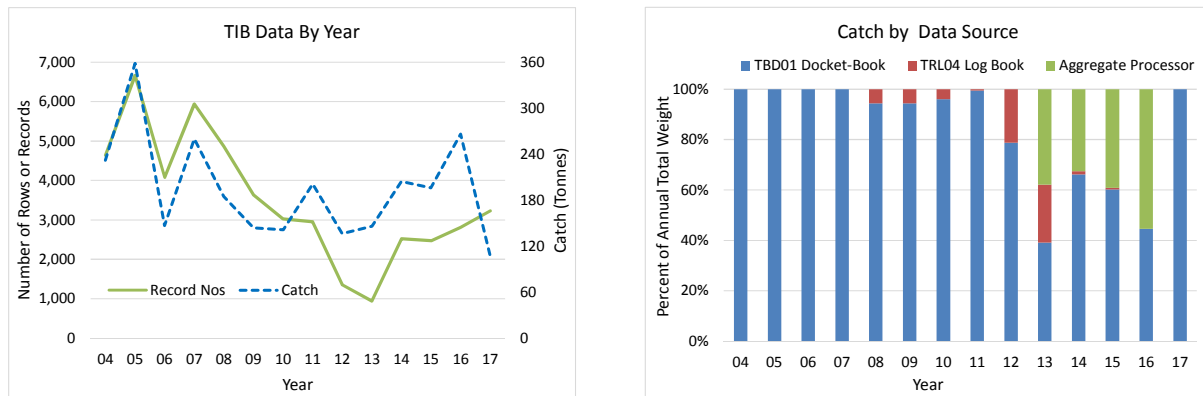


Table 1 indicates that the TIB data for 2017 is seen to be sourced entirely from the Docket-Book data (the first time since 2007). This change was the result of ongoing requests by AFMA for the Docket-Book to be used for the recording all catches. While it has been noted that a substantive portion of 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 years remains unknown.

### 3. The TIB Docket-Book Data

The number of distinct vessel-symbols and seller-names associated with the 49,130 TIB catch records identified above is 1,167 and 2,322 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 656 and 1,084 respectively. However, the percentage of all records (and total catch) without a vessel-symbol remains high at 72.3% (and 73.6% respectively). On the other hand, only 1.3% of all records (and 3.5% 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 41% of all records, and 39.5% of the total catch, are associated with hookah-diving, while free diving and lamp fishing are associated with 26% and 4.8% of the total catch respectively. Smaller amounts of the catch are also associated with the handling 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 11.8% of all catch records (and 26.2% of the total catch) remains unknown.

The distribution of all Record Nos (and catch) across each of the 21 TIB areas (shown in Figure 1) is given in Table 3. Around 42% of the records and slightly over a quarter (27.2%) of the catch have come from the Thursday Island region, with another 17.7% and 10.0% of the total catch coming from the Mabuiag and Badu regions respectively. Ten of the 21 regions each account for less than one-percent of the total catch over all years (and only 1.4% in total). However, across all records the region fished remains unknown for 7.6% of all records (and 20.7% of the total catch).

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

METHOD	N-recs	%	Catch	%
HOOKAH DIVING	20357	41.4%	1,075,159	39.5%
FREE DIVING	17380	35.4%	719,588	26.4%
UNKNOWN	5792	11.8%	714,749	26.2%
LAMP FISHING	4435	9.03%	130,658	4.80%
FREE DIVING-LAMP FISHING	371	0.76%	25,661	0.94%
FREE DIVING-HOOKAH DIVING	243	0.49%	25,262	0.93%
DIVING UNSPECIFIED	214	0.44%	15,897	0.58%
HANDLINING-FREE DIVING	141	0.29%	7,182	0.26%
HOOKAH DIVING-LAMP FISHING	31	0.06%	3,139	0.12%
TROLLING-FREE DIVING	44	0.090%	1,293	0.047%
HANDLINING	30	0.061%	812	0.030%
UNKNOWN-HOOKAH DIVING	18	0.037%	933	0.034%
FREE DIVING-HOOKAH DIVING-LAMP FISHING	11	0.022%	1,485	0.055%
HANDLINING-TROLLING-FREE DIVING	18	0.037%	561	0.021%
UNKNOWN-FREE DIVING	13	0.026%	419	0.015%
FREE DIVING-UNKNOWN	12	0.024%	659	0.024%
HOOKAH DIVING-UNKNOWN	3	0.006%	284	0.010%
UNKNOWN-LAMP FISHING	3	0.006%	49	0.002%
UNKNOWN-FREE DIVING-LAMP FISHING	3	0.006%	228	0.008%
TROLLING	3	0.006%	202	0.007%
LAMP FISHING-FREE DIVING	1	0.002%	53	0.002%
UNKNOWN-FREE DIVING-HOOKAH DIVING	1	0.002%	18	0.001%
TROLLING-DIVING UNSPECIFIED	2	0.004%	146	0.005%
HANDLINING-FREE DIVING-UNKNOWN	2	0.004%	30	0.001%
DIVING UNSPECIFIED-LAMP FISHING	1	0.002%	32	0.001%
HANDLINING-TROLLING	2	0.004%	22	0.001%
HANDLINING-DIVING UNSPECIFIED	1	0.002%	2	0.000%
ROD AND REELING-FREE DIVING	1	0.002%	30	0.001%
UNKNOWN-TROLLING-FREE DIVING	1	0.002%	74	0.003%
FREE DIVING-TROLLING	1	0.002%	13	0.000%
Total	49,135	1	2,724,640	1

The number of recorded days-fished associated with the above TIB catch records (c.f. Table 4) varies between 1 and 16 days, though is only one, two or three days for 75.6%, 6.2% and 3.1% of all catch records respectively. The days-fished remains unknown (i.e. not recorded) for 11.4% of these records (but for 26.3% of the total catch). Finally, the number of crew varies between 1 and 14 (c.f. Table 5), though is only numbers one or two for 59.1% and 26.9% of records respectively. The number of crew remains unknown for 11.8% of all records (and 28.2% of the total catch).



Figure 1. Spatial structure of the TIB data

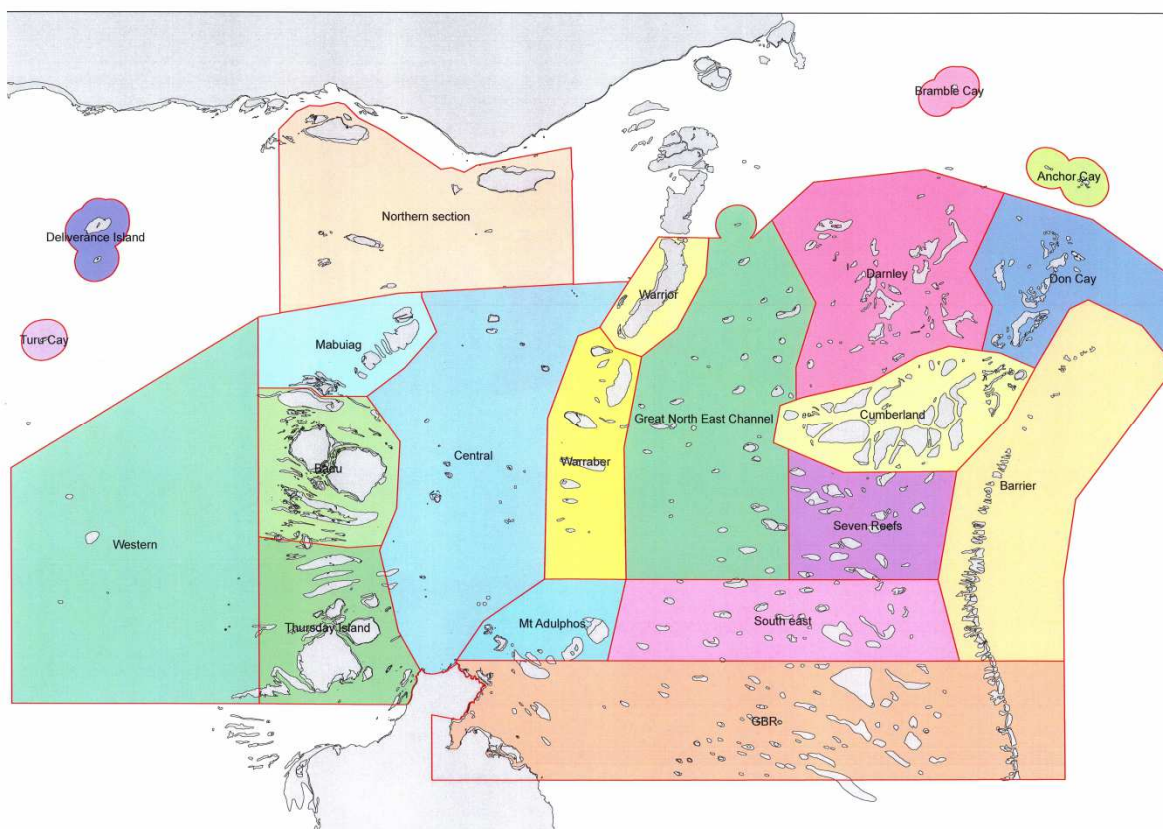


Table 3. Number of TIB records (and associated catch in kilograms) by region.

Area	Area-Name	N-recs	%	Catch	%
9	Thursday Island	20748	42.23%	741,336	27.2%
0	Unknown	3713	7.56%	563,278	20.7%
7	Mabuiag	6053	12.32%	454,694	16.7%
8	Badu	5535	11.27%	272,790	10.0%
12	Warraber	4166	8.48%	192,658	7.07%
11	Warrior	2882	5.87%	159,169	5.84%
14	Great NE Channel	1742	3.55%	96,626	3.55%
13	Mt Adolphus	682	1.39%	53,454	1.96%
17	Cumberland	782	1.59%	42,789	1.57%
16	Darnley	1217	2.5%	42,390	1.6%
10	Central	742	1.51%	38,634	1.42%
3	Northern Section	265	0.54%	27,703	1.02%
1	Turu Cay	230	0.47%	12,999	0.48%
15	South East	117	0.24%	10,897	0.40%
21	GBR	155	0.32%	10,083	0.37%
4	Bramble Cay	18	0.04%	1,470	0.05%
2	Deliverance Island	29	0.1%	1,348	0.0%
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		49,130	1	2,724,640	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	37,134	75.6%	1,371,597	50.3%
Unknown	5,591	11.4%	717,139	26.3%
2	3,052	6.2%	198,206	7.3%
3	1,502	3.1%	131,186	4.8%
4	695	1.4%	83,703	3.1%
5	553	1.1%	80,554	3.0%
6	186	0.4%	40,574	1.5%
7	174	0.4%	35,239	1.3%
8	95	0.2%	26,789	1.0%
9	69	0.1%	20,920	0.8%
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	6	0.0%	1,062	0.0%
12	8	0.0%	768	0.0%
16	3	0.0%	524	0.0%
15	2	0.0%	192	0.0%
	49,130	100.0%	2,724,640	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	29,038	59.1%	1,162,397	42.7%
Unknown	5,807	11.8%	769,655	28.2%
2	13,233	26.9%	731,346	26.8%
3	882	1.8%	46,643	1.7%
4	133	0.3%	6,655	0.2%
6	6	0.0%	3,844	0.1%
5	11	0.0%	2,492	0.1%
8	6	0.0%	1,086	0.0%
7	7	0.0%	285	0.0%
12	2	0.0%	99	0.0%
10	1	0.0%	60	0.0%
14	1	0.0%	37	0.0%
9	2	0.0%	31	0.0%
11	1	0.0%	9	0.0%
	49,130	100.0%	2,724,640	100.0%

The annual percentage of the TIB catch stratified by various levels of (a) fishing method, (b) area fished, (c) days fished and (d) number of crew are shown in Figure 3. The annual percent of blank (unknown) levels for each data field are also shown. After 2012 there was a significant increase in the proportion of the annual catch for which the information relating to these four effort variables remains unknown and this percent remains above 60% in 2016. This lack of information impedes the ability to construct indices of resource abundance that represent the distribution of lobsters across the TIB fishery based on the catch and effort data from this fishery. This is largely due to the high proportion of the total catch (>40%) in recent years which is not being recorded in the docket-books but instead is being supplied in aggregate form by processors. However, there is still room for improving the information recorded on docket-books (e.g. the fishing method was not completed for 20% of records in 2016, cf. Table 3b).

Figure 3a. Annual 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.

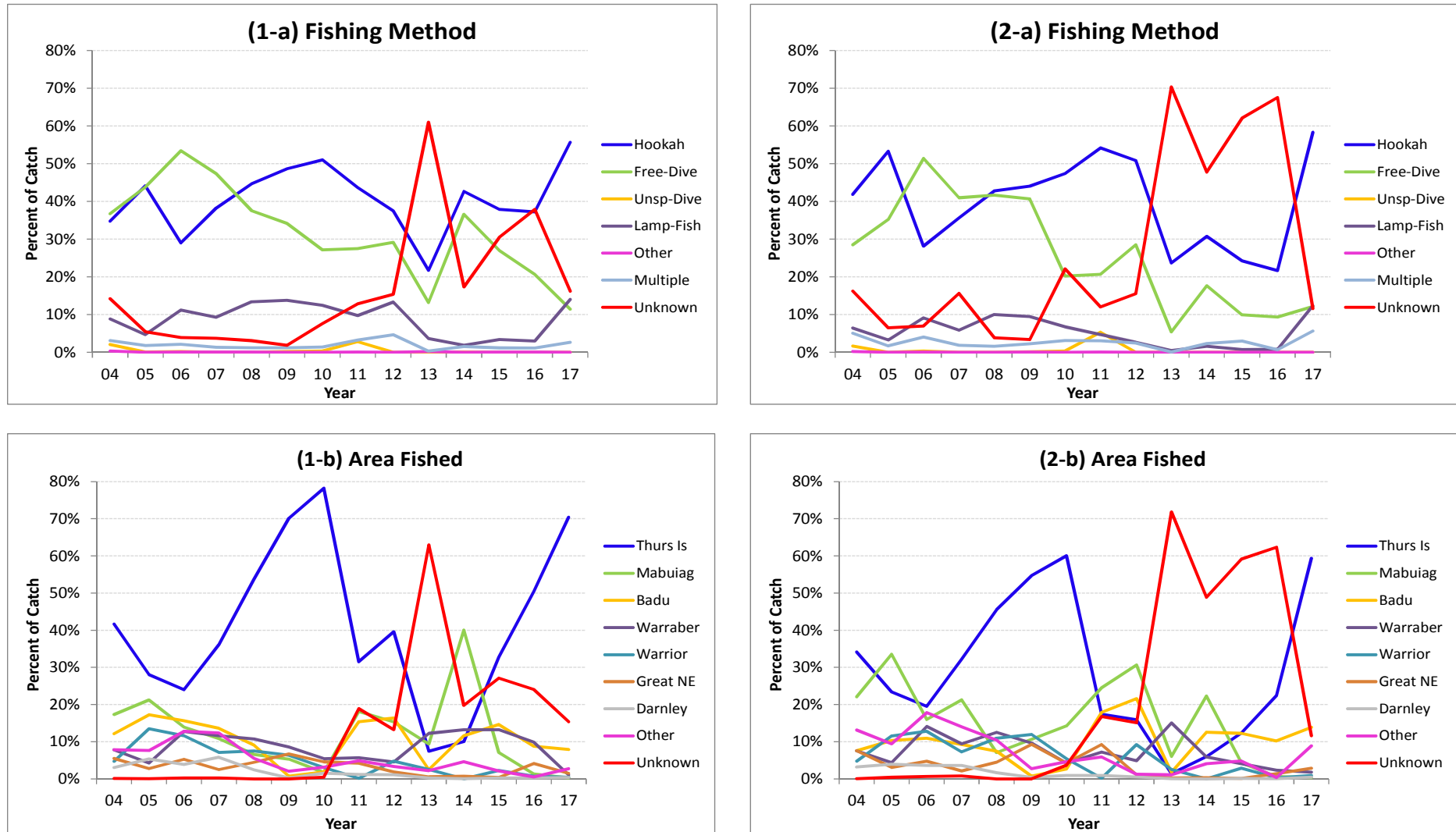
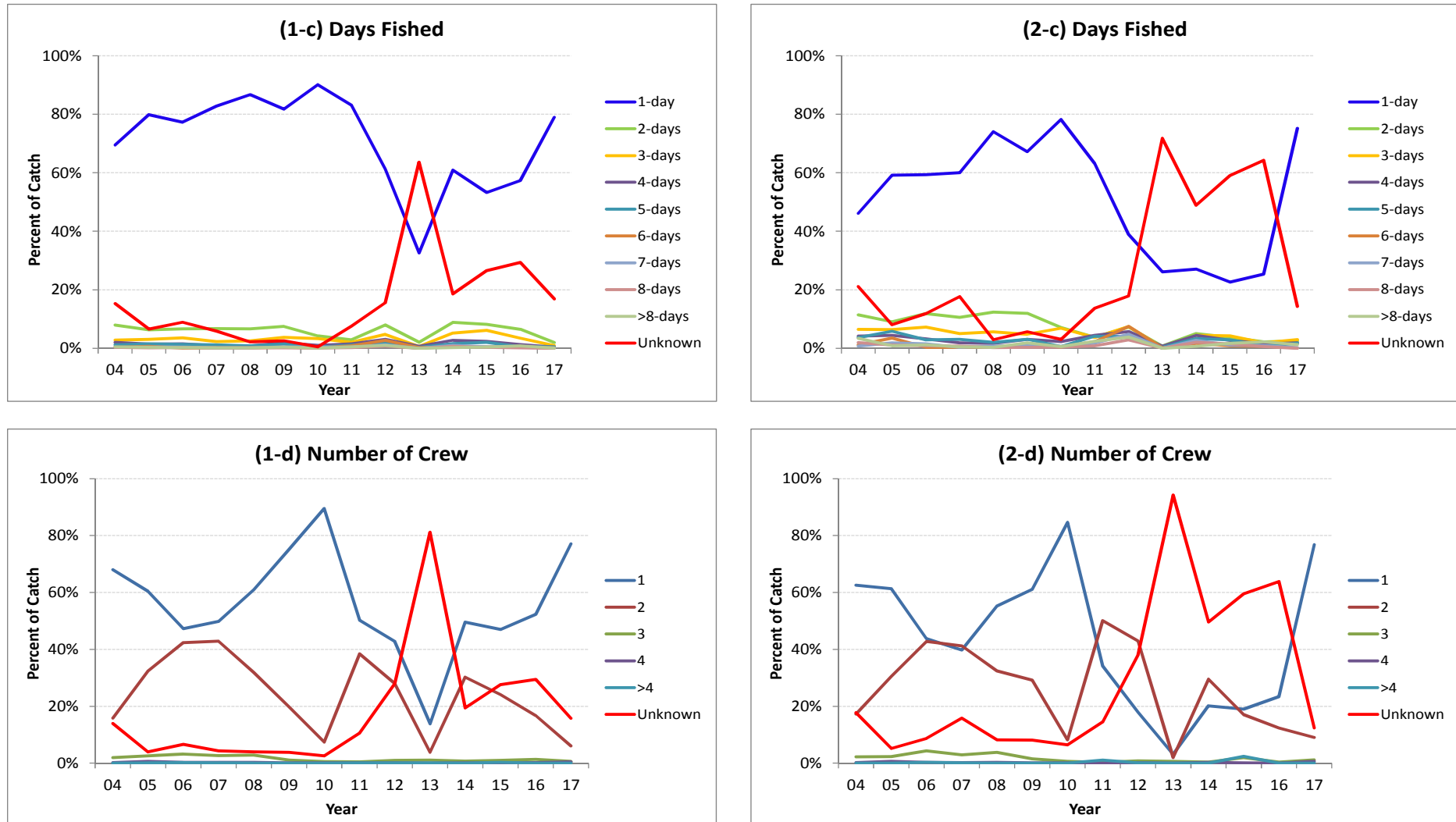


Figure 3b. Annual percent of (1) number of TIB catch records and (2) total TIB catch for the various levels of: (c) days fished and (d) number of crew. The percent of the annual catch for which each data field was not completed (and therefore remains unknown) is also shown.



### 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- Number 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. 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' or 'Free diving' were selected. This resulted in a total of 37,243 aggregate records (hence-forth known as GLM records);
3. Only those GLM records having a unique Record-No were selected for analysis – accounting for 36,123 (97.0%) 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 (1718), the area fished was not recorded (641), 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 (12);
6. Finally, the records for the year 2013 were also deleted due to the small number of records for this year (109) compared to all other years (between 681 and 5,170). 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 33,713 GLM records being created and selected.

The number of GLM records, and associated nominal CPUE, within each year, 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 year, quarter 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 three types of fishing methods were in the data. There were also 893 distinct seller-names (unknown for only 9 records) and 564 distinct vessels (but unknown for 70.7% 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 year decreasing from 3,535 between 2004 to 2010 to only 1,386 between 2011 and 2016. However, with the greater use of the Docket-Book after 2016 this situation improved substantially during 2017 when the number of records selected for the GLM analysis again exceeded 2000.

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

Year	N-Recs	CPUE
2004	3,059	33.3
2005	5,170	40.3
2006	3,017	26.6
2007	4,763	32.4
2008	3,711	31.9
2009	2,777	27.8
2010	2,247	33.4
2011	1,685	51.9
2012	681	46.9
2014	1,665	30.3
2015	1,454	25.2
2016	1,444	32.0
2017	2,040	28.0
Total	33,713	

Month	N-Recs	CPUE
1	2,179	31.6
2	4,511	38.3
3	5,502	38.2
4	4,012	37.2
5	4,034	34.9
6	3,593	34.2
7	3,421	31.8
8	2,575	30.8
9	1,789	27.5
10	37	23.8
11	6	23.7
12	2,054	27.0
Total	33,713	

Qtr	N-Recs	CPUE
1	11,639	35.5
2	7,785	30.5
3	2,097	26.9
4	12,192	37.1
Total	33,713	

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	74
2	6	20
3	6	190
4	16	14
5	16	3
6	6	15
7	7	4,667
8	8	4,733
9	9	15,074
10	10	373
11	11	2,172
12	12	2,707
13	13	475
14	14	1,343
15	15	102
16	16	912
17	17	698
18	15	8
19	16	3
20	15	10
21	15	120
Total		33,713

GLM-Area	N-Recs	CPUE
6	299	47.6
7	4,667	41.5
8	4,733	30.9
9	15,074	32.9
10	373	38.4
11	2,172	42.0
12	2,707	24.2
13	475	51.3
14	1,343	34.5
15	240	45.4
16	932	31.2
17	698	37.3
Total		33,713

%-Tails	N-Recs	CPUE
<20%	7,149	23.7
20-40%	2,705	35.2
40-60%	2,285	35.9
60-80%	2,085	38.7
>80%	19,489	37.5
Total		33,713

Method	N-Recs	CPUE
FREE	15291	31.6
HOOKAH	17830	36.7
MIXED	592	37.5
Total		33,713

Days	N-Recs	CPUE
1	28,508	34.9
2	2,422	33.3
3	1,198	29.5
4	581	30.7
5	482	30.3
6	164	36.9
7	150	28.6
8	80	36.9
9	62	33.0
10	28	22.6
11	18	27.5
12	6	10.5
13	7	18.5
14	3	8.0
15	1	5.8
16	3	10.9
Total		33,713

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 (Year, Month, Quarter, Area and Fishing-Method). As mentioned previously, the measure of effort for the TIB data is 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.

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

In order to investigate the influence of the various effects on the catch rate associated with each GLM data record, the following two models were fitted to the data records described in the previous section. All GLMs were weighted as described in Campbell (2016c).

GLM-1: Main Effects only

$$CPUE = \text{Intercept} + \text{Year} + \text{Quarter} + \text{Area} + \text{Method} + \text{Proportion-Tails} + \text{SOI}$$

/ distribution = gamma, link = log

GLM-2: Main Effects + Quarter\*Area Interaction

$$CPUE = \text{Intercept} + \text{Year} + \text{Quarter} * \text{Area} + \text{Method} + \text{Proportion-Tails} + \text{SOI}$$

/ distribution = gamma, link = log

where:

- a) *Year* has 12 levels: 2004-2012, 2014-2016 (see below)
- b) *Quarter* has 4 levels: (1) Jan-Mar, (2) Apr-Jun, (3) Jul-Sep, and (4) Oct-Dec.
- c) *Area* has the 12 levels as shown in Table 6b.
- d) *Fishing-Method* has 3 levels: (1) Hookah, (2) Free Diving, and (3) 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

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

The above models were fitted to the TIB described in the previous section with the following filters: a) the 66 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, and b) the 319 records where the catch was less than 1.0kg or greater than 300 kilograms as these could also be outliers. This left a total of 33,348 records.

Using the results from each GLM an annual abundance index was constructed based on the standardised CPUE calculated for each of the (Year, Quarter, 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 quarter is given by:

$$\text{Index}(\text{year} = y, \text{quarter}, q) = \frac{1}{\sum_{a=1}^{NA} \text{Area}_a} \sum_{a=1}^{NA} \text{Area}_a \cdot \text{stdCPUE}(y, q, a)$$

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  $NQ$  quarter indices in each year.

$$Index(year = y) = \frac{1}{NQ} \sum_{q=1}^{NQ} \left[ \frac{1}{\sum_{a=1}^{NA} Area_a} \sum_{a=1}^{NA} Area_a \cdot stdCPUE(y, q, a) \right]$$

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

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

For those models which do not included an interaction with the Year effect (i.e. models GLM-1 and GLM-2), 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  $NY$   $Year$  effects included in the model. In these situations the abundance is independent of the relative size of each  $Area$  effect included in the GLM.

No models including an interaction with the  $Year*Area$  interaction effect were fitted as there were a number of  $Year*Area$  strata having no data records (c.f. Appendix B) and construction of an abundance index from a model including a  $Year*Area$  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 one  $Year*Quarter$  strata having no data records (c.f. Appendix B), unlike previous years no models including an interaction with the  $Year*Quarter$  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 – see Campbell 2016c) and the related uncertainty noted in previous reports about the spatial size of each GLM-area.

As a sensitivity analysis several alternative model runs were conducted. First, the Seller-Name was fitted as an additional effect to the above two 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 years and for which there were 30 or more data records were included in the analyses. Second, as seen from Table B(i) in Appendix B the data coverage for many of the GLM-areas has been poor since 2012 with only four areas (GLM-areas 7, 8, 9 and 12) having a reasonable data coverage in recent years. As this poor data coverage will influence our ability to estimate representative  $Area$  effects for many areas, the analysis was repeated where the above models were fitted only to the data for GLM-areas 7 (Mabuiag), 8 (Badu), 9 (Thursday Island) and 12 (Warraber). A summary of the number of records fitted to each model is shown in Table 7.

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

(a) All Areas

Model		# Fitted Parameters	# Sellers Parameters	Records	AIC
1	Main Effects	33	0	33,348	301,262
2	Main Effects + Q.A	66	0	33,348	299,606
3	Model 1 + Seller-Name	275	242	27,828	244,847
4	Model 2 + Seller-Name	308	242	27,828	244,308

(b) Four Areas Only

Model		# Fitted Parameters	# Sellers Parameters	Records	AIC
1	Main Effects	25	0	26,896	236,191
2	Main Effects + Q.A	34	0	26,896	235,932
3	Model 1 + Seller-Name	205	180	22,344	186,547
4	Model 2 + Seller-Name	214	180	22,344	186,388

## 5. Results and Abundance Indices

### (a) Standardising Effects

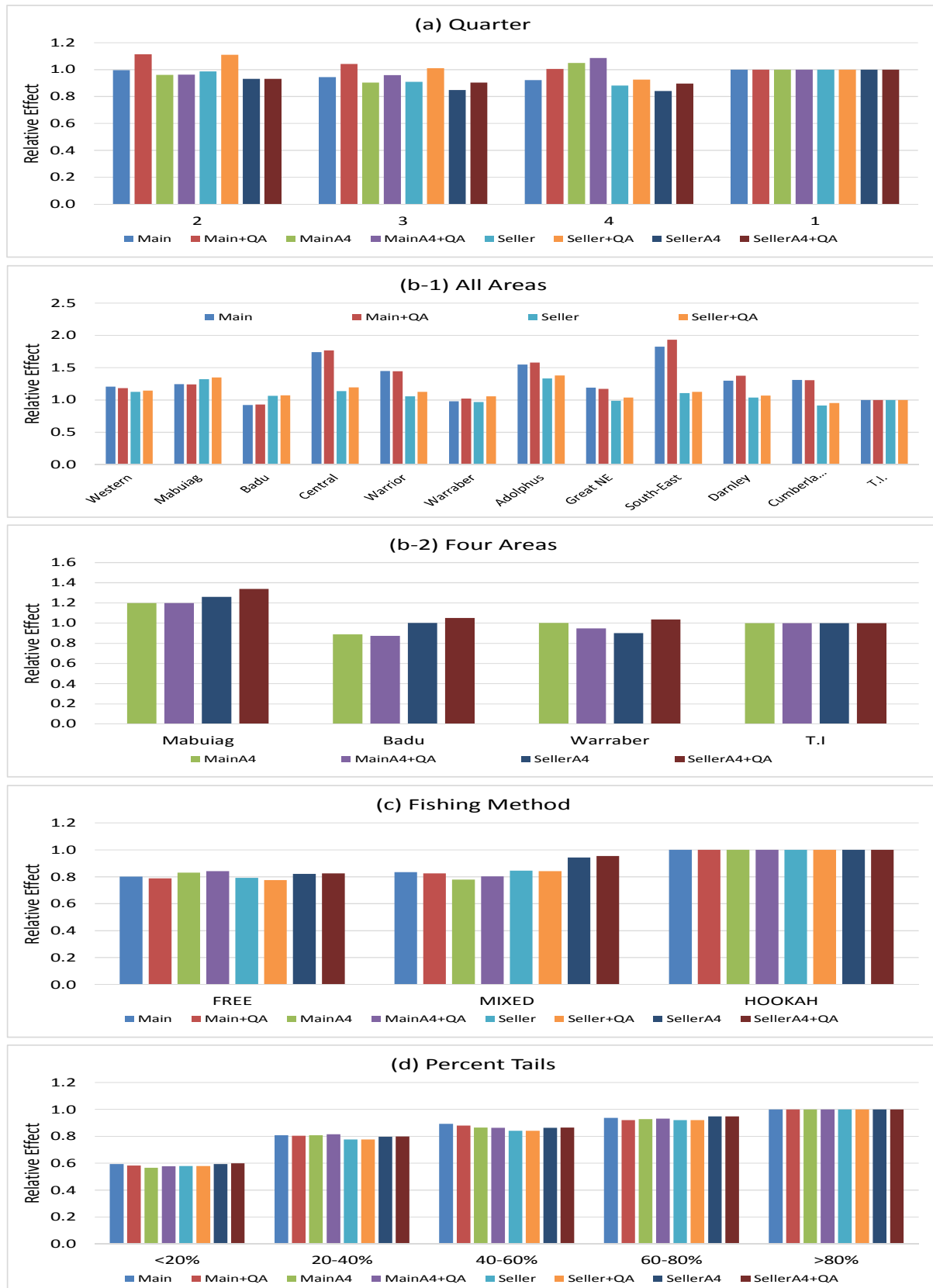
Statistics for the Type 3 contrasts computed for each fitted effect indicated that each effect was highly significant. A comparison of relative influence of each level of the *Quarter*, *Area*, *Method* and *Proportion-Tails* effects for each GLM model is shown in Figure 4. For each effect the values have been scaled so that the influence of each effect is relative to that of the last level of each effect (i.e, Qtr=1, Area=T.I., Method= Hookah and %-Tail >80%). For those models which included the *Quarter\*Area* interaction the *Quarter* and *Area* effects were determined by calculating the mean effect across all areas and quarters respectively.

Relative CPUE is similar across the four quarters of the year, though taking the average effect across the individual results for the eight models for each quarter indicates that CPUE is highest during the first and second quarters and lowest in the fourth quarter. However, this result is influenced by the variation shown between the results for those models with all 12 areas included and those limited to only four areas. For example, the second quarter has the highest relative CPUE when averaged across models with all areas included, but for those models limited to only four areas the CPUE for this quarter is 10% lower (and the first quarter has the highest relative CPUE).

Relative CPUE varies considerably between the various areas included in the GLM. There is also considerable variation in the relative effect for a particular area between the different models. For example, for the two models with all areas and no *Seller* effect the relative CPUE's vary between 188% (for South East) to 93% (for Warraber), while for the two models which include the *Seller*-effect, the relative CPUE's varies between 134% (for Mabuiag) to 94% (for Cumberland). For the four models limited to the four area effects, the relative CPUE is higher in Mabuiag for the two sets of models with and without the *Seller* effect, while there is some variation in relative CPUE for both Badu and Warraber across these models.



Figure 4. Comparison of relative influence of each level of the Quarter, Area, Method and Percent-Tails effects for each fitted model. Results are shown for both 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, Qtr=1, Area=T.I., Method= Hookah and %-Tails= '>80%').



Apart from the four area only models including a Seller effect for mixed fishing, the relative CPUE of each fishing method is similar across all models. On average the CPUE for hookah fishing is found to be around 24% higher than for free diving and 17% 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 %-tails category is 0.58, 0.80, 0.86, 0.93 and 1.00 respectively.

#### (b) Annual Abundance Indices

The relative abundance indices based on each of the eight GLM models listed in the previous section are listed and displayed in Table 8 and Figures 5&6 respectively. Relative to the nominal index, each of the standardised indices displays a number of substantive shifts, being lower than the nominal index at the start of the time-series and for 2011 and 2012 and higher than the nominal index for 2009 and 2010 and since 2014. These changes are likely due to shifts in the percentage of the catch which are processed as tailed or whole lobsters (c.f. Figure 7). There are some small differences, especially for the last year, in the relative indices between the all areas, no *Seller*-effect model with and without the *Quarter\*Area* interaction included (c.f. Figure 5a) but these differences are negligible for the other models (c.f. Figure 5b-d). There are also some differences between the models which include all 12 GLM-areas and those which only include the four selected GLM-areas, with these differences being similar across the two sets of models with and without the *Quarter\*Area* interaction included (c.f. Figure 6).

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 the models with the *Quarter\*Area* interaction included are found to provide a better fit to the data for all the four sets of models. Although 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 Models 3 and 4 (i.e. 27,828 records) that the model including the *Seller*-effect provides the better fit. Based on these observations, Model 4 is therefore seen as the preferred model. Of the two sets of models fitted to the data

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 years is equal to 1.

Year	Nominal	Main	Main+QA	Main.A4	Main.A4+QA	Seller	Seller+QA	Seller.A4	Seller.A4+QA
04	0.97	0.89	0.89	0.91	0.90	0.88	0.87	0.90	0.90
05	1.17	0.92	0.94	0.95	0.97	1.03	1.03	1.04	1.05
06	0.82	0.71	0.73	0.68	0.69	0.76	0.76	0.72	0.72
07	0.99	0.83	0.84	0.86	0.86	0.86	0.86	0.89	0.89
08	0.98	0.96	0.93	0.97	0.95	0.90	0.89	0.92	0.91
09	0.87	0.90	0.90	0.89	0.88	0.88	0.87	0.84	0.84
10	1.01	1.05	1.04	1.10	1.07	1.06	1.06	1.05	1.05
11	1.48	1.32	1.32	1.29	1.29	1.40	1.37	1.24	1.22
12	1.31	1.19	1.22	1.24	1.26	1.26	1.26	1.26	1.25
14	0.88	0.85	0.89	0.85	0.87	0.90	0.93	0.92	0.95
15	0.72	0.91	0.93	0.90	0.90	0.90	0.92	0.93	0.94
16	0.96	1.24	1.24	1.31	1.30	1.27	1.28	1.34	1.34
17	0.84	1.24	1.14	1.06	1.05	0.90	0.90	0.93	0.93
Mean	1.00	1.00	1.00	1.00	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.

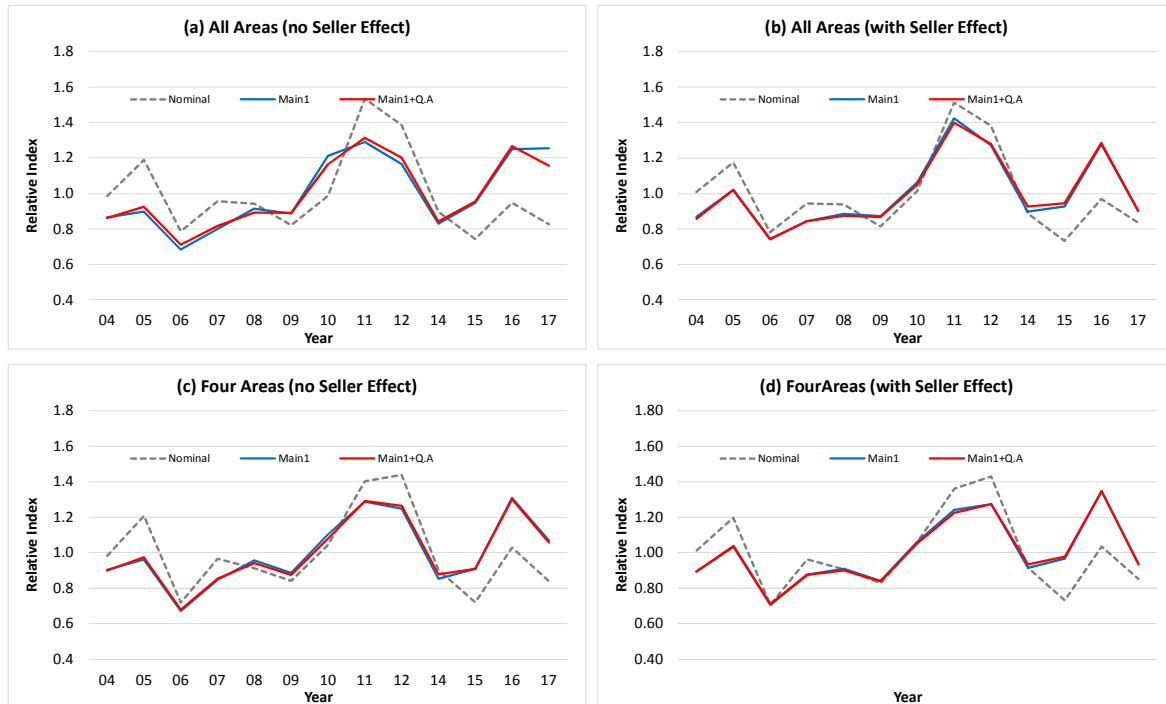


Figure 6. Comparison of the relative indices of resource availability based on (a) Main-Effects only and the (b) Main Effects + Quarter\*Area interaction models fitted to the catch and effort data for the TIB fishery.

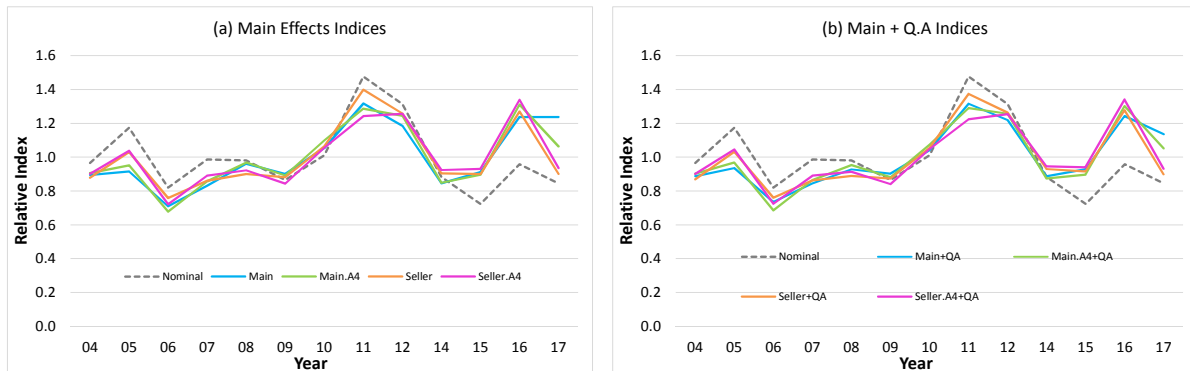
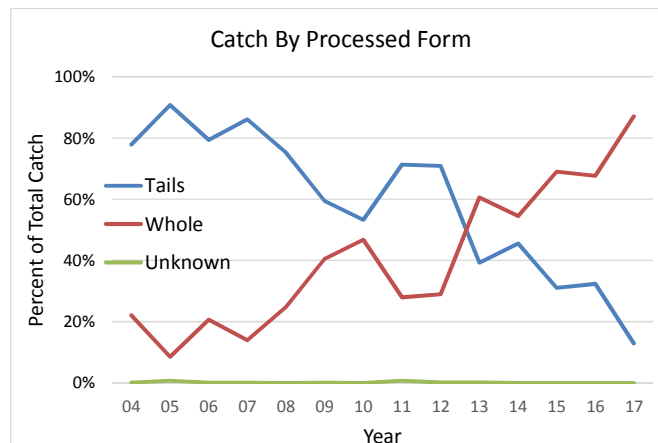


Figure 7. Percent of total annual catch (whole weight) by processed form.



for all 12 GLM-areas or just the four selected GLM-areas it can be argued that as the *Area*-effect are assumed to be the same across all years, and despite the poor data coverage in some areas in more recent years, that the latter model only provides an index across the smaller region comprising the selected four areas while the former model should provide a better index across the entire fishery.

## 5. 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,  $\rho$ , 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 years 2005, 2011 and 2016 while local minimum occur for 2006, 2009, 2015 and 2017. This similarity is also reflected in the relatively high correlation ( $\rho = 0.76$ ) between the TIB index (*seller+Q.A*) and the two TVH indices. As both the TIB and TVH fisheries are fishing the same resource, this result is not unexpected. The reasons for the flatter trend in the TIB indices remain uncertain and warrants further investigation but may be due to the more limited 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 decline in the amount of data available for analysis from the TIB fisher in more recent years, and its more limited spatial extent. due to the fact that some of the data fields in the docket-book were not completed and that a large proportion (>40%) of the data was not recorded on the docket-book.

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

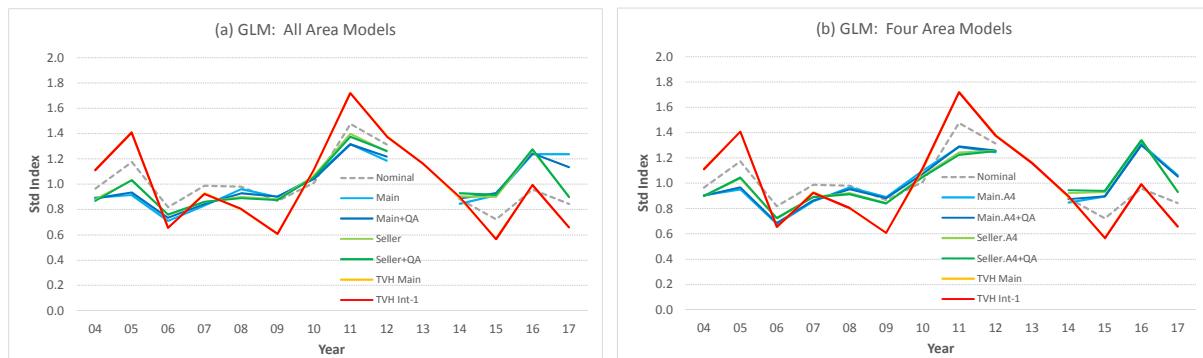


Table 9. Pearson correlation between the various TIB and TVH-based indices.

Model	All Areas		Four Areas	
	TVH-Main	TVH-Int1	TVH-Main	TVH-Int1
Main	0.49	0.49	0.61	0.61
Main+QA	0.57	0.57	0.64	0.64
Seller	0.78	0.78	0.68	0.69
Seller+QA	0.76	0.76	0.68	0.68

## 6. 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 et al, 2017). 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.


Finally, it has been noted that either the Docket-Book or many of the fields in the Docket-Book were not completed in recent years, though there were improvements in 2017. 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.

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- 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., 2014. Use of TIB Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2014. Information paper presented to the 13<sup>th</sup> meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 27-28 August 2014, Brisbane.
- Campbell, R.A., Dennis, D., Plaganyi, E., Deng, R., 2015. Use of TIB Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2015 Update. Information paper presented to the 14<sup>th</sup> meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 25-26 August 2015, Thursday Island.

- Campbell, R.A, Dennis, D., Plaganyi, E., Deng, R., 2016. Use of TIB Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2016 Update. Information paper presented to the 19<sup>th</sup> meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 13 December 2016, 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 21<sup>st</sup> meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12-13 December 2017, Cairns.
- Campbell, R.A, Plaganyi, E., Deng, R., 2017. Use of TVH Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2017 Update. Information paper to be presented to the 21<sup>st</sup> meeting of the Torres Strait Rock Lobster Resource Assessment Group, held 12-13 December 2017, Cairns.

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

<b>Torres Strait Seafood Buyers and Processors Docket Book</b>  <b>RECIPIENT CREATED TAX INVOICE</b>		<b>FOR Name:</b> ..... <b>Address:</b> ..... <b>A.B.N.:</b> ..... <b>Lic. No.</b> .....				
<b>Seller:</b>		<b>Book No.</b>		<b>Page No.</b>		
<b>Seller's ABN:</b>		<b>Seller's Licence No.</b>				
<b>Seller's Address:</b>				<b>Date:</b>		
<b>Fishing effort and boat details – Traditional Inhabitant Boat (TIB) only</b>						
<b>Boat symbol:</b>		<b>No. of divers/fishers:</b>				
<b>Days fishing:</b>		<b>Area fished:</b>		From map (write no. of area most fished)		
<b>Methods used:</b> (tick box, use more than one if needed) <input type="checkbox"/> Hookah (MDH) <input type="checkbox"/> Handline (LHL) <input type="checkbox"/> Drop line (LDR) <input type="checkbox"/> Free dive (MDF) <input type="checkbox"/> Rod and reel (LRR) <input type="checkbox"/> Other—specify _____ <input type="checkbox"/> Lamp fishing (MLF) <input type="checkbox"/> Troll (LTL)						
<b>Non Traditional Inhabitant Boat (TIB) fishers &amp; buyers of PNG &amp; east coast product only</b>						
<b>Region Fished:</b> (tick box) <input type="checkbox"/> Torres Strait <input type="checkbox"/> East Coast Queensland <input type="checkbox"/> Papua New Guinea						
<b>Has the seller recorded their catches elsewhere?:</b> (tick box) <input type="checkbox"/> YES (please indicate) → <input type="checkbox"/> TRL04 Logbook <input type="checkbox"/> No <input type="checkbox"/> TSF01 Logbook <input type="checkbox"/> Other → _____						
<b>Details of catch being sold</b>						
Species	Processing Code	Grade	Kg	\$/Kg	\$/Kg	Amount
<b>Completed by:</b>				<b>Subtotal</b>		
<b>Signature:</b>				<b>GST</b>		
<b>Payment received:</b>				<b>TOTAL</b>		
Australian Fisheries Management Authority PO Box 376 Thursday Island QLD 4875			<b>For assistance</b> Phone: (07) 4069 1990 Fax: (07) 4069 1277		WHITE COPY: <b>Fisher</b> (seller) YELLOW COPY: <b>AFMA</b> PINK COPY: <b>Buyer</b> (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.

<p><small>Australian Fisheries Management Authority Box 7051 Canberra Mail Centre ACT 2610</small></p>	<table border="1" style="margin: 0 auto;"> <tr> <td style="padding: 2px;">CDR No.</td> <td style="padding: 2px; color: red;">40</td> <td style="padding: 2px;">Page No.</td> <td style="padding: 2px; color: red;">34</td> </tr> </table> <h3 style="margin: 5px 0;">Torres Strait Catch Disposal Record TDB02</h3>	CDR No.	40	Page No.	34
CDR No.	40	Page No.	34		

**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 Year\*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 10 or greater.

(a) Number of TIB RECORDS

Area	Year														Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
6	39	33	63	47	7	6	4	12	5	0	57	20	1	5	299
7	637	1104	424	463	260	110	16	428	169	43	869	158	22	7	4710
8	440	986	569	710	389	23	50	362	191	18	277	350	218	168	4751
9	1338	1413	619	1683	2031	1991	1841	592	271	30	131	562	862	1740	15104
10	38	107	46	67	10	8	10	14	3	0	26	11	2	31	373
11	76	737	383	401	305	174	12	3	0	0	0	52	17	12	2172
12	137	165	338	525	281	213	124	92	19	15	284	283	226	20	2722
13	76	64	99	93	18	11	42	55	2	1	2	5	3	5	476
14	145	139	181	119	181	212	104	94	14	1	18	7	88	41	1344
15	14	38	26	90	40	26	2	1	0	0	0	2	1	0	240
16	93	254	120	287	78	3	41	32	7	1	0	4	3	10	933
17	26	130	149	278	111	0	1	0	0	0	1	0	1	1	698
Total	3059	5170	3017	4763	3711	2777	2247	1685	681	109	1665	1454	1444	2040	33822

(b) Total Number of DAYS FISHED

AREA	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
6	99	39	84	78	10	7	6	14	6	0	110	52	1	11	517
7	828	2014	732	663	308	423	44	658	594	43	1100	223	24	27	7681
8	478	1018	601	757	451	28	66	631	617	42	834	966	700	278	7467
9	1486	1540	662	1928	2118	2044	1969	602	282	30	132	570	870	1758	15991
10	99	138	56	71	10	8	15	14	3	0	53	33	3	48	551
11	102	767	423	498	384	233	12	5	0	0	0	111	19	35	2589
12	394	410	646	714	474	404	244	103	20	43	556	546	423	27	5004
13	167	125	147	148	44	18	98	64	2	1	2	6	3	9	834
14	401	296	241	151	253	687	198	117	18	1	22	12	199	73	2669
15	65	67	46	128	75	30	4	1	0	0	0	5	1	0	422
16	123	318	129	290	79	3	45	33	11	1	0	5	3	11	1051
17	41	200	217	393	188	0	1	0	0	0	1	0	1	1	1043
Total	4283	6932	3984	5819	4394	3885	2702	2242	1553	161	2810	2529	2247	2278	45819

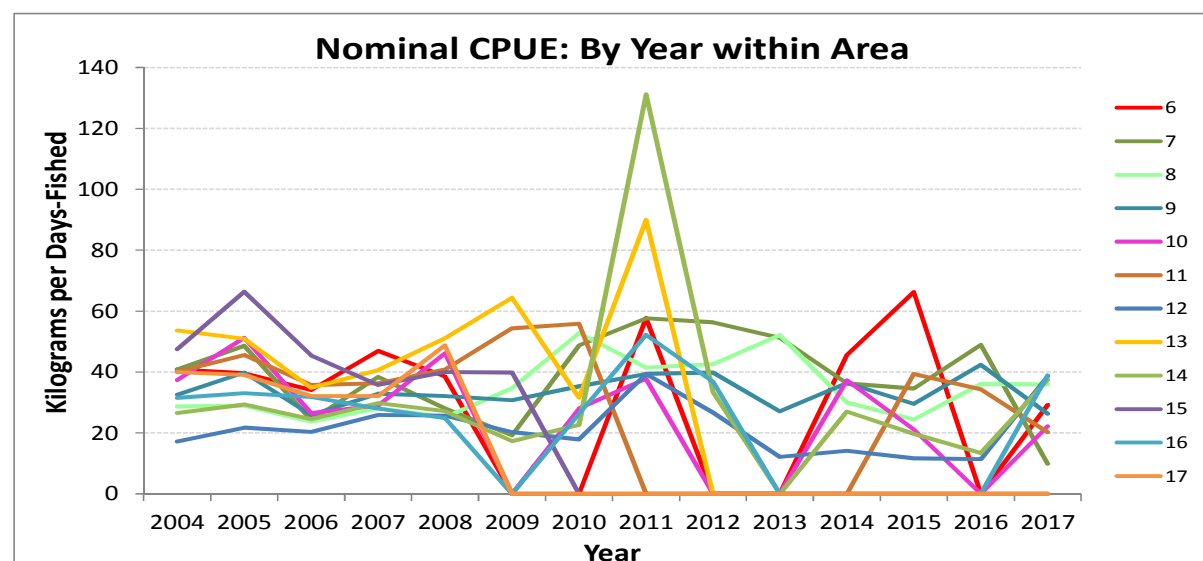
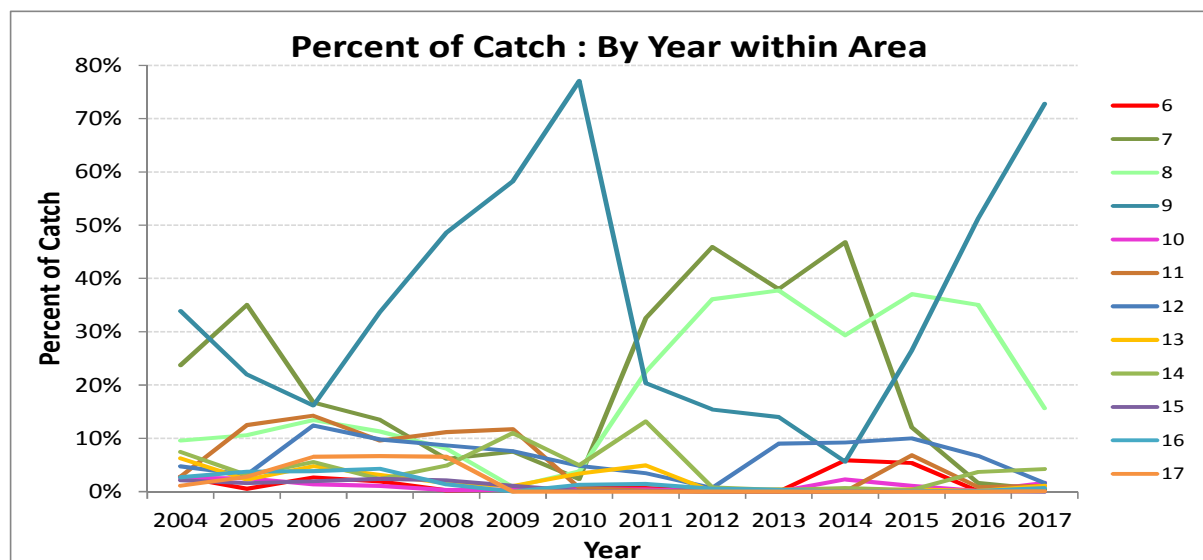
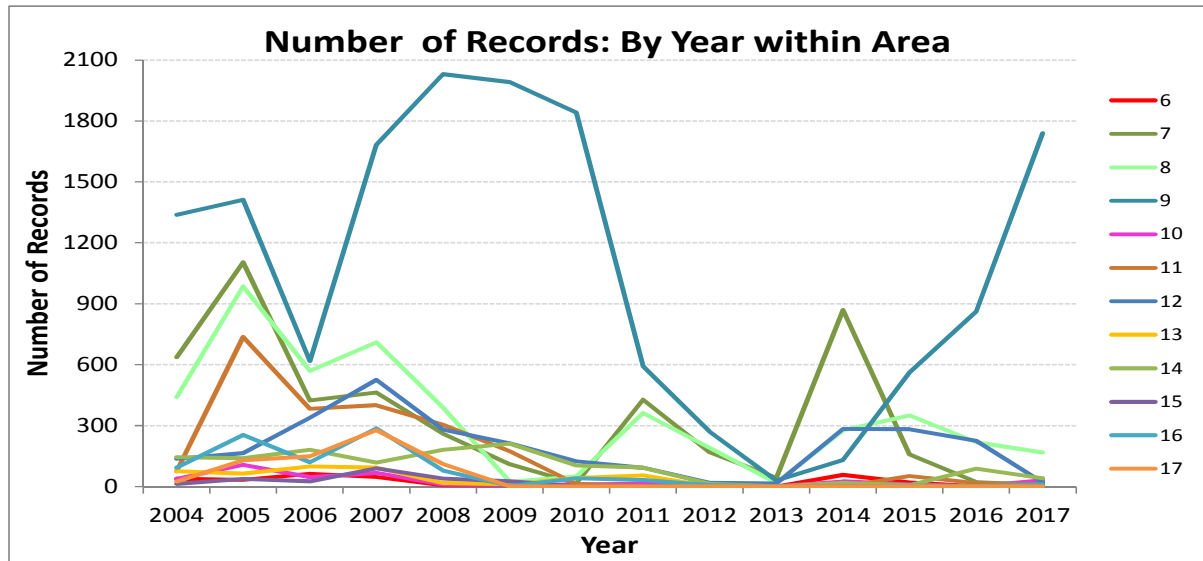
(c) Total CATCH WEIGHT

AREA	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
6	4043	1545	2863	3658	386	429	676	808	181	0	5016	3445	99	321	23469
7	33864	97824	17737	25445	8656	8118	2144	37908	33448	2205	39934	7709	1175	267	316433
8	13713	29529	14260	21289	11355	970	3485	26147	26308	2190	25039	23625	25227	9997	233134
9	48407	61355	17163	63511	68070	62857	69541	23735	11244	813	4805	16842	36914	46393	531651
10	3701	7067	1483	2065	462	411	420	529	62	0	1976	696	119	1067	20057
11	4097	34985	15125	18093	15660	12663	671	285	0	0	0	4371	652	708	107310
12	6806	8930	13181	18527	12170	8212	4374	4049	535	522	7866	6376	4836	1042	97427
13	8951	6365	5118	6017	2246	1159	3098	5756	70	27	31	316	126	722	40002
14	10651	8680	5915	4501	6865	11887	4479	15347	602	19	595	237	2683	2734	75193
15	3086	4447	2092	4577	2998	1196	143	135	0	0	0	27	54	0	18755
16	3877	10516	4103	8130	1969	66	1182	1723	405	22	0	89	89	428	32603
17	1641	7816	6970	12636	9166	0	31	0	0	0	20	0	15	62	38358
Total	142837	279059	106010	188449	140003	107968	90244	116422	72855	5798	85282	63733	71989	63741	1534392

(d) Nominal CPUE

AREA	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
6	40.8	39.6	34.1	46.9	38.6			57.7			45.6	66.3		29.2	45.4
7	40.9	48.6	24.2	38.4	28.1	19.2	48.7	57.6	56.3	51.3	36.3	34.6	49.0	9.9	41.2
8	28.7	29.0	23.7	28.1	25.2	34.6	52.8	41.4	42.6	52.1	30.0	24.5	36.0	36.0	31.2
9	32.6	39.8	25.9	32.9	32.1	30.8	35.3	39.4	39.9	27.1	36.4	29.5	42.4	26.4	33.2
10	37.4	51.2	26.5	29.1	46.2		28.0	37.8			37.3	21.1		22.2	36.4
11	40.2	45.6	35.8	36.3	40.8	54.3	55.9					39.4	34.3	20.2	41.4
12	17.3	21.8	20.4	25.9	25.7	20.3	17.9	39.3	26.8	12.1	14.1	11.7	11.4	38.6	19.5
13	53.6	50.9	34.8	40.7	51.0	64.4	31.6	89.9							48.0
14	26.6	29.3	24.5	29.8	27.1	17.3	22.6	131.2	33.4		27.0	19.8	13.5	37.5	28.2
15	47.5	66.4	45.5	35.8	40.0	39.9									44.4
16	31.5	33.1	31.8	28.0	24.9		26.3	52.2	36.8					38.9	31.0
17	40.0	39.1	32.1	32.2	48.8										36.8
SUM	33.3	40.3	26.6	32.4	31.9	27.8	33.4	51.9	46.9	36.0	30.3	25.2	32.0	28.0	33.5

Appendix B (i). Number of GLM data records, percent of catch, and associated CPUE in each Year\*Area strata. Note, nominal CPUE is only shown for strata where the number of the days fished is 10 or greater.



Appendix B (ii). Number of GLM data records, total number of days fished, total catch weight, and associated CPUE in each Year\*Quarter 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 10 or greater.

(a) Number of TIB RECORDS

Qtr	Year														Total
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
1	913	1434	1264	1833	1597	971	855	820	359	6	449	554	517	626	12198
2	921	2155	1014	1730	1220	1005	793	446	222	13	427	494	452	760	11652
3	835	1353	383	961	763	639	519	296	93	17	523	325	446	649	7802
4	390	228	356	239	131	162	80	123	7	73	266	81	29	5	2170
Total	3059	5170	3017	4763	3711	2777	2247	1685	681	109	1665	1454	1444	2040	33822

(b) Total Number of DAYS\_FISHED

Qtr	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
1	1050	1876	1538	2226	1707	1269	941	847	781	6	860	923	917	723	15664
2	1482	2919	1440	2126	1450	1359	925	801	619	14	860	879	725	824	16423
3	1287	1844	573	1186	1079	1035	740	461	146	17	706	579	573	726	10952
4	464	293	433	281	158	222	96	133	7	124	384	148	32	5	2780
Total	4283	6932	3984	5819	4394	3885	2702	2242	1553	161	2810	2529	2247	2278	45819

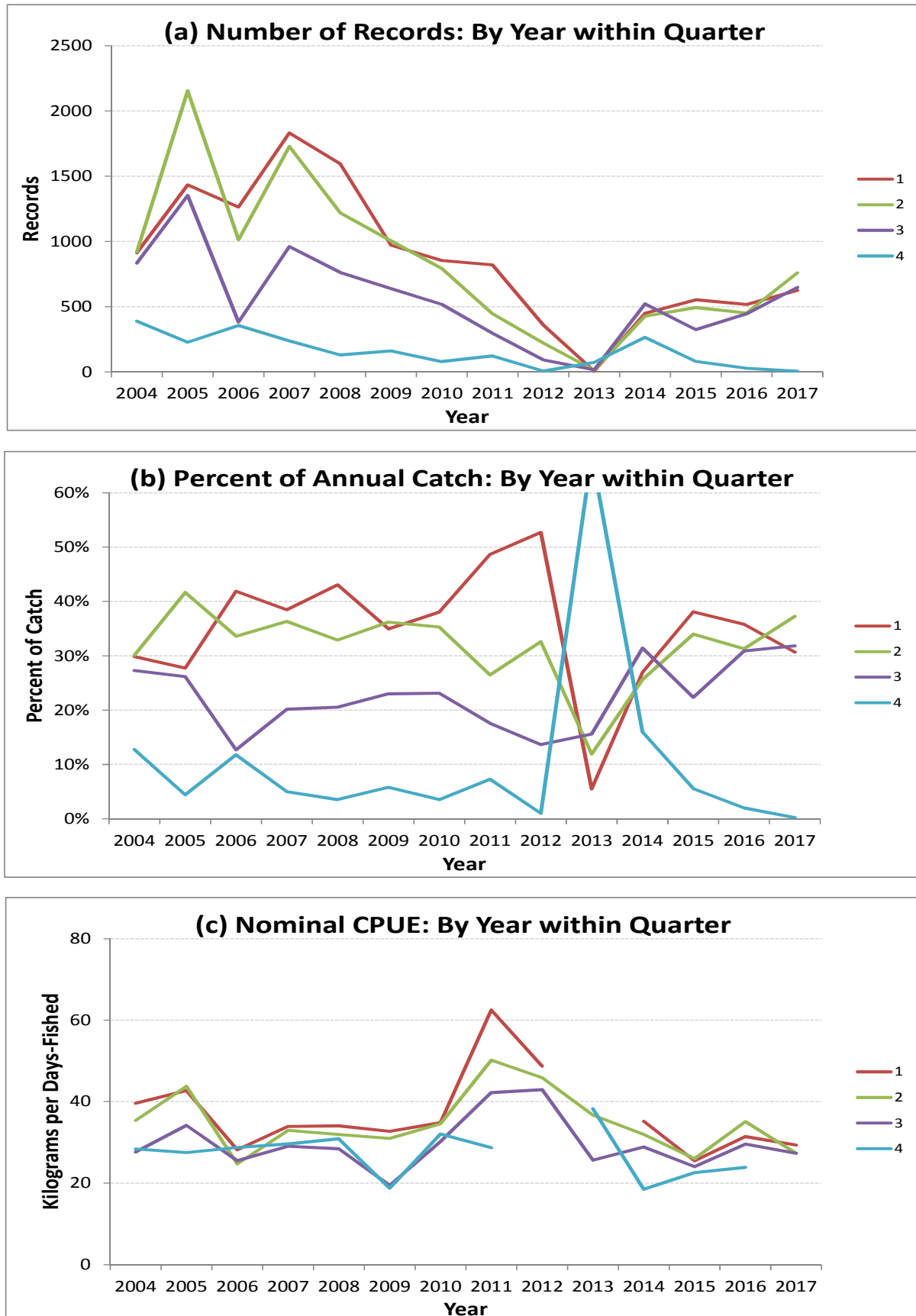
(c) Total CATCH\_WEIGHT

Qtr	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
1	41607	80138	43333	75577	58120	41536	32806	52929	38072	104	30268	23573	28812	21215	568090
2	52472	127796	35584	70084	46316	42089	31993	40209	28419	514	27509	22870	25455	22541	573851
3	35581	63063	14632	34454	30685	20173	22365	19466	6271	436	20397	13942	16956	19861	318281
4	13178	8064	12461	8336	4881	4170	3079	3817	92	4744	7109	3348	765	124	74169
Total	142838	279061	106010	188451	140002	107968	90243	116421	72854	5798	85283	63733	71988	63741	1534391

(d) Nominal CPUE

Qtr	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
1	39.6	42.7	28.2	34.0	34.0	32.7	34.9	62.5	48.7		35.2	25.5	31.4	29.3	36.3
2	35.4	43.8	24.7	33.0	31.9	31.0	34.6	50.2	45.9	36.7	32.0	26.0	35.1	27.4	34.9
3	27.6	34.2	25.5	29.1	28.4	19.5	30.2	42.2	43.0	25.6	28.9	24.1	29.6	27.4	29.1
4	28.4	27.5	28.8	29.7	30.9	18.8	32.1	28.7		38.3	18.5	22.6	23.9		26.7
Total	33.3	40.3	26.6	32.4	31.9	27.8	33.4	51.9	46.9	36.0	30.3	25.2	32.0	28.0	33.5

Appendix B (ii). Number of GLM data records, percent of catch, and associated nominal CPUE in each Year\*Quarter strata. Note, nominal CPUE is only shown for strata where the number of the days fished is 10 or greater.



Appendix B (iii). Number of GLM data records, total number of days fished, total catch weight, and associated CPUE in each Area\*Quarter 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 10 or greater.

(a) Number of TIB RECORDS

AREA	Q-1	Q-2	Q-3	Q-4	Total
6	108	110	68	13	299
7	2068	1254	1016	372	4710
8	2052	1593	822	284	4751
9	5084	5587	3761	672	15104
10	146	116	79	32	373
11	834	640	408	290	2172
12	789	983	679	271	2722
13	113	213	132	18	476
14	354	524	403	63	1344
15	85	90	56	9	240
16	353	276	198	106	933
17	212	266	180	40	698
Total	12198	11652	7802	2170	33822

(b) Total Number of DAYS FISHED

AREA	Q-1	Q-2	Q-3	Q-4	Total
6	218	167	110	22	517
7	3077	2453	1707	444	7681
8	3007	2698	1334	428	7467
9	5284	5963	4023	721	15991
10	180	198	131	42	551
11	991	753	478	367	2589
12	1275	1937	1382	410	5004
13	155	372	268	39	834
14	673	991	881	124	2669
15	126	170	114	12	422
16	383	325	223	120	1051
17	295	396	301	51	1043
Total	15664	16423	10952	2780	45819

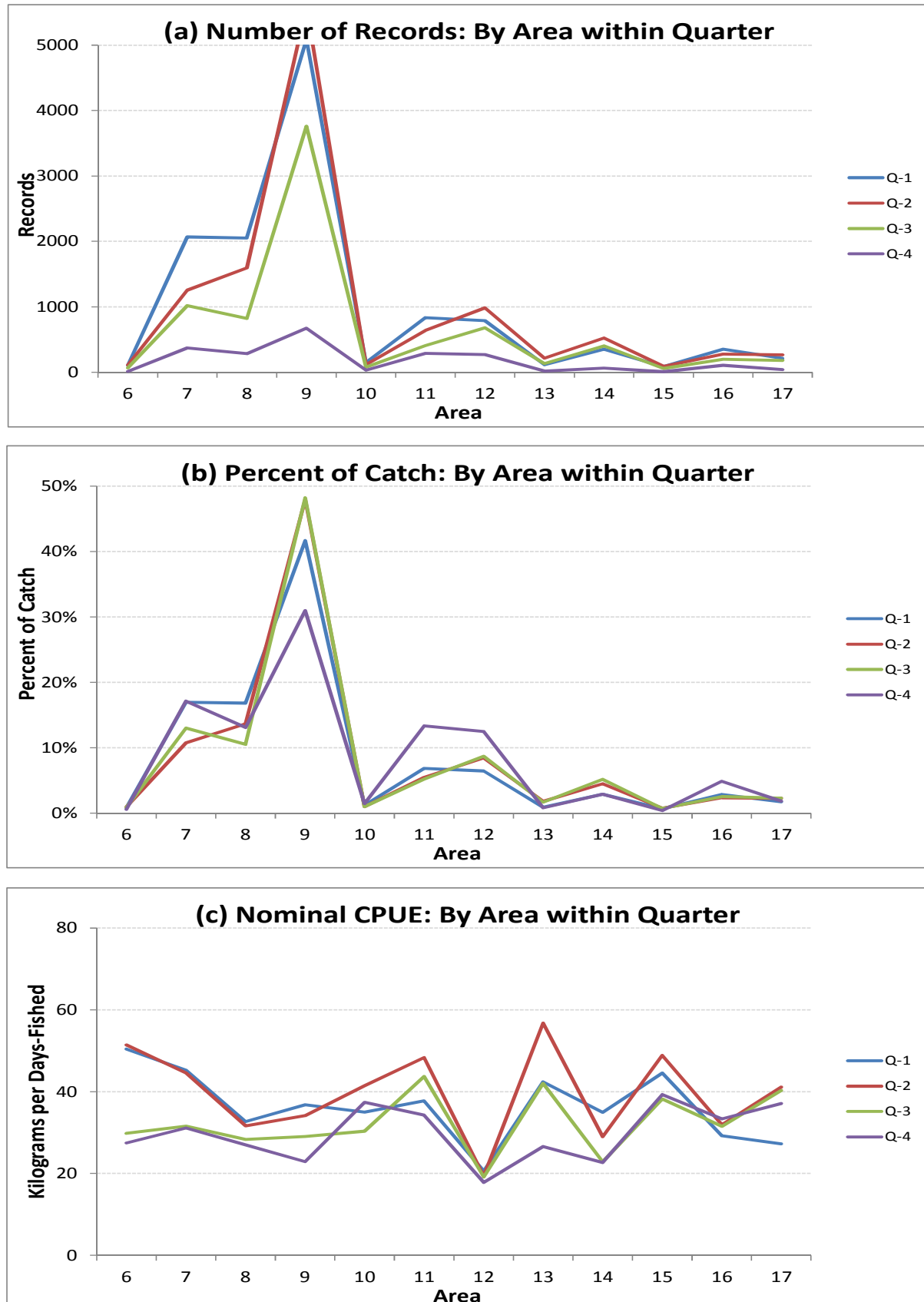
(c) Total CATCH WEIGHT

AREA	Q-1	Q-2	Q-3	Q-4	Total
6	10998	8589	3278	604	23469
7	139312	109367	53933	13820	316433
8	98373	85424	37781	11556	233134
9	194498	203631	117003	16518	531651
10	6304	8207	3975	1570	20057
11	37419	36412	20904	12574	107310
12	26230	37408	26484	7305	97427
13	6576	21126	11263	1037	40002
14	23532	28709	20136	2816	75193
15	5612	8313	4358	472	18755
16	11193	10374	7033	4003	32603
17	8043	16289	12133	1892	38358
Total	568090	573849	318281	74167	1534392

(d) Nominal CPUE

AREA	Q-1	Q-2	Q-3	Q-4	Total
6	50.4	51.4	29.8	27.5	45.4
7	45.3	44.6	31.6	31.1	41.2
8	32.7	31.7	28.3	27.0	31.2
9	36.8	34.1	29.1	22.9	33.2
10	35.0	41.4	30.3	37.4	36.4
11	37.8	48.4	43.7	34.3	41.4
12	20.6	19.3	19.2	17.8	19.5
13	42.4	56.8	42.0	26.6	48.0
14	35.0	29.0	22.9	22.7	28.2
15	44.5	48.9	38.2	39.3	44.4
16	29.2	31.9	31.5	33.4	31.0
17	27.3	41.1	40.3	37.1	36.8
Total	36.3	34.9	29.1	26.7	33.5

Appendix B (iii). Number of GLM data records, percent of catch, and associated CPUE in each Area\*Quarter strata. Note, nominal CPUE is only shown for strata where the number of the days fished is 10 or greater.



# Use of TVH Logbook Data to construct an Annual Abundance Index for Torres Strait Rock Lobster – 2017 Update

*Robert Campbell, Eva Plaganyi, Roy Deng*

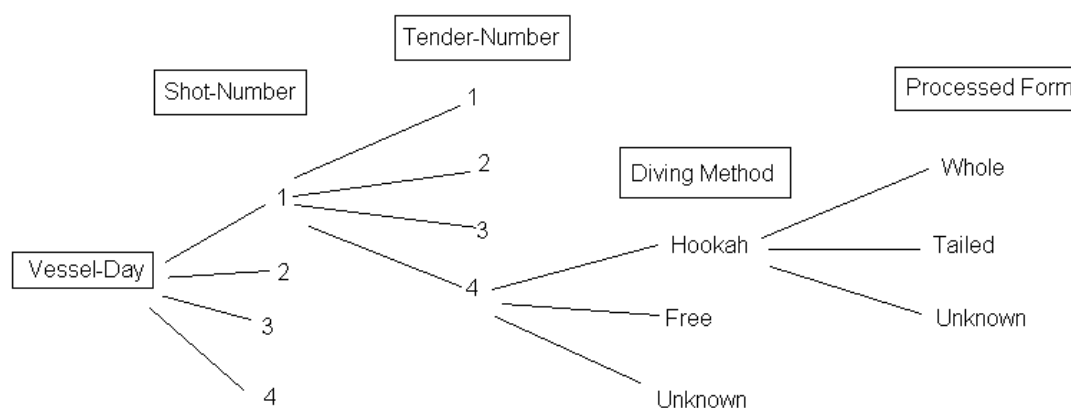
CSIRO Oceans and Atmosphere Flagship

December 2017

## 1. TVH Data

Logbook data obtained from AFMA consists of 96,215 individual catch records for the TVH rock-lobster fishery for the 24 years from 1994 to 2017. 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 68,777 records.

Figure 1. Structure of the TVH data



The distribution of these 68,777 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
Total	2,171	7,698	8,944	7,816	8,982	8,542	8,277	8,162	5,665	30	83	2,407	68,777

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

Diving Method			Total Records	Catch by Processed State (kg)			Total Catch		
Hookah	Free	Unknown		Tails	Whole	Unknown		%Tails	%Whole
1,505	136	804	2,445	123,006	0	0	123,006	100.0%	0.0%
947	59	629	1,635	100,407	635	0	101,042	99.4%	0.6%
1,609	87	1,851	3,547	219,045	7,810	0	226,855	96.6%	3.4%
1,890	112	2,009	4,011	273,151	1,880	8	275,040	99.3%	0.7%
2,681	169	2,331	5,181	310,635	18,922	0	329,556	94.3%	5.7%
1,412	38	365	1,815	88,416	6,681	0	95,097	93.0%	7.0%
2,330	114	267	2,711	118,824	10,038	0	128,862	92.2%	7.8%
812	26	1,047	1,885	66,347	2,729	0	69,076	96.0%	4.0%
1,721	10	1,380	3,111	108,216	39,471	0	147,687	73.3%	26.7%
3,958	104	100	4,162	255,447	105,964	0	361,411	70.7%	29.3%
5,045	154	1	5,200	317,467	163,651	0	481,118	66.0%	34.0%
4,101	199	2	4,302	484,497	60,480	0	544,977	88.9%	11.1%
2,307	119	2	2,428	108,909	26,539	0	135,448	80.4%	19.6%
2,829	39	1	2,869	207,463	61,133	0	268,596	77.2%	22.8%
1,205	6	0	1,211	63,378	37,060	0	100,438	63.1%	36.9%
1,281	27	0	1,308	51,322	39,729	10	91,061	56.4%	43.6%
2,356	12	0	2,368	67,817	214,797	0	282,614	24.0%	76.0%
2,668	1	1	2,670	171,469	332,064	0	503,533	34.1%	65.9%
2,311	0	0	2,311	65,282	305,198	2	370,482	17.6%	82.4%
3,006	2	0	3,008	61,631	300,030	0	361,661	17.0%	83.0%
2,910	0	0	2,910	42,105	230,961	120	273,186	15.4%	84.5%
2,682	1	0	2,683	22,479	130,231	0	152,709	14.7%	85.3%
2,642	21	0	2,663	42,714	200,986	0	243,700	14.7%	85.3%
2,340	3	0	2,343	23,885	125,163	0	149,048	16.0%	84.0%
56,548	1,439	10,790	68,777	3,393,912	2,422,152	140	5,816,203	58.4%	41.6%



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

	Northern		Mabuag	Badu	Thurs Is.	Central	Warrior	Warraber	Kirkaldie	Adolphus	East TS	East TS	GBR	East Coast	
YEAR	A101	A102	A103	A104	A105	A106	A107	A108	A109	A201	A202	A401	A0	A-99	TOTAL
1994	51	257		11	119	252	926	64	89	106	177	1		392	2445
1995	106	289	2	41	83	187	487	111	26	36	32	4	8	223	1635
1996	620	1152	2	11	51	269	719	41	37	1	32		4	608	3547
1997	425	1324	21	21	73	524	881	4	21	52	33	2		630	4011
1998	463	1681	51	130	107	661	1042	160	16	31	45			794	5181
1999	158	457	34	33	66	254	348	177	17	14	30	15		212	1815
2000	137	252	66	48	51	825	605	229	59	7	22	35	5	370	2711
2001	42	70	5	44	26	712	366	83	40	3	41	44	4	405	1885
2002	107	278	18	176	44	692	592	718	48		17	16	4	401	3111
2003	808	719	115	317	344	404	432	832	96	7	49	3	3	33	4162
2004	921	766	209	163	551	344	980	970	205	11	58	4	9	9	5200
2005	682	588	164	196	164	203	511	1680	90	3	18	1	2		4302
2006	301	332	21	130	187	300	440	355	276	34	48	4			2428
2007	362	417	42	146	134	323	367	980	62	10	24	2			2869
2008	227	63	6	91	53	238	240	206	48	2	31	3	1	2	1211
2009	272	42	5	80	145	371	231	47	26	23	59	7			1308
2010	493	138	101	102	31	197	206	997	43	12	32	14	2		2368
2011	389	111	34	83	17	159	430	1406	25		14		2		2670
2012	417	217		14	46	155	1166	267	18	5	5	1			2311
2013	719	239	34	16	63	168	469	1267	6	6	21				3008
2014	777	263	15	27	165	268	786	445	47	14	93		10		2910
2015	176	173	45	5	116	876	660	486	25		121				2683
2016	72	12	62	7	202	681	454	950	18	131	60		14		2663
2017	727	108	9	43	67	401	461	422	15		74		11		2343
Total	9,452	9,948	1,061	1,935	2,905	9,464	13,799	12,897	1,353	508	1,136	156	79	4,079	68,777

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).

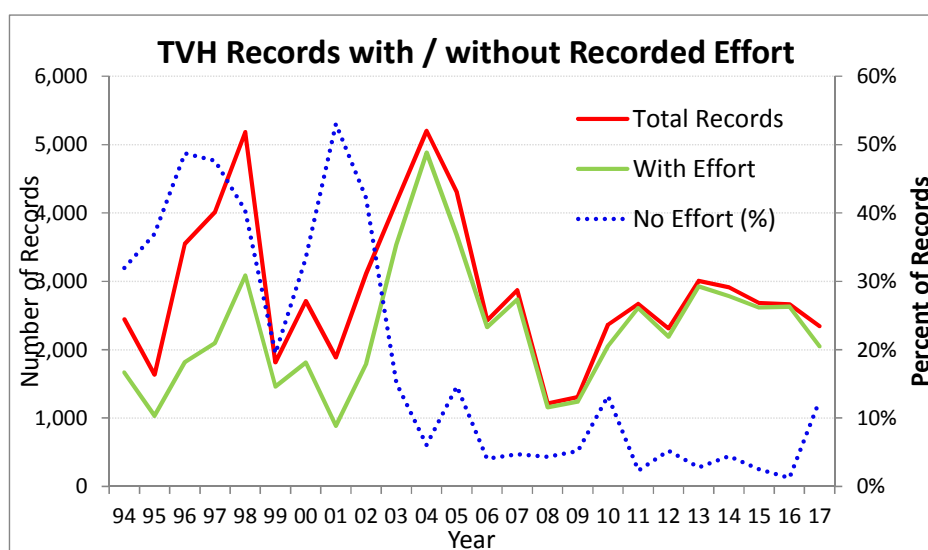


Figure 3. The percent of total TVH catch each year (a) caught by each fishing method, and (b) landed as Tails or Whole weight.

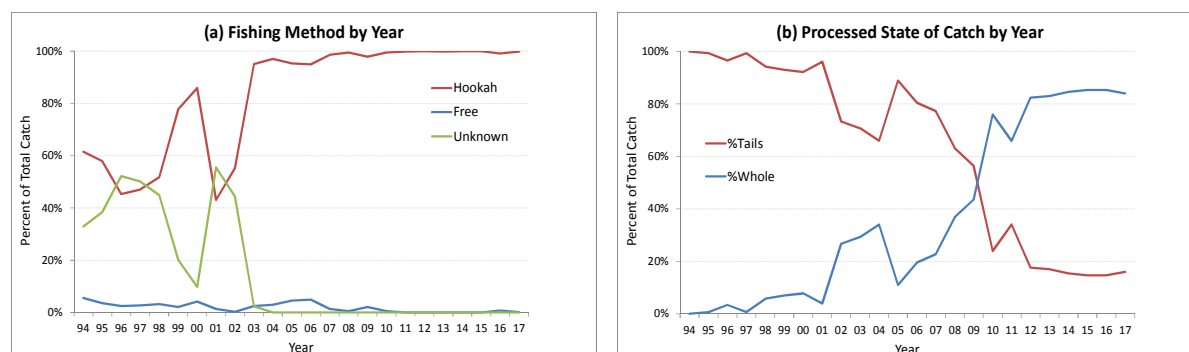


Figure 4. Distribution of (a) effort, (b) catch and (c) CPUE for the 55,061 records for which effort was recorded on TVH logbooks.

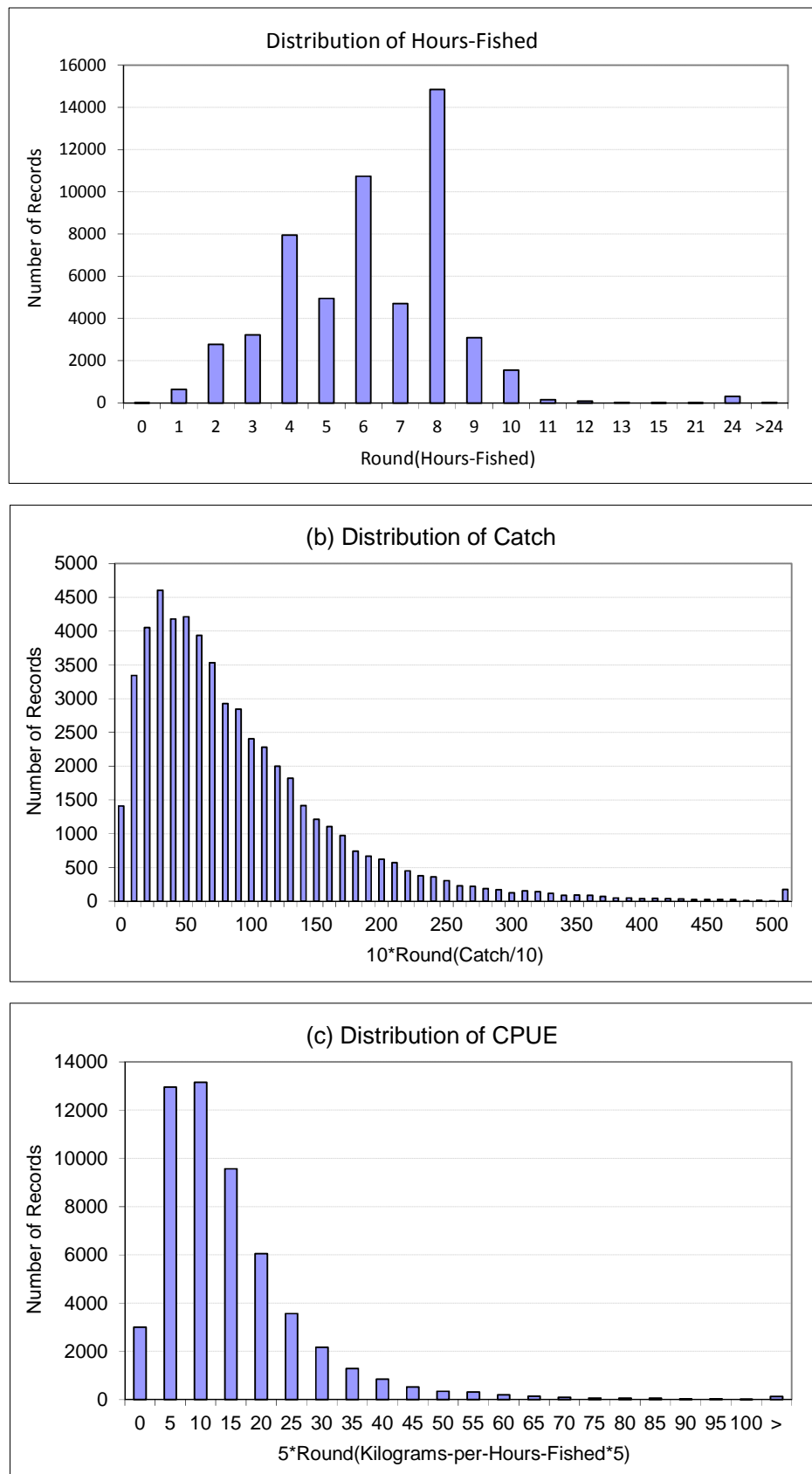
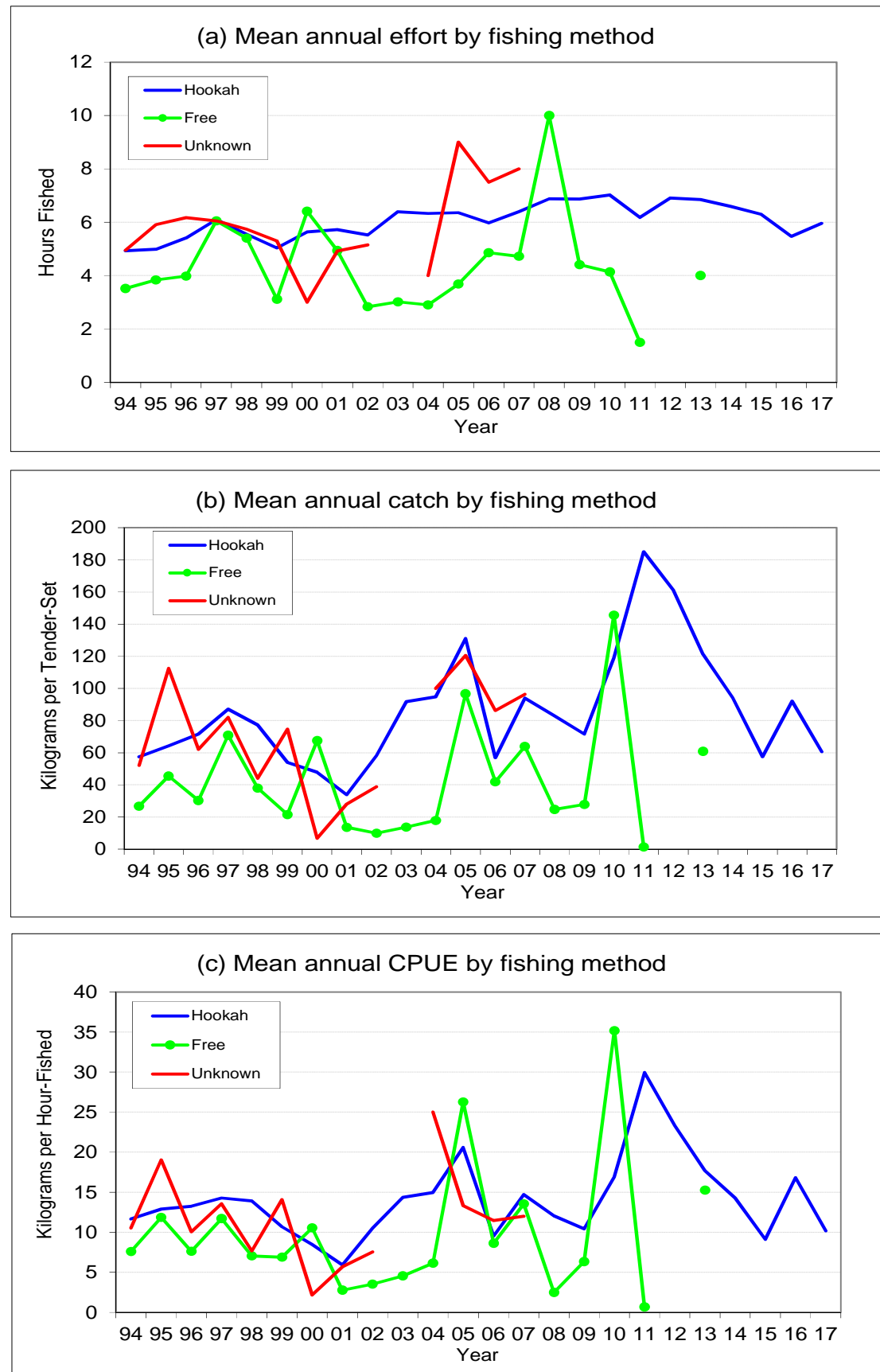


Figure 5. Mean (a) effort, (b) catch and (c) CPUE by fishing method and year for the 50,126 unique vessel-day, shot, tender and diving method records for which this effort was between 0 and 12 hours and areas and months restricted as described in the text.



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 55,061 (80.1%) of the 68,777 records. (Note, the proportion of records where the effort was not recorded was 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 was 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 due to possible recording errors 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 50,126. The mean (a) effort, (b) catch and (c) CPUE by fishing method and year for these records are shown in Figure 5.

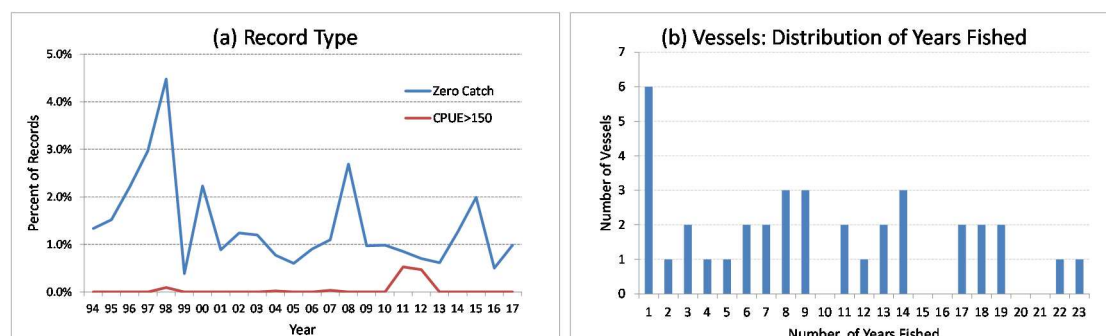
## 2. GLM Analysis

### i) *Fitted Data*

Of the 50,126 records selected above for analysis it was noted that there were a small percentage of records (638 or 1.27%) 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 4.48% in 1998 to a low of 0.39% 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 89 vessels identified in this manner in the selected data, only the data pertaining to the 46 vessels which had fished for 3 or more years and for which there were more than 50 data records were included in the analysed data (c.f. Figure 6b). Combined with the other two filters the total number of records remaining in the data for analysis was 44,658.

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.

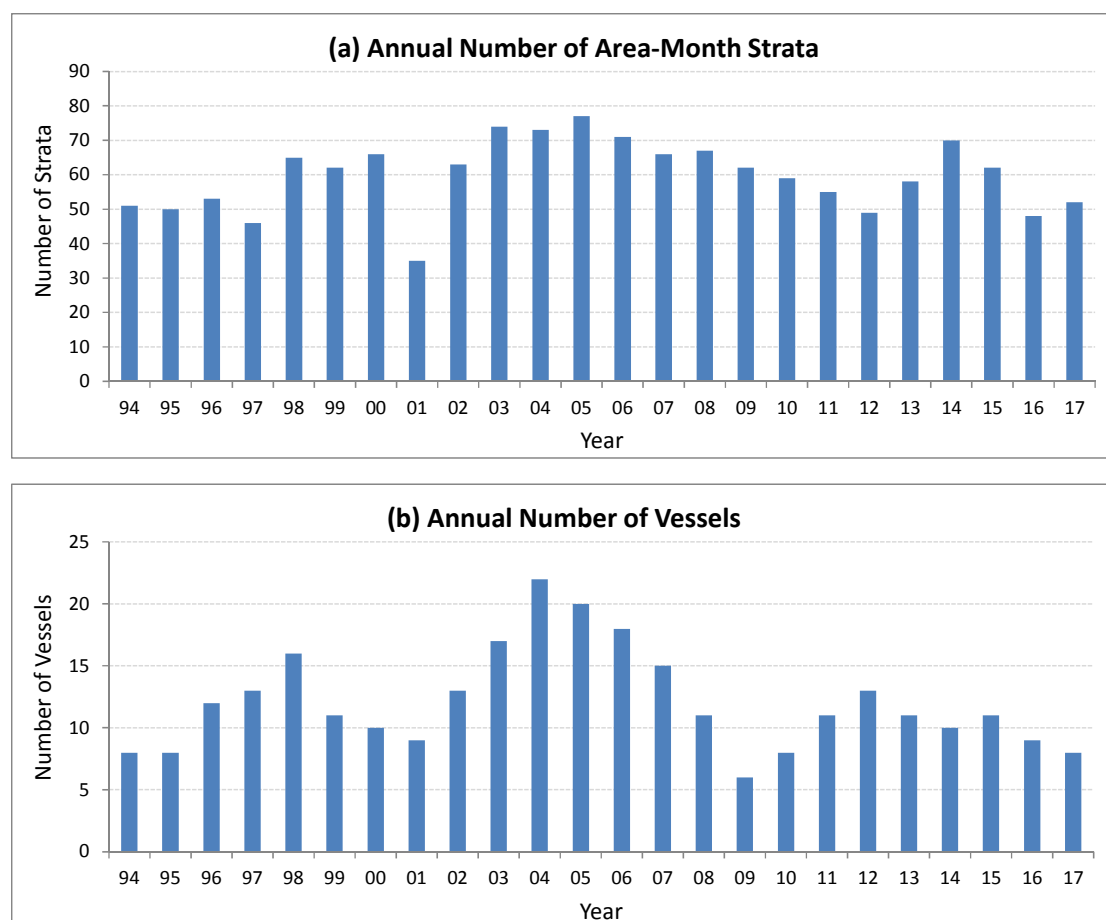
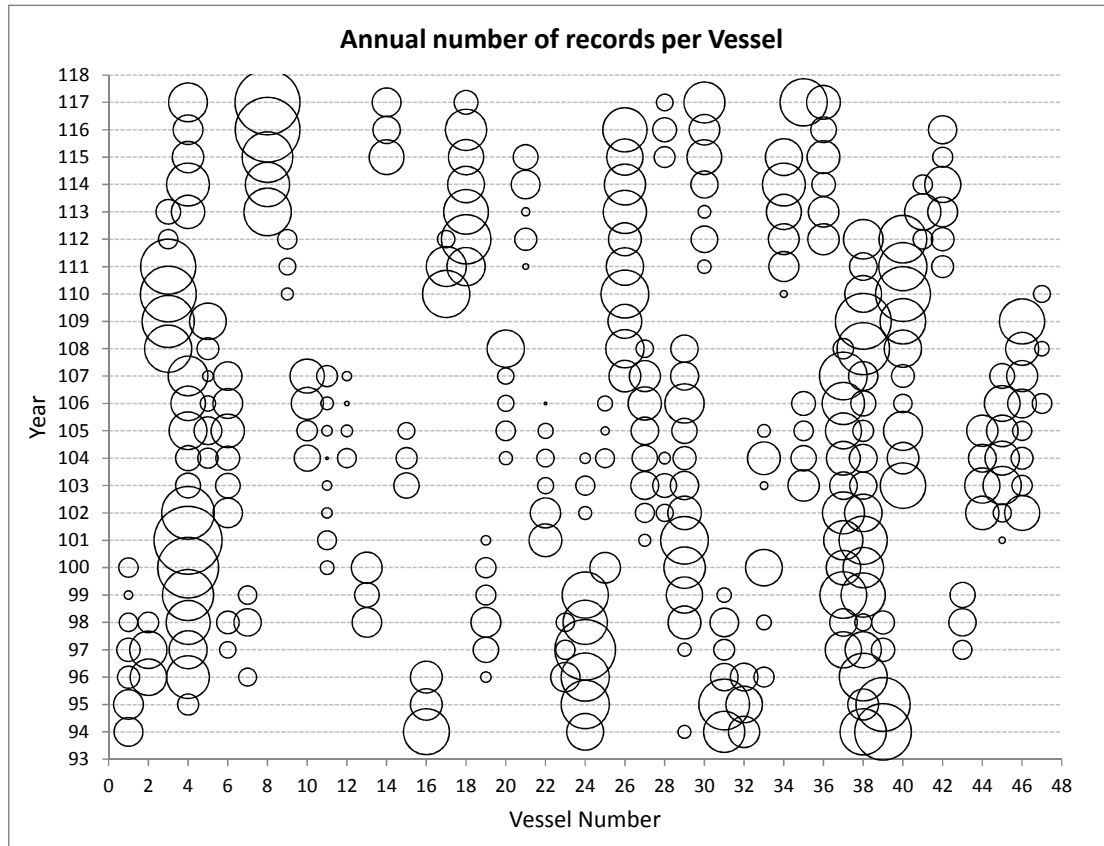


Figure 8. Bubble plot displaying the number of observations for each vessel each year in the data selected for inclusion in the GLM analyses.



## 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:

$$CPUE = \text{Intercept} + \text{Year} + \text{Month} + \text{Area} + \text{Vessel} + \text{Fishing-Method} \\ + \text{Proportion of Catch Landed as Tails} + \text{Southern Oscillation Index} \\ / \text{distribution} = \text{gamma, link} = \text{log}$$

$$= I + Y + M + A + V + F + P + SOI / \text{dist} = \text{gamma, link} = \text{log}$$

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%). 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:

<i>Month</i>	September
<i>Area</i>	Eastern Torres Strait
<i>Method</i>	Hookah diving
<i>Vessel</i>	Vessel with the largest number of records
<i>Proportion-tails</i>	>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:

$$CPUE = \text{Intercept} + \text{Year} + \text{Month} + \text{Month} * \text{Area} \\ + \text{Vessel} + \text{Fishing-Method} + \text{Proportion-Tails} + \text{SOI} \\ / \text{distribution} = \text{gamma, link} = \log$$

#### Int-2A:

$$CPUE = \text{Intercept} + \text{Year} * \text{Month} + \text{Month} * \text{Area} \\ + \text{Vessel} + \text{Fishing-Method} + \text{Proportion-Tails} + \text{SOI} \\ / \text{distribution} = \text{gamma, link} = \log$$

#### Int-2B:

$$CPUE = \text{Intercept} + \text{Year} * \text{Area} + \text{Month} * \text{Area} \\ + \text{Vessel} + \text{Fishing-Method} + \text{Proportion-Tails} + \text{SOI} \\ / \text{distribution} = \text{gamma, link} = \log$$

#### Int-2C:

$$CPUE = \text{Intercept} + \text{Year} * \text{Month} + \text{Year} * \text{Area} \\ + \text{Vessel} + \text{Fishing-Method} + \text{Proportion-Tails} + \text{SOI} \\ / \text{distribution} = \text{gamma, link} = \log$$

#### Int-3:

$$CPUE = \text{Intercept} + \text{Year} * \text{Month} + \text{Year} * \text{Area} + \text{Month} * \text{Area} \\ + \text{Vessel} + \text{Fishing-Method} + \text{Proportion-Tails} + \text{SOI} \\ / \text{distribution} = \text{gamma, link} = \log$$

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:

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

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 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:

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

where  $\text{Area}_a$  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.

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

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

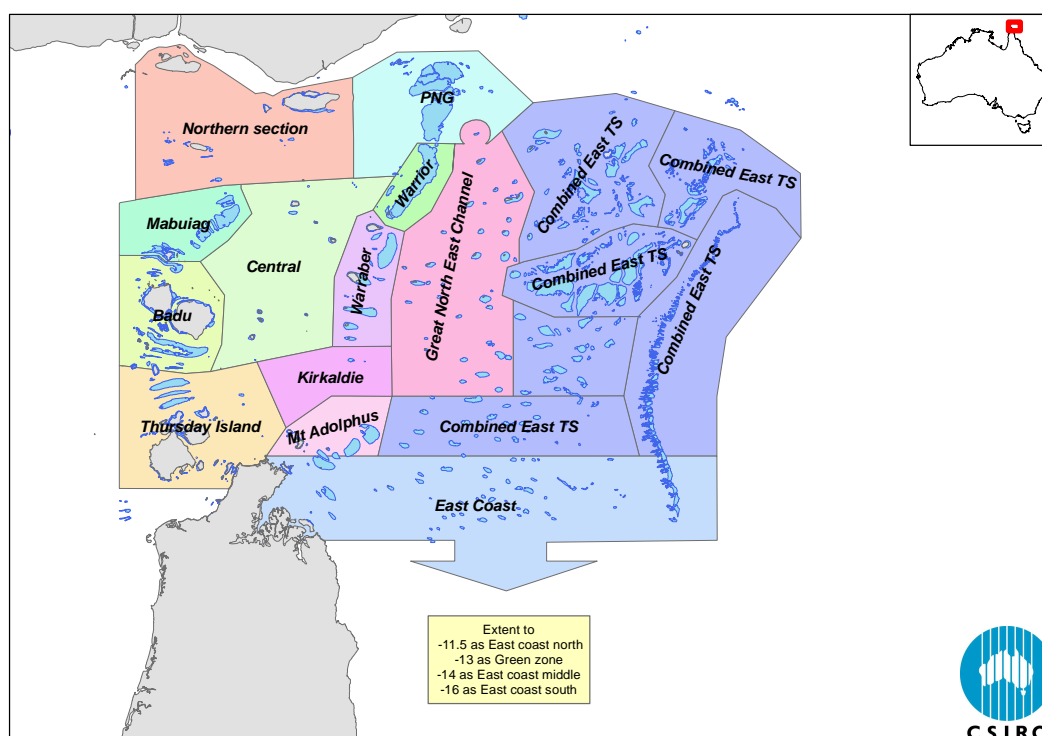
$$B_y = \frac{\text{Index}(\text{year} = y)}{\frac{1}{NY} \sum_{i=1}^{NY} \text{Index}(\text{year} = i)}$$

Two different sets of spatial sizes,  $\text{Area}_a$ , were used in calculating the above abundance index. These were:

1. The total spatial size of the each MSE area shown in Figure 9.
2. The spatial extent of each MSE area which had been fished between 1994 and 2013. This was based on the number of 0.1x0.1-degree squares in which a fishing operation had been reported in each area during this period. For those squares which included more than one MSE area, the square was apportioned between the different areas based in the total number of records in each area.



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



In order to ascertain the spatial size of each MSE area 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 region was determined for each year (c.f. Table 4). Across the entire Torres-Strait region the number of squares fished each year has varied between 31 (in 1995) and 101 (in 2004). Across all years, the maximum and mean number of squares fished within each area was determined together with the number of unique squares fished and the spatial size of each area in 10,000 hectares. Each size metric for each area was then expressed as a percentage of the combined total across all areas. These calculations are shown in Table 4 and displayed in Figure 10. For each area the relative sizes based on the maximum and mean number of squares fished are similar and for the GLM analysis the size of each area was taken to be the mean of these two metrics (see GLM area in Table 4).

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:

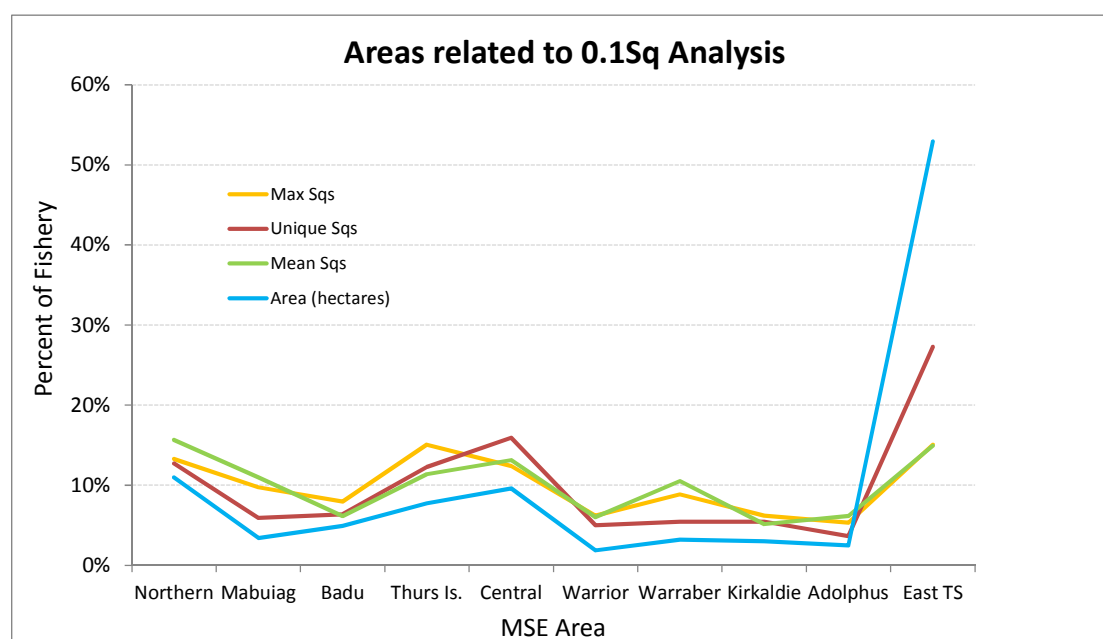
$$B_y = \frac{\exp(Y_y)}{\frac{1}{NY} \sum_{i=1}^{NY} \exp(Y_i)}$$

where  $Y_i$ ,  $i=1, NY$  are the parameters estimates relating to  $NY$  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.

Table 4. Number of 0.1x0.1-degree squares fished (based on location of mother ship) within each MSE areas used in the GLMs fitted to the TVH data.

	N_01	N_02	N_03	N_04	N_05	N_06	N_07	N_08	N_09	N_10	
Year	Northern	Mabuiag	Badu	Thurs Is.	Central	Warrior	Warraber	Kirkaldie	Adolphus	East TS	Total
1994	2	6	0	1	5	1	3	1	1	14	34
1995	4	5	1	2	3	1	4	1	1	9	31
1996	5	6	1	3	3	2	3	1	1	7	32
1997	4	6	5	8	2	2	4	1	1	17	50
1998	5	6	5	6	5	2	4	1	3	13	50
1999	4	6	5	4	3	2	4	1	2	14	45
2000	6	6	4	9	3	2	4	1	2	6	43
2001	4	4	2	5	3	2	5	1	3	4	33
2002	4	5	4	8	3	2	4	3	2	3	38
2003	12	8	7	17	14	7	8	7	6	4	90
2004	14	11	9	12	15	7	10	4	6	13	101
2005	13	10	7	14	13	5	10	6	5	6	89
2006	15	10	5	10	14	5	6	4	5	15	89
2007	13	10	4	9	12	5	5	4	4	8	74
2008	12	6	3	5	9	4	7	2	4	9	61
2009	15	4	2	6	8	6	6	3	4	10	64
2010	11	4	5	9	6	2	4	5	6	6	58
2011	8	3	3	4	2	2	6	3	3	4	38
2012	13	6	0	5	6	2	10	1	4	3	50
2013	9	7	1	1	7	2	6	2	1	4	40
2014	12	4	1	4	9	1	7	3	5	7	53
2015	6	3	3	3	11	6	5	4	4	7	52
2016	5	3	2	2	8	4	7	4	4	5	44
2017	8	4	1	1	7	4	5	4	3	6	43
Total	204	143	80	148	171	78	137	67	80	194	1302
mean	8.50	5.96	3.33	6.17	7.13	3.25	5.71	2.79	3.33	8.08	54.25
max	15	11	9	17	15	7	10	7	6	17	114
unique	28	13	14	27	35	11	12	12	8	60	220
mean	15.7%	11.0%	6.1%	11.4%	13.1%	6.0%	10.5%	5.1%	6.1%	14.9%	100.0%
max	13.2%	9.6%	7.9%	14.9%	13.2%	6.1%	8.8%	6.1%	5.3%	14.9%	100.0%
unique	12.7%	5.9%	6.4%	12.3%	15.9%	5.0%	5.5%	5.5%	3.6%	27.3%	100.0%
GLM area	14.4%	10.3%	7.0%	13.1%	13.1%	6.1%	9.6%	5.6%	5.7%	14.9%	100.0%

Figure 10. Relative size of each MSE Area (expressed as a percent of the combined areas) based on the size of each Area as specified in Table 4.

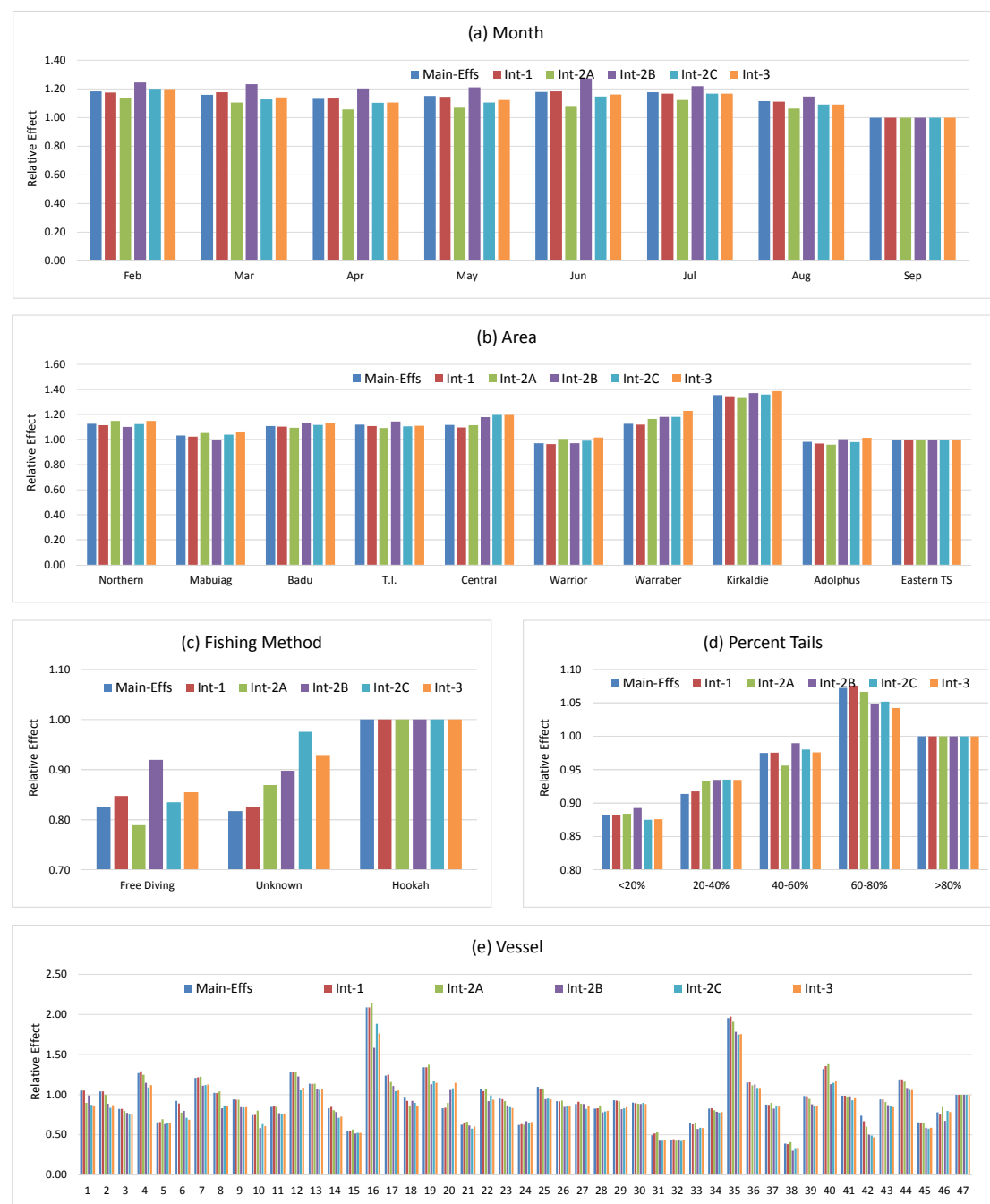


### 3. Results

#### (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-Tails* >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.

Figure 11. The relative impact of each level for each main effect fitted to the each GLM model.



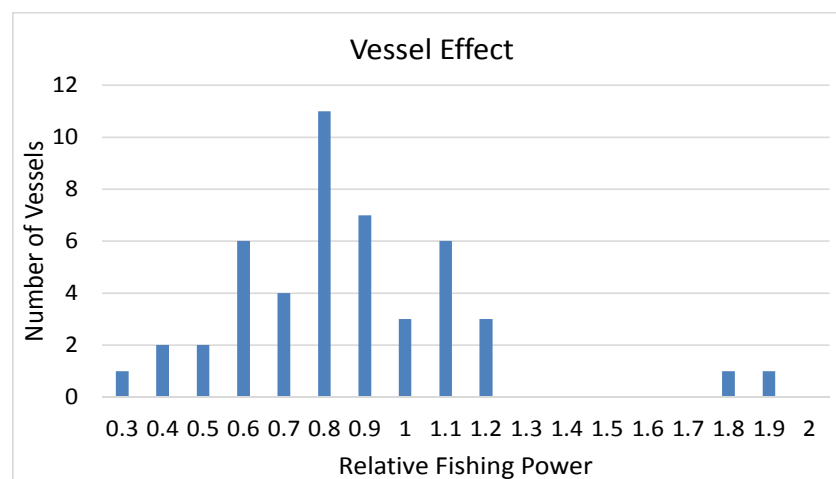
Relative CPUE is relatively constant across the eight months of the year and displays only small variation across the six GLM models, though the CPUE in September is the lowest across all models (c.f. Figure 11a). Taking the average of the relative effect across the results for the six models for each month indicates that the CPUE during February to August is between 11-17% higher than the CPUE in September. The greatest variation (as measured by the standard deviation,  $\sigma$ ) between models in the relative CPUE across all months is between the results for the 2Ints-A ( $\sigma=0.04$ ) and 2Ints-B models ( $\sigma=0.09$ ). For all other models  $\sigma=0.06$ .

The relative CPUE across the various areas included in the GLM also displays little 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 (98%), Warrior (99%) and Eastern TS (100%) and highest in Kirkaldie (136%), Warraber (117%) and Central (115%).

Unlike the previous results, the relative CPUE across the three fishing methods displays some 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 79% and 92% while that for the unknown method varies between 82% and 98%. Across all models, the CPUE for hookah fishing is found to be around 15% higher than for free diving and 11% higher than for unknown method. This latter result is to be expected if this fishing method is a combination of the two other fishing methods

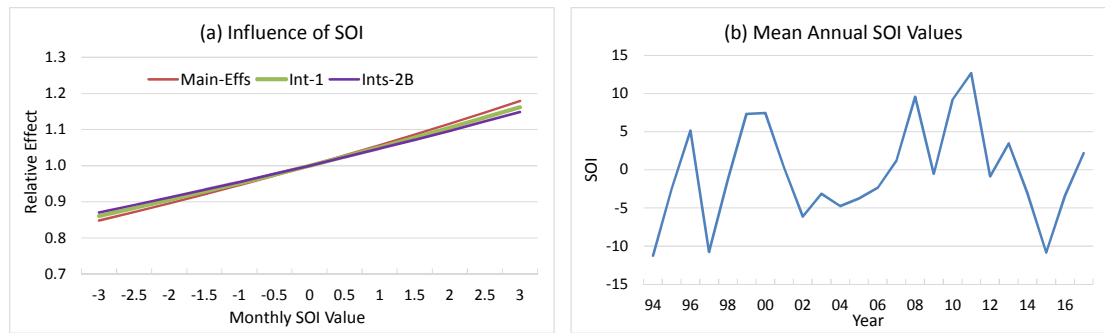
The relative CPUE across all models is similar for each category of the proportion of the catch which is tails with the relative CPUE generally increasing as the *Proportion-Tails* increases in the catch (c.f. Figure 11d). However, the highest CPUE is found for those catches which include 60-80% tails. Across all models, the relative CPUE within each *Proportion-Tails* category is 88%, 93%, 98%, 106% and 100% respectively. Finally, there is substantial variation in the relative CPUE across the 47 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 36% to 192% 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 47 vessels included in the GLM models.



The monthly value of the SOI was fitted as a simple continuous linear term and the estimated influence of this effect on CPUE based on the results from three of the fitted GLM models is shown in Figure 13. 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 in Figure 13, 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) 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).



#### (b) Annual Abundance Indices

The relative abundance indices based on each of the six GLM models listed in the previous section are listed and displayed in Table 5 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.

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).

Table 5. 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	1.39	1.39	1.31	1.45	1.38	1.35
95	0.96	1.31	1.29	1.25	1.35	1.30	1.30
96	0.93	0.93	0.94	0.96	0.94	0.94	0.96
97	1.03	1.17	1.16	1.09	1.19	1.12	1.09
98	0.98	1.05	1.05	1.05	1.09	1.09	1.10
99	0.76	0.64	0.64	0.67	0.63	0.66	0.66
00	0.62	0.63	0.63	0.71	0.59	0.67	0.68
01	0.44	0.48	0.47	0.48	0.50	0.50	0.51
02	0.76	0.70	0.69	0.67	0.62	0.58	0.59
03	1.02	1.07	1.06	1.04	1.04	1.02	1.01
04	1.09	1.16	1.16	1.16	1.05	1.05	1.05
05	1.48	1.47	1.48	1.43	1.43	1.37	1.40
06	0.68	0.68	0.69	0.68	0.66	0.64	0.65
07	1.08	0.97	0.97	0.96	0.95	0.96	0.95
08	0.86	0.84	0.84	0.86	0.90	0.92	0.90
09	0.62	0.64	0.64	0.64	0.67	0.68	0.68
10	1.23	1.15	1.17	1.26	1.21	1.27	1.31
11	2.10	1.80	1.80	1.92	2.05	2.15	2.14
12	1.63	1.44	1.44	1.42	1.33	1.33	1.30
13	1.26	1.21	1.22	1.26	1.21	1.29	1.29
14	1.03	0.93	0.94	0.93	0.91	0.90	0.90
15	0.63	0.60	0.59	0.56	0.54	0.53	0.52
16	1.18	1.03	1.04	1.06	1.00	1.00	1.02
17	0.74	0.69	0.69	0.67	0.70	0.66	0.64
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.

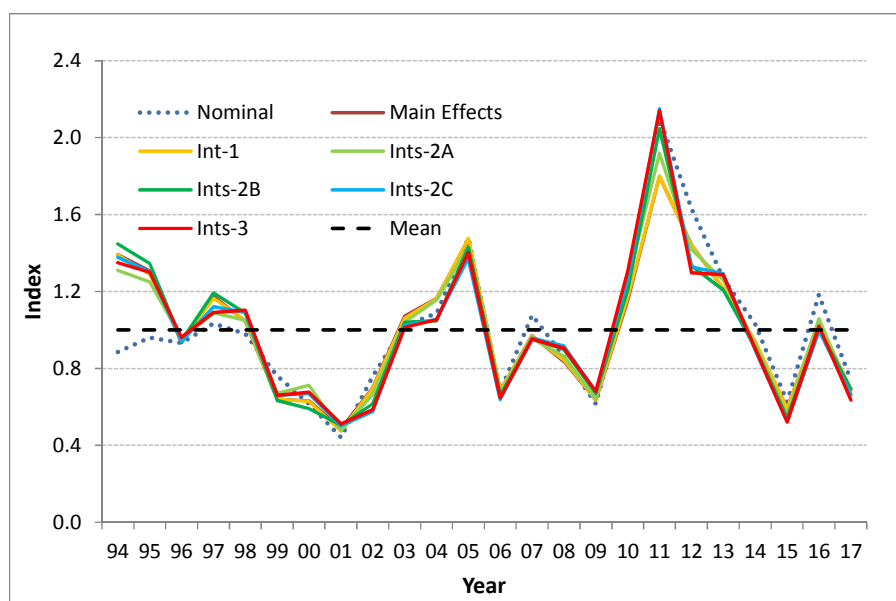


Figure 15. Annual influence of the fixed effects fitted to (a) the Main-Effects model and (b) the Int-1 model.

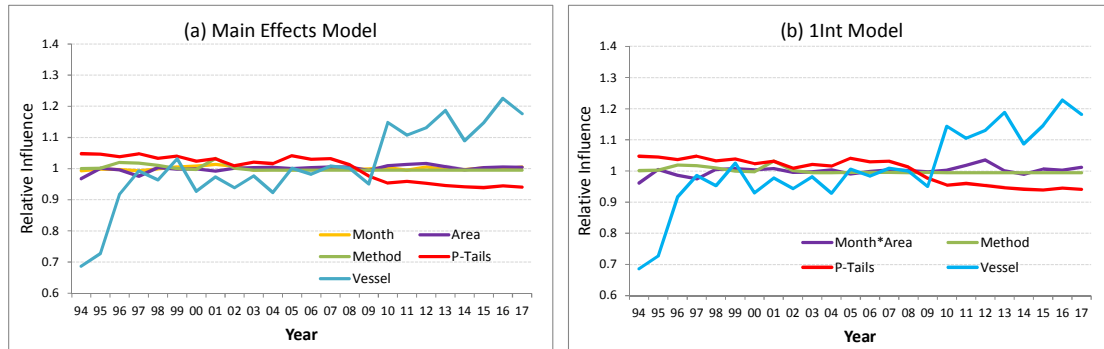


Table 6. Criteria for assessing the goodness-of-fit of each GLM.

GLM	Main	Int-1	Int-2A	Int-2B	Int-2C	Int-3
N-records	44,658	44,658	44,658	44,658	44,658	44,658
df	94	157	316	356	452	515
Deviance	20,553	20,165	18,764	17,965	17,951	16,765
Chi-sq	21,987	21,160	19,068	17,889	17,883	16,477
likelihood	-171,115	-170,631	-168,805	-167,707	-167,687	-165,972
AIC	342,419	341,576	338,242	336,126	336,090	332,973
BIC	343,237	342,943	340,993	339,226	339,207	337,457
N-Strata	1,920	1,920	1,920	1,920	1,920	1,920
Imputed	0	0	10	64	74	74

Several criteria for assessing the goodness-of-fit for each of the GLM models are shown in Table 6. 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 greater 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 (515) estimated in the full interaction model Int-3 is considerably greater than the number of parameters (94) 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 (or more importantly biased).

Histograms of the number of observations per 2-way strata (for which a separate parameter was estimated) are shown in the Appendix. For 31 (13.4%) of the 240 *Year\*Area* strata the number of observations was less than 10 (with 8 of these strata having zero observations) while only two of the 192 *Year\*Month* strata had less than 10 observations (being zero for one strata). On the other hand, the number of observations was greater than 34 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 6.) 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 74 (or 3.8% of the 1920 number of strata in total). For the Int-2B model the number of imputed strata was 64. . On the other hand, the number of imputed strata for the Int-2A model was only 10 (or 0.5% 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 likely 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 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 GLM assumes that within each year the distribution of fishing effort within any area is random. 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. (Note, 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 quite widely). Such ‘effort creep’ would result in higher catches and higher CPUE compared to the situation where no new technologies were available. 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) 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 delayed effects such as those which influence recruitment and which sub-sequentially propagate through the fishery over time) and 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, 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., 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 21<sup>st</sup> 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: Summary of Data fitted to GLM

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

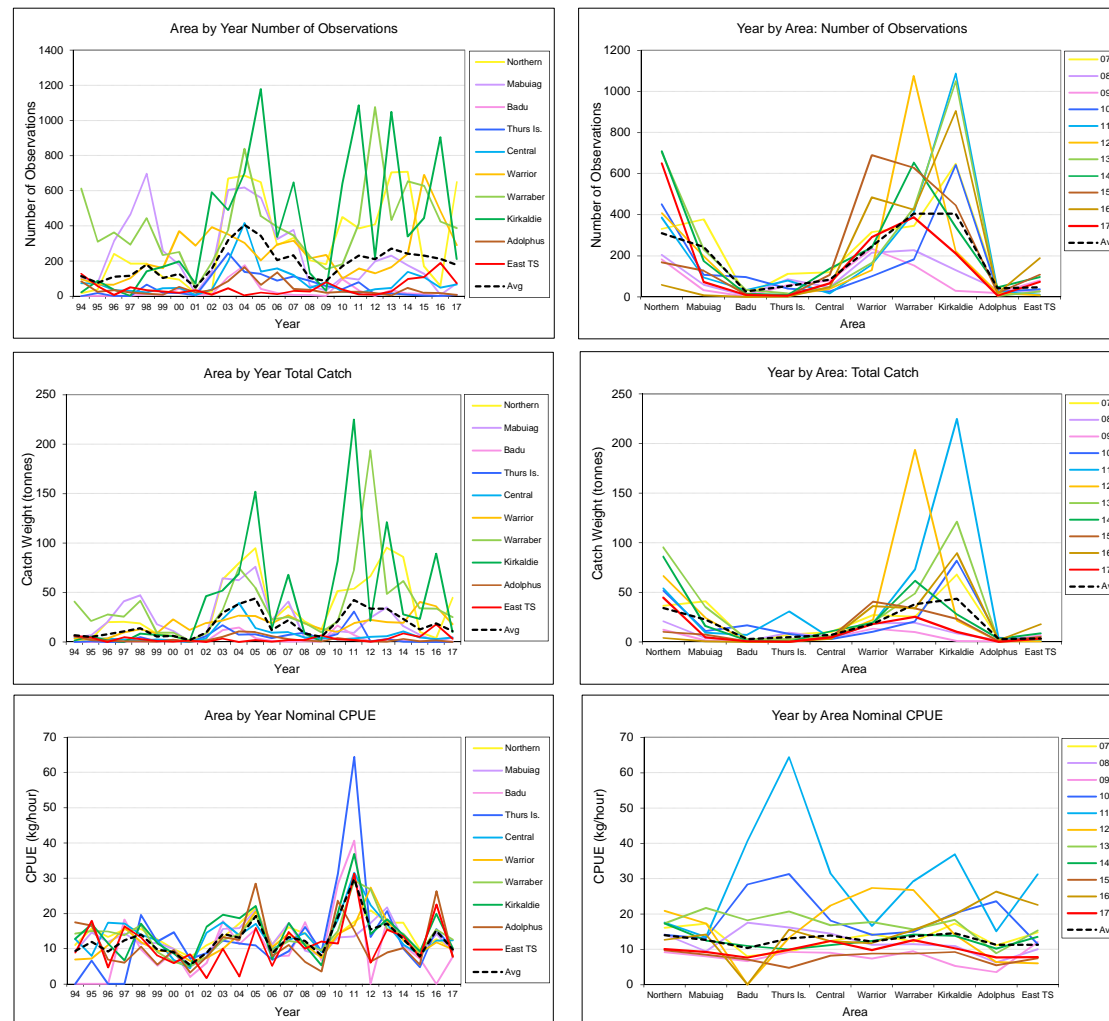
- 1) Year (all 24 years between 1994 and 2017)
- 2) Month (all 8 months between February and September)
- 3) MSE-Area (10 areas)

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

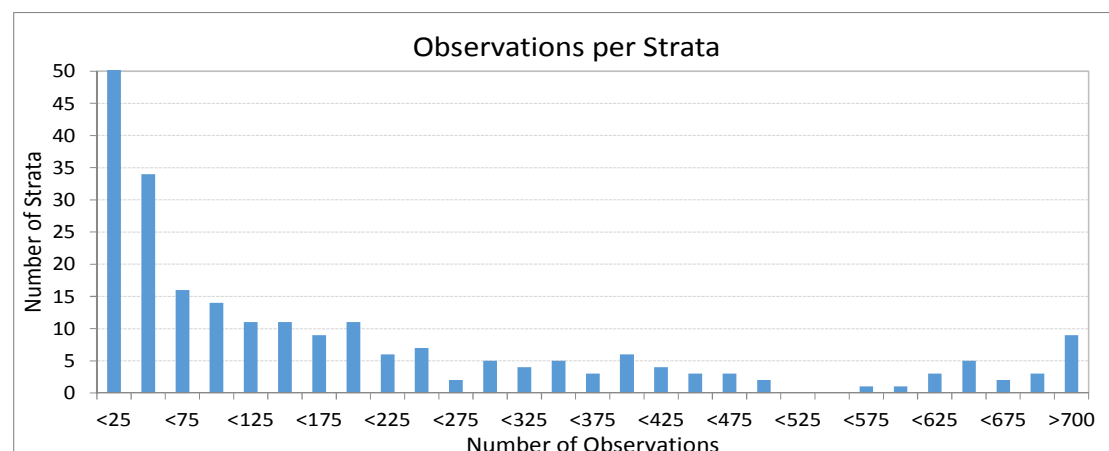
- 1) Number of data observations
- 2) Total catch (kilograms of lobsters)
- 3) Nominal CPUE (kilograms per hour fished)

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

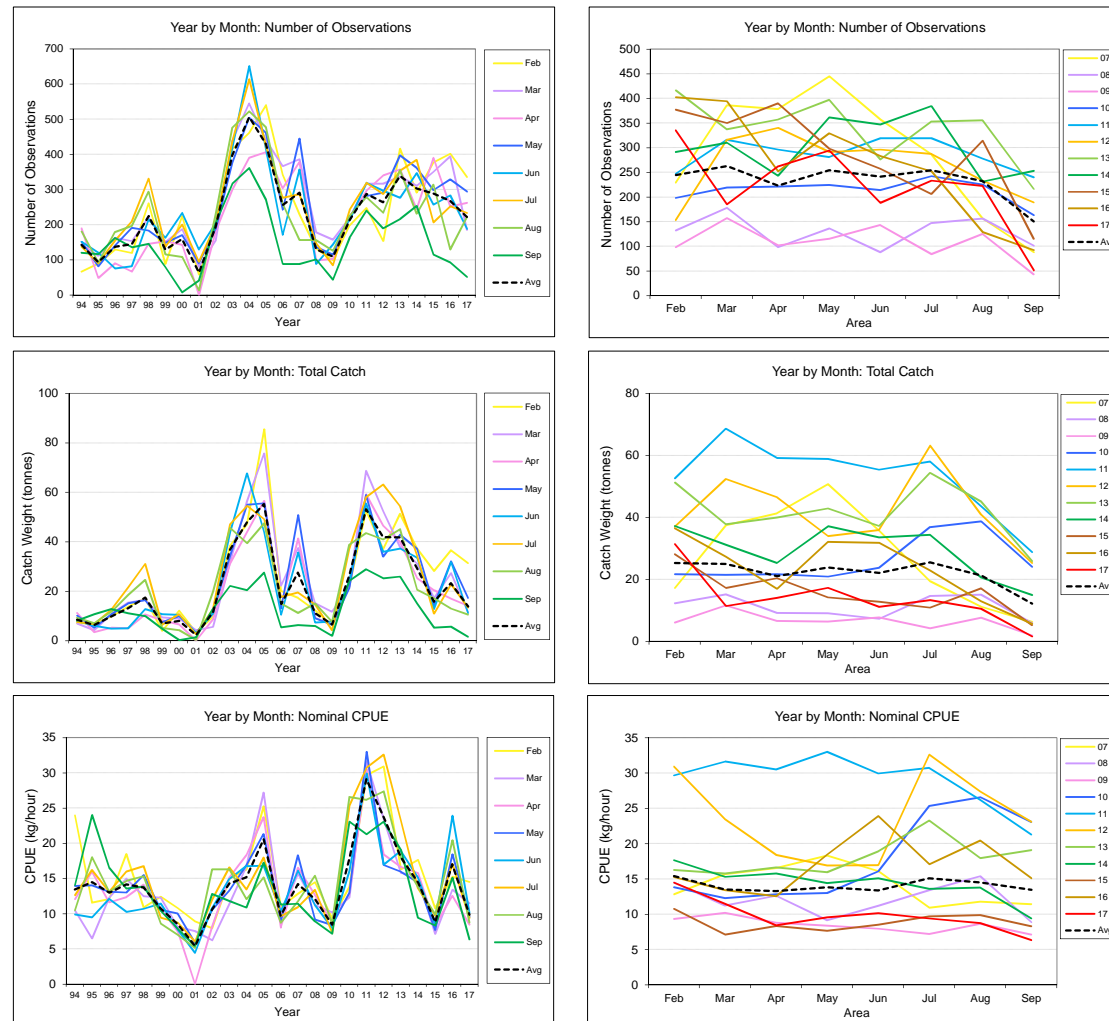
(a) Year\*Area



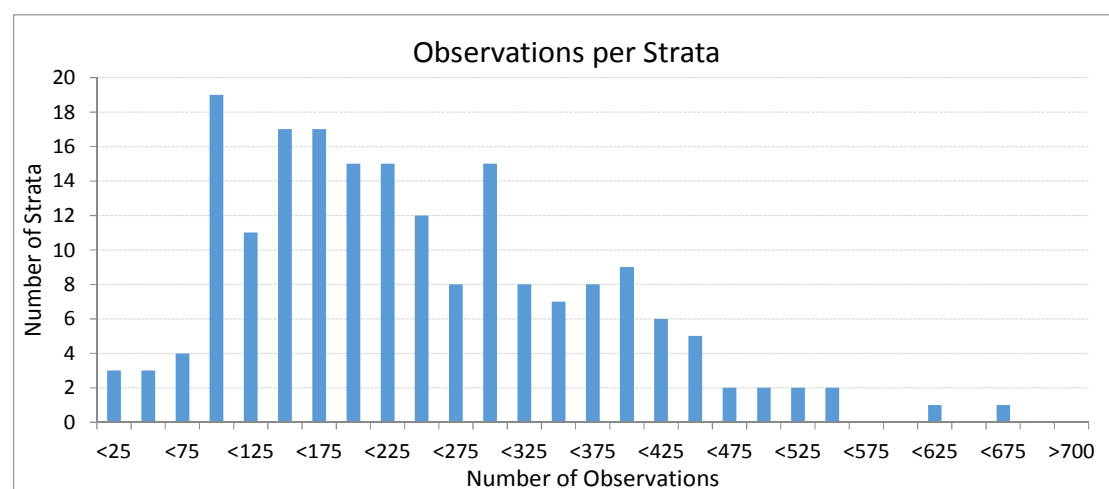
Of the 240 Year\*Area strata (24 years x 10 areas) the number of observations is zero for 8 strata: There are a further 8 strata where the number of observations was between 1 and 4 and 15 strata where the number of observations was between 5 and 9. The number of observations for all other strata was between 10 and 1,178.



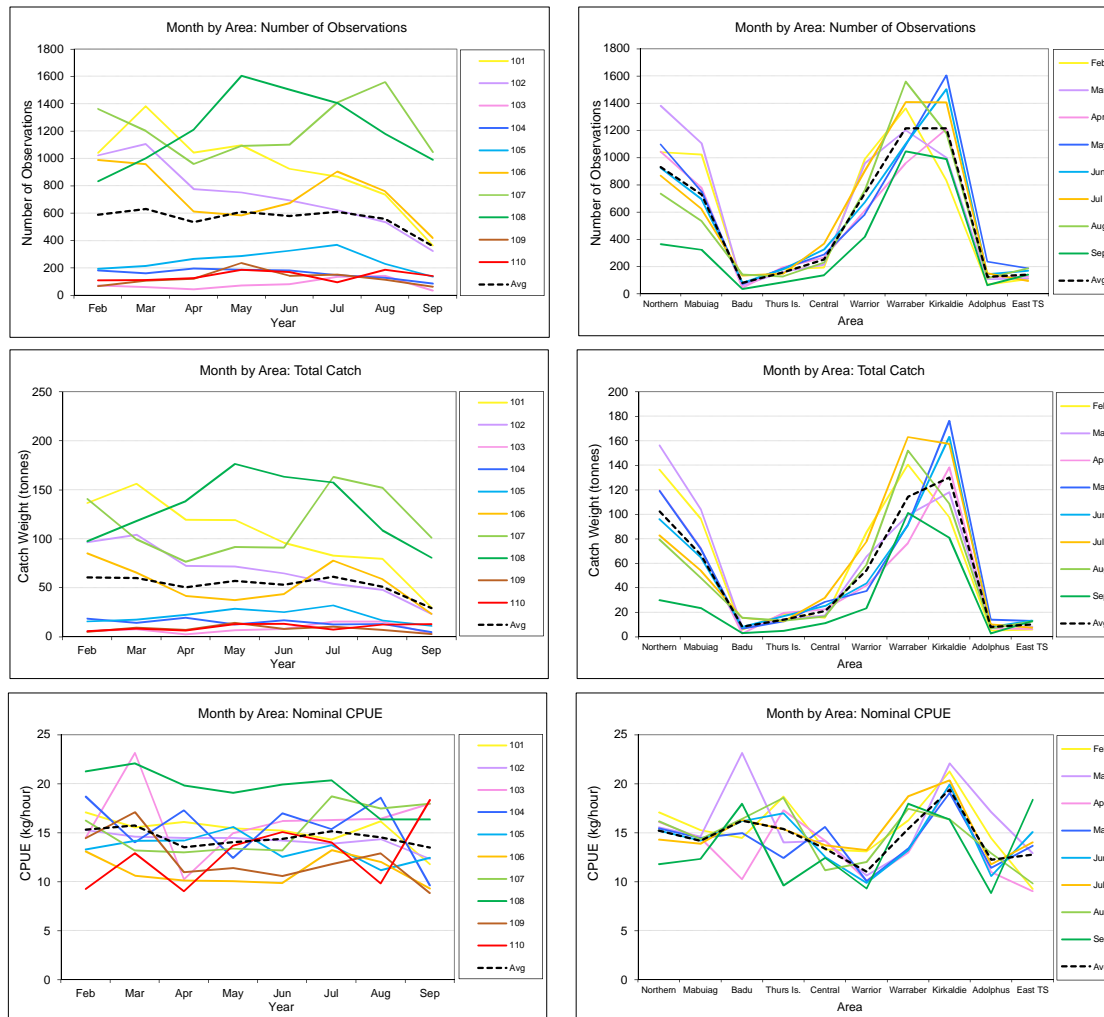
## (b) Year\*Month



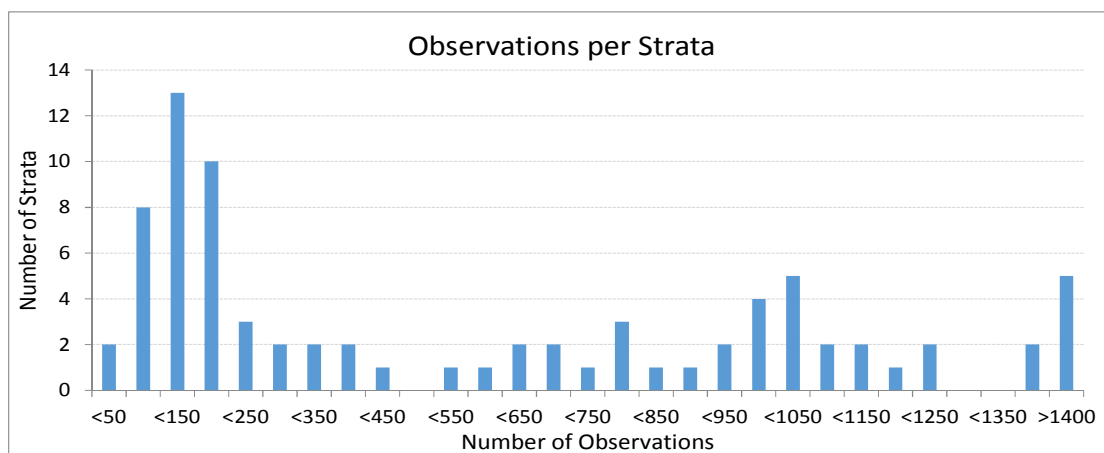
Of the 192 Year\*Month strata (24 years x 8 months) there was zero observations in one strata (2001, April) and one other strata where the number of observations was less than ten. For the remaining 190 strata the number of observations was between 10 and 651.



## (c) Month\*Area



Of the 80 Month\*Area strata (8 months x 10 areas) the number of observations for all strata was between 34 and 1,604.



<b>TROPICAL ROCK LOBSTER</b>	<b>MEETING No. 21</b>
<b>RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>12-13 December 2017</b>
<b>Results from the November 2017 pre-season survey</b>	<b>Agenda Item 5 For discussion and advice</b>

## RECOMMENDATIONS

1. That the RAG **discuss** and **provide advice** the results of the November 2017 pre-season survey to be presented by CSIRO at the RAG meeting.

## KEY ISSUES

2. CSIRO conducted the annual pre-season survey between 1 and 12 November 2017. A total of 78 sites were surveyed.
3. The pre-season survey data is a key data input for the integrated stock assessment and proposed empirical harvest control rule.
4. The results of the pre-season survey will be presented by CSIRO at the RAG meeting.
5. The RAG is being asked to review the analysis and where relevant provide advice on the findings and/or need for further analysis.

<b>TROPICAL ROCK LOBSTER</b>	<b>MEETING No. 21</b>
<b>RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>12-13 December 2017</b>
<b>TRL larval movement: Environmental influences on Torres Strait lobster recruitment</b>	<b>Agenda Item 6</b> <b>For discussion and advice</b>

## RECOMMENDATIONS

1. That the RAG **discuss** and **provide advice** the draft findings from the research project titled: '*Environmental influences on Torres Strait lobster recruitment*' (**Attachment A**).

## KEY ISSUES

2. Having regard for advice from the Torres Strait Scientific Advisory Committee and TRLRAG, AFMA funded CSIRO research project titled: '*Environmental influences on Torres Strait lobster recruitment*'.
3. CSIRO will provide draft findings from the project at the meeting. The RAG is asked to consider the draft findings and provide advice to the Project Team to support the finalisation of the project.
4. The objectives of the proposal are to address suggestions from the TRLRAG to improve the understanding of climate change impacts to growth, mortality, distribution and recruitment of TRL (TRLRAG meeting, Thursday Island, April 2017):
  - Co-ordinate all climate monitoring and climate work – use all funding and resources more effectively
  - Circulate links to freely available temperature, forecast etc data
  - CSIRO to provide further advice on how use of the stock assessment and CONNIE 3 modelling outputs may improve the understanding of climate change impacts to growth, mortality, distribution and recruitment of TRL
  - Propose tropical rock lobster to be included as an indicator species for the project '*Decadal scale projection of changes in Australian fisheries stocks under climate change.*'
  - Identify gaps for future research
5. The proposal has three related components:
  - Advection modelling of TRL larvae in the North Western Coral Sea (simulations by B. Gorton)
  - Analysis of environmental correlates of TRL recruitment and survival (habitat variables collated and analysed by M. Haywood)
  - Model projections of medium- and long-term climate impacts on TRL (Imodel projections by E. Plaganyi)
6. A copy of the funding proposal is at **Attachment B**.

## BACKGROUND

7. At the last TRLRAG meeting (4- 5 April 2017 meeting 20) the RAG noted presentations from AFMA, TSRA and CSIRO about ongoing and planned climate change research for the region and Australia more broadly. The purpose of the

discussion was to improve the RAG's understanding on climate change research initiatives and information relevant to the fishery.

8. The scientific member noted that the biggest climate change risk that is likely to affect TRL and should be accounted for in the stock assessment model is likely to be changes to sea temperature and its influence on growth and mortality of TRL. The member noted the assessment could be updated using information from climate projections and higher resolution projections from CONNIE 3 to identify the possible impacts of climate change.
9. The RAG agreed that CSIRO should provide further advice on how updating the stock assessment with CONNIE 3 modelling outputs may improve the understanding of climate change impacts to growth, mortality and recruitment of TRL.
10. In response CSIRO developed a funding proposal titled: "*Environmental influences on Torres Strait lobster recruitment*" to refine, improve and extend preliminary model runs done using CSIRO's Connie3 which provides an update of previous advection modelling of TRL larvae in the coral sea.



<b>x</b>

## AFMA Research Committee (ARC)

## Torres Strait Scientific Advisory Committee (TSSAC)

Please indicate the type of application you are submitting – an EOI in response to a call for research; or a full proposal in response to ARC/TSSAC advice that your initial application has been approved for further development:

<b>X</b>

**Expression of Interest** (Please complete Sections 1-4 inclusive)

**Full Research Proposal** (Please complete all sections)

### SECTION 1 - ADMINISTRATIVE SUMMARY

<b>Project title:</b>	Environmental influences on Torres Strait lobster recruitment		
<b>Applicant:</b>	Eva Plaganyi		
<b>Contacts</b>			
<u>Administrative</u>			
Title/Name:	Bonnie Lau	Phone:	08 6436 8614
Position:	Finance Advisor	Email:	<a href="mailto:Bonnie.Lau@csiro.au">Bonnie.Lau@csiro.au</a>
Organisation:	CSIRO	Postal address:	Crawley, CSIRO
<u>Principal Investigator</u>			
Title/Name:	Dr Eva Plaganyi	Phone:	38335955
Position:	Principal research scientist	Email:	<a href="mailto:Eva.Plaganyi-lloyd@csiro.au">Eva.Plaganyi-lloyd@csiro.au</a>
Organisation:	CSIRO	Postal address:	Queensland BioSciences Precinct (QBP), 306 Carmody Rd, St Lucia, Brisbane, QLD 4072
<u>Co-investigator (s)</u>			
Title/Name:	Mr Mick Haywood	Phone:	38335930

Position:	Senior Experimental Scientist	Email:	<a href="mailto:Mick.Haywood@csiro.au">Mick.Haywood@csiro.au</a>
Organisation:	CSIRO	Postal address:	Queensland BioSciences Precinct (QBP), 306 Carmody Rd, St Lucia, Brisbane, QLD 4072
<u>Co-investigator (s):</u>			
Title/Name:	Ms Bec Gorton	Phone:	0416 372 052
Position:	Senior Engineer	Email:	<a href="mailto:Bec.Gorton@csiro.au">Bec.Gorton@csiro.au</a>
Organisation:	CSIRO	Postal address:	CSIRO, GPO Box 1538, Hobart, Tasmania, 7001

#### Planned Start and End Date

Start Date:	<b>30/5/2017</b>	End Date: 15/12/2017
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### SECTION 2 - PROJECT SUMMARY

#### PROJECT BUDGET: (Excluding GST)

Financial Year	AFMA	Applicant	Other
<b>2016/17</b>	21,332	14,221	\$0.00
<b>2017/18</b>	27,960	18,640	\$0.00
<b>Totals</b>	<b>49,292</b>	<b>32,861</b>	<b>\$0.00</b>

### SECTION 3 – PROJECT DESCRIPTION

#### Background

The TRLRAG and fishery stakeholders have been requesting additional information on 3 related aspects: (1) scientific basis to further assess the interaction of recent PNG trawl fishing with the TRL spawning migration; (2) the need to better understand environmental drivers of TRL survival and recruitment variability, and in particular the impact of El Nino years; (3) the need to advance understanding of medium and long-term impacts of climate change on Torres Strait fisheries and communities, and the need to better co-ordinate all

the climate monitoring and climate work. In addition, the larval circulation plots may assist in understanding connectivity of the Torres Strait lobster stock with that of the East Coast

**Consultation** (*consultation with the relevant fisheries manager or senior manager when developing the application is highly recommended*)

The need for research on TRL of climate and environmental factors has been discussed periodically at TRLRAG meetings for several years, and more recently has been emphasised by TSRA. Traditional owners have requested more information on physical drivers affecting lobster recruitment and survival – for example, this was a key topic of discussion at the TRL CSIRO science capability training workshop held in Brisbane, 3-6 November 2015 and attended by 6 Traditional Owner representatives, including a TSRA representative. During 2015-2016, the El Nino and high temperatures influenced the lobster fishery and it was acknowledged that forewarning of large changes or eg spikes in temperature would assist the industry.

### **Objectives:**

The objectives of this proposal are to address suggestions from the TRLRAG to improve the understanding of climate change impacts to growth, mortality, distribution and recruitment of TRL (TRLRAG meeting, Thursday Island, April 2017):

- Co-ordinate all climate monitoring and climate work – use all funding and resources more effectively
- Circulate links to freely available temperature, forecast etc data
- CSIRO to provide further advice on how use of the stock assessment and CONNIE 3 modelling outputs may improve the understanding of climate change impacts to growth, mortality, distribution and recruitment of TRL
- Propose tropical rock lobster to be included as an indicator species for the project ‘*Decadal scale projection of changes in Australian fisheries stocks under climate change.*’
- Identify gaps for future research

This proposal will investigate environmental correlates of TRL growth, mortality, distribution and recruitment, and will use this as a basis to inform model projections of TRL under future climate change (using a high emission scenario RCP8.5 as described in Methods section) to improve understanding of climate change impacts and identify potential relationships that could be included in future revisions of the TRL stock assessment model.

### **Needs:**

The TRLRAG and fishery stakeholders have been requesting additional information on 3 related aspects: (1) scientific basis to further assess the interaction of recent PNG trawl fishing with the TRL spawning migration; (2) the need to better understand environmental drivers of TRL survival and recruitment variability, and in particular the impact of El Nino years; (3) the need to advance understanding of medium and long-term impacts of climate

change on Torres Strait fisheries and communities, and the need to better co-ordinate all the climate monitoring and climate work. In addition, the larval circulation plots may assist in understanding connectivity of the Torres Strait lobster stock with that of the East Coast.

### Planned outcomes, benefits and extension:

The planned outcomes will be as follows:

- Generate larval circulation plots for all years from 1993 using large scale BRAN 10km model for Connie
- Improve understanding of link between large environmental signals and lobster recruitment – warning for recruitment failure risk and improve model predictions for management
- Improved understanding of relationship between environmental variables and fishery performance can assist Torres Strait Islanders in better planning their fishery operations and optimising use and ensuring sustainability of the stock
- Further assessment of the interaction of recent PNG trawl fishing with the TRL spawning migration i.e. exploring evidence of the link between the spawning population at Yule Island and the subsequent TS stock to quantify the risk of trawling to the sustainability of the whole TRL fishery.
- Updated climate change projections and the impact for the TRL fishery in particular are useful to inform planning for future change, as well as identifying adaptation options, and will facilitate inclusion of TRL as an indicator species for the project *'Decadal scale projection of changes in Australian fisheries stocks under climate change.'*

This project will assist in pulling together all available information from the TRL survey habitat monitoring database extending back to 1989, as well as previous studies in order to facilitate sharing of data and co-ordination efforts by AFMA and TSRA regarding other climate-related research in the region as per the TRLRAG recommendation that “AFMA in collaboration with CSIRO and TSRA to put together a list of all climate change projects in the region or that may be relevant to the region more broadly”

### Methods:

This proposal has three related components:

- (A) Advection modelling of TRL larvae in the North Western Coral Sea (simulations by B. Gorton)

TRL are known to migrate to the eastern Gulf of Papua to breed and spawn during summer (November to February) (Moore and MacFarlane 1984). Surveys also showed that breeding also occurs on the far northern Great Barrier Reef during summer (Prescott and Pitcher 1991), with settlement peaks into Torres Strait around June each year suggesting a larval duration of 4 to 7 months (Dennis et al. 1997).

In the north-west Coral Sea, oceanic transport is largely influenced by the influx of warm equatorial water flowing westward in the South Equatorial Current (SEC) that enters

between the Solomon Islands and Vanuatu (Fig. 1) (Church 1987). In the Great Barrier Reef, the SEC bifurcates between 14 and 18°S, and feeds south into the East Australian Current (EAC) and north along the GBR into the Gulf of Papua (Andrews and Clegg 1989). The northern flow of the SEC then forms a western boundary current, which circulates clockwise around the Gulf of Papua, following the Queensland and PNG continental slopes. This closed gyre is termed the Coral Sea Gyre.

Dennis et al. (2001) undertook an extensive plankton survey in the Coral Sea to research the distribution and transport pathways of *P. ornatus* and other lobster larvae. Their study confirmed the hypothesis that phyllosomas are transported from the Gulf of Papua breeding grounds by the Hiri boundary current into the Coral Sea Gyre and then by surface onshore currents onto the Queensland coast and into Torres Strait (Fig. 2).

Two preliminary model runs have been done using CSIRO's Connie3 ([www.csiro.au/connie/](http://www.csiro.au/connie/)), which provides an update of previous advection modelling of tropical rock lobster (TRL) *Panulirus ornatus* larvae in the Coral Sea. The modelling was used to test the hypothesis that larvae that originate at Yule Island, considered an important spawning location for TRL, may be advected via the Coral Sea gyre back to Torres Strait to reseed future generations. Preliminary simulations confirmed that this is the case. Information on individual particle tracks can be used for various types of analysis, including the potential distribution of settlement over viable habitat. This proposal aims to refine, improve and extend (e.g. for different years) these results to improve understanding of TRL larval advection. The analysis will be extended to consider all years from 1993, which will mean moving to a larger-scale CONNIE model which has the advantage of eliminating potential issues associated with the open boundary of the Coral Sea model.

This will give insight into potential annual changes in TRL recruitment linked to broader scale oceanographic features, and this information will assist in management of the stock, both in terms of prediction and also understanding any consequences of trawling occurring in PNG. This will also provide further information on connectivity in the stock, as well as with the East Coast lobster stock. If a relationship can be established between changes in environmental drivers and TRL recruitment, this could be used in future stock assessments and to inform modelling of future climate impacts.

(B) Analysis of environmental correlates of TRL recruitment and survival (habitat variables collated and analysed by M. Haywood)

The outputs of part (A) will be used as part of an analysis that examines the relationship between changes in larval advection patterns and the strength of TRL recruitment. All existing habitat and environmental information will be used in this analysis as there is a long time series of habitat and environmental information, supplemented also by other monitoring sources including TSRA, that can be used to improve understanding of stock dynamics and forecasting ability.

The inter-annual differences in larval dispersal will be quantified and will be compared with survey observations of recruitment of TRL in Torres Strait, and this will also be complemented by comparing with the stock-recruitment residuals estimated in the stock assessment model to also account for differences in spawning biomass. The 1+ recruitment numbers are a function of both how many are advected to Torres Strait and the survival rate. Other environmental variables such as temperature affect the survival rate of the lobsters and this relationship will be used also in simulating future response of TRL to

increasing temperatures as part of (C) below. The analyses will firstly be conducted at the scale of the entire Torres Strait region covered by the stock assessment model, which corresponds to the scale shown in Figure 3. Hence environmental information collected from survey sites will be compared with lobster abundance both averaged over the year, and also by spatial region if appropriate. Note that survey and habitat data are available for every year since 1989, but there have been changes in the number of survey sites, time of the survey (mid-year (May-June) or pre-season (November)), and the mid-year survey provides estimates of 1+ and 2+ lobsters whereas the more recent pre-season survey provides estimates of relative abundance of 0+ and 1+ lobsters.

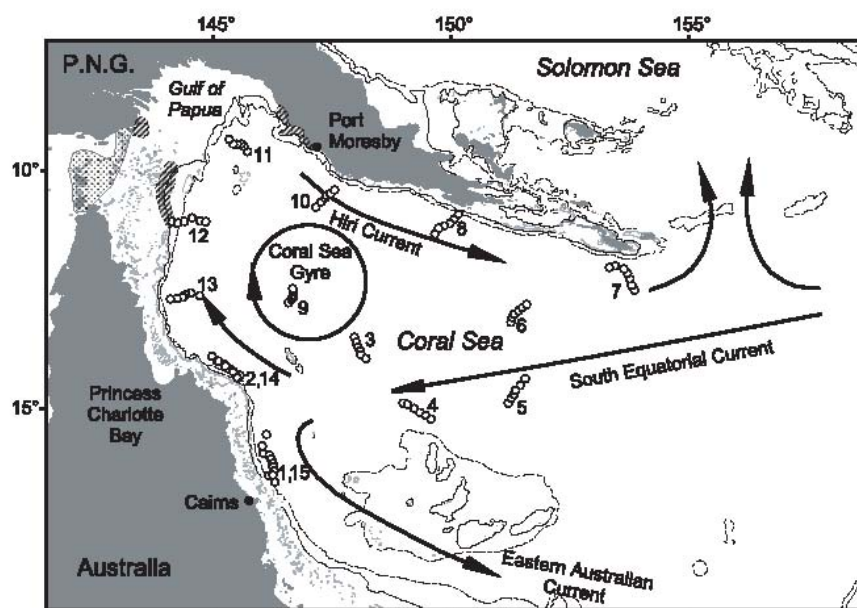
If sufficiently rigorous relationships are found as part of this project, the stock assessment model will be updated with results from this project and therefore improve estimates of the RBC. CSIRO has conducted annual surveys for TRL since 1989; as part of these surveys, divers have collected data on major habitat characteristics e.g. cover of seagrass, substrate types etc. This data combined with freely available long-term remotely sensed data on sea surface temperatures and chlorophyll and the TSRA/AIMS/NERP weather station data (<http://data.aims.gov.au/aimsrtids/>) will be included to examine how environmental and habitat variables influence recruitment strength.

(C) Model projections of medium- and long-term climate impacts on TRL (model projections by E. Plaganyi)

As part of a previous TRLMSE project, the impact and likelihood of a range of climate change impacts on TRL life history parameters was evaluated and integrated into the stock assessment model to provide projections under future climate change scenarios (Norman-Lopez et al. 2013). These runs can be updated with the latest information and using the same decadal climate projections as the project '*Decadal scale projection of changes in Australian fisheries stocks under climate change.*' The projections will be provided by the CSIRO decadal forecasting project (Matear and Zhang), with international models accessed from the CMIP5 archive.

The CSIRO model is a global high-resolution (0.1o) ocean general circulation model (OGCM) is used to dynamically downscale climate changes in the 21st century derived from Coupled Model Intercomparison Project Phase 5 (CMIP5) climate models. The global OGCM is integrated over the historical period (1979-2014) then projected from 2006 to 2101 under a high emission scenario (RCP8.5). Model results provide downscaled climate change projections for all common ocean state variables including sea level, temperature and currents. This will provide a basis for planning for anticipated climate change impacts on the major fisheries in the region. Currently projections are being done as part of a AFMA/FRDC proposal for a number of fisheries around Australia and hence rerunning the lobster projections with the new scenario will facilitate inclusion of Torres Strait in this bigger project. It's relatively quick to rerun these projections with the physical drivers from the RCP 8.5 scenario, and minor updates to the model will also be made, for example to take into account findings from (A) and (B) above.

Hence this project will focus on producing future projections of TRL under a climate change scenario as described above. However the research undertaken as part of (A), (B) and (C) above will also be useful in informing potential modifications to the stock assessment model, as an outcome of this project (but not implemented as part of this project). Hence, if appropriate, these modifications will be incorporated in the stock assessment model as part of the ongoing TRL survey and assessment project (AFMA Project 2016/0822). Note however that the modelling exercise to generate future TRL trajectories under a climate change scenario is a strategic modelling exercise that is useful in longer-term strategic decision making. In contrast, the stock assessment model is a tactical model used to provide short-term management advice pertaining to the status of the stock and sustainable catches. The latter is therefore a more rigorous model because it is used directly in providing management advice, and hence environmental relationships will not be included in this model unless they can be shown to be statistically rigorous and reliable in terms of prediction of short-term TRL changes in abundance, recruitment and sustainable catch.



**Fig. 1.** Map of the north-west Coral Sea showing major near-surface ocean currents, breeding grounds of *Panulirus ornatus* (hatched area), the Torres Strait fishery (dotted area), and the 13 sampling locations surveyed during May 1997. Resamplings of stations 1 and 2 are denoted stations 14 and 15. The solid and dashed lines represent the 200-m and 1000-m isobaths, respectively.

Source: Dennis, D., Pitcher, R. and T.D. Skewes (2001).

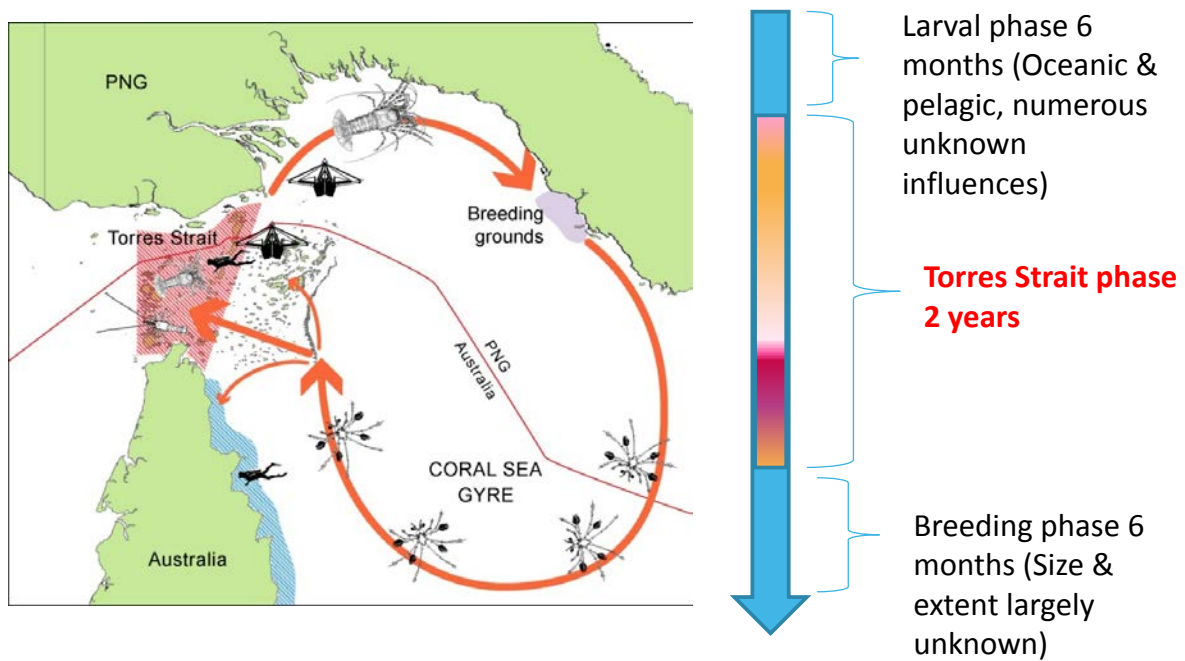


Fig. 2. Schematic showing lifecycle of Torres Strait *P. ornatus* (source: CSIRO)

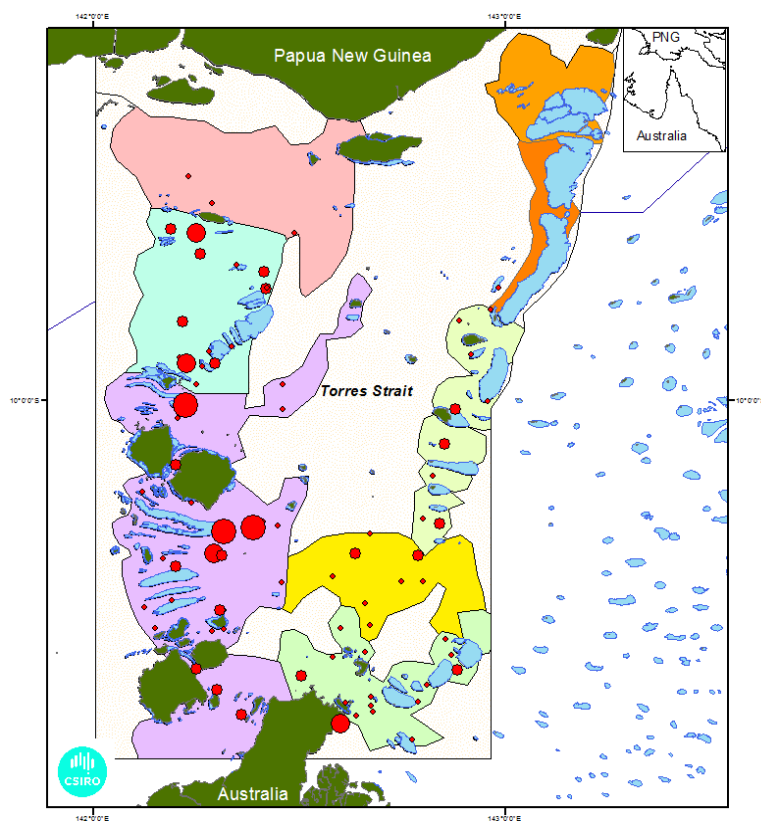


Fig. 3. Map showing areas (coloured sections) surveyed for lobster abundance since 1989. This example is for 0+ lobsters during the 2015 pre-season population survey, with the size of the red bubbles indicating relative abundance and showing the 0+ lobsters occur predominantly along the western margin of the fishery.



### References:

- Andrews JC, Clegg S (1989) Coral Sea circulation and transport deduced from modal information models Deep Sea Research Part A Oceanographic Research Papers 36:957-974
- Church J (1987) East Australian Current adjacent to the Great Barrier Reef Mar Freshwater Res 38:671-683
- Dennis DM, Pitcher CR, Skewes TD (2001) Distribution and transport pathways of *Panulirus ornatus* (Fabricius, 1776) and *Panulirus* spp. larvae in the Coral Sea, Australia Mar Freshwater Res 52:1175-1185 doi:10.1071/Mf01186
- Dennis DM, Skewes TD, Pitcher CR (1997) Habitat use and growth of juvenile ornate rock lobsters, *Panulirus ornatus* (Fabricius, 1798), in Torres Strait, Australia Mar Freshwater Res 48:663-670
- Moore R, MacFarlane J (1984) Migration of the ornate rock lobster, *Panulirus ornatus* (Fabricius), in Papua New Guinea Mar Freshwater Res 35:197-212
- Prescott J, Pitcher C (1991) Deep water survey for *Panulirus ornatus* in Papua New Guinea and Australia Lobster Newsletter 4:8-9

### Work Plan:

Continue ongoing discussions with stakeholders and other researchers to ensure the research below is aligned with broader research co-ordination efforts being planned by AFMA and TSRA.

- (A) Produce advection plots before end of June;
- (B) Start collating information by end July, and complete preliminary analysis by end September;
- (C) Obtain RCP scenario variables in near future and start updating model with new scenario before end of June; incorporate biological and environmental information during July-August and initial projections output by end of September

July – November: analyses refined

December: results reported to TRLRAG and final report to summarise findings and recommendations

### **Performance Indicators**

1. Larval circulation plots produced for all years from 1993
2. Environmental information analysed to look for relationships with TRL recruitment
3. Climate drivers obtained and climate projection scenarios run using stock assessment model
4. Relevant updates identified that could be made to stock assessment model in the next revision of the stock assessment model (outcome of this proposal is to identify potential rigorous relationships that could be included)
5. Report prepared summarising study findings and implications for management
6. Results communicated to relevant stakeholders, including AFMA, TSRA, TRLRAG, including also a plain English short version of project results

## Risk Analysis

Threat: Key staff (E.P., B.G., M.H.) not being available to complete the project.

Contingency: This is a short term (project that should mitigate this risk. Also, there are other staff within CSIRO with similar skills to the key staff that will have a close association with the project and that could complete the project.

Threat: Climate variables for input to model for climate projections not available in time

Contingency: Low risk and this will delay delivery of climate projections to link with related Climate project

## Communication and Community Extension (*Compulsory category for TSSAC Applications*)

(Describe the extension and communication activities planned for the project. End-users are often in the best position to decide the most appropriate outputs, so consider having them describe their output needs. Particular emphasis should be included on communication and extension strategies that are suitable for Traditional Owners and consider 'A Guide for Fisheries Researchers Working In the Torres Strait'<sup>2</sup>)

The results will be communicated to Torres Strait islanders, managers, stakeholders and industry at TRL working group meetings and TRL RAG meetings. The results of this project will be discussed under an agenda item specifically added to the TRLRAG agenda. Depending on the future dates of TRLRAG meetings, discussions on this agenda item may also continue into 2018 even if the project has formally ended. Extension to PNG will be at the PNG bilateral meetings. QLD Fisheries are a member of the TRLRAG and WG and hence this will simultaneously provide an opportunity to provide feedback to QLD Fisheries also. The information may be useful in informing recommendations by the RAG to set sustainable levels of catch and effort. This information will also flow to the PNG fishery managers and incorporate obligations under the catch sharing arrangements. The results will also flow to the Queensland rock lobster fishery since the stock is shared and some non-islander vessels are dual endorsed.

Dissemination of the results of this research will be through progress and final reports; the latter including executive summaries written to include a wide audience.

## Engagement of Aboriginal and Torres Strait Islanders (*Compulsory category for TSSAC Applications*)

(Describe how the project plans to engage Torres Strait Islanders/Prescribed Body Corporates in meaningful and appropriate ways. Include details on the level of engagement and, in particular if employment is included)

This proposal is being developed in response to feedback from Torres Strait Islanders around concerns from increasing climate change impacts and need to understand environmental drivers of variability in the fishery to improve the fishery. The project will take into account local knowledge in the form of information shared at previous and

ongoing TRLRAG and WG meetings, as well as the 2015 CSIRO science capability training workshop, as to on-the-ground observations of environmental changes and their impacts in the Torres Strait – these include for example, observations of sand incursions, lobsters reliance on pearl-shell, lobster increased post-capture mortality in response to high temperatures. A plain English short version of project results will be prepared.

Following preliminary discussions at the TRLRAG meeting (April 2017), the project team will contact TSRA to discuss sharing study findings and facilitate use of water temperature monitored daily at automated weather stations located at Thursday Island, Masig and Saibai. The collection of these data won't be co-ordinated as part of this project, but data will be used in the analyses and the results communicated, as well as any gaps identified from the analyses in this project. A meeting with TSRA will also be arranged to discuss ways to collaborate and share data and outputs from this study, and to collaboratively contribute to the broader climate change projections project.

### **Related Projects and Research Capacity**

This project links closely with the TRL survey and stock assessment project as the outcomes can inform improvement of the models and forecasting ability. The project builds on work done as part of the TRL Management Strategy Evaluation (MSE) project completed in 2012.

The proposal also links with a new proposal led by Beth Fulton (CSIRO) on Decadal scale projection of changes in Australian fisheries stocks under climate change (FRDC project number 2016-139).

CSIRO has conducted TRL population surveys, including seabed habitat monitoring and subsequent stock assessments since 1989. CSIRO has collaborated with Torres Strait islander communities, organizations and individuals throughout its research history to ensure research outcomes are relevant to Torres Strait and Torres Strait islanders are provided with results of the research projects

## SECTION 4 - Schedule of Payments

As a general rule, up to 10% of the total project cost may be provided as an initial payment and a minimum of 30% of the total project cost must be left for the draft and/or final report.

<b>Milestones</b> <i>Details on each milestone must provide sufficient information to justify the milestone cost. The description field will describe the work to be completed for that milestone with the justification field elaborating further on the categories of cost - for example salary splits, details of travel.</i>	<b>Deliverable date (Please refer to instructions)</b>	<b>Schedule of AFMA payment(s) (excluding GST)</b>
Initial payment on contract signing, Collation and Compilation	30/05/17	\$21332.00
		\$0.00
Draft final report	30/11/17	\$27960.00
Final report		\$0.00
<b>TOTAL</b>		<b>\$49292.00</b>

## SECTION 5 - Description of Milestones

**Milestone 1:** Initial payment on contract signing, Collation and Compilation

**Date: 30 May 2017 or when signed**

Financial Year	Salaries	Travel	Operating	Capital	Total
2016/17	\$21092.00	\$0.00	\$240.00	\$0.00	\$21332.00

### Description:

Commence doing Connie model runs

Collate all environmental information

Contribute to compiling information on climate projects for Torres Strait

### Justification:

Time for Bec Gorton to do model simulations

Mick Haywood and Eva Plaganyi to start collating information for study

**Milestone 2:**  
**Draft Final**  
**Report**

**Date:30/11/2017**

Financial Year	Salaries	Travel	Operating	Capital	Total
2017/18	\$27360.00	\$0.00	\$600.00	\$0.00	<b>\$27960.00</b>

**Description:**

Complete all analyses (Connie model runs, collation of environmental variables and analysis to determine relationships plus incorporation of relevant information in stock assessment model; climate variables input to lobster model and climate projections produced)

Results summarised in Draft Final Report and communicated to AFMA and stakeholders.

**Justification:**

Time allocations for project team (EP, BG, MH) to run models and complete analyses and summarise in report

### Special Conditions

*If relevant, this field will be used to assist in contract preparation for any special conditions. Examples of special conditions may relate to IP, marine spatial closures (including access) or any other clauses not specifically contained in the contract.*

*Identify the appropriate Intellectual Property category applicable to this application. Choose ONE from below:*

Code	Description
<b>1</b>	Published, widely disseminated and promoted, and/or training and extension provided. Relates mainly to outputs that will be available in the public domain
<b>2</b>	Published, widely disseminated and promoted, and/or training and extension provided. Related products and/or services developed. Relates mainly to outputs that will largely be available in the public domain, but components may be commercialised or intellectual property protected.

<b>3</b>	Published, widely disseminated and promoted, and/or training and extension provided. Related products and/or services developed. Relates mainly to outputs that may have significant components that are commercialised or intellectual property protected.
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The following IP category applies to this application:1

### Data management

I have searched for existing data ( refer to guidelines on how to search the Australian Spatial Data Directory and Oceans Portal:

[Yes ]

Provide a brief description of the resulting data from the project and how this data will be stored for future protection and access:

Data updates are entered into the existing ORACLE database managed by the TRL survey/assessment project. This database is part in the large ORACLE database managed by CSIRO Oceans and Atmosphere and is fully secure. All data will be checked for errors and updated where possible in collaboration with the data providers.

Data management should include a description of the data to be produced by the research and show details on the following aspects:

Data security or privacy issues,  
applying to the data  
Nominated data custodian

Environmental data form TRL surveys currently stored in  
Oracle database and new data will be added  
Data custodian: Rob Campbell; Mick Haywood

<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>MEETING No. 21 12-13 December 2017</b>
<b>Stock Assessment update and Recommended Biological Catch</b>	<b>Agenda Item 7 FOR discussion and advice</b>

## RECOMMENDATION

1. The RAG **consider** the preliminary stock assessment update for the Torres Strait Tropical Rock Lobster Fishery following the November 2017 pre-season survey to be presented by the Scientific Member;
2. The RAG **discuss** and **provide advice** on the preliminary Recommended Biological Catch (RBC) for the 2017/18 fishing season; and
3. The RAG **note** that a final updated stock assessment will be presented at the next RAG meeting tentatively scheduled for March/April 2018. RAG advice on the preliminary RBC will be recorded in the meeting record and taken into account in the final updated stock assessment.
4. The RAG **note** that final advice on the RBC for the 2017/18 fishing season will be sought at the RAG's March/April 2018.

## KEY ISSUES

1. The 2017/18 RBC is to be calculated using the integrated fishery stock assessment model and interim harvest strategy (see below).
2. A preliminary stock assessment update will be presented to the RAG by the Scientific Member. The stock assessment update incorporates catch and effort data for the 2016/17 fishing season, historic catch and effort information and the pre-season survey conducted in November 2017.
3. The empirical harvest control rule (eHCR) and final TRL Harvest Strategy have not been agreed by the PZJA.

## Interim TRL Harvest Strategy

- $B_0$  = varied between 0.65 and 0.80 of unfished biomass
- $B_{TARG} = 0.65 B_0$
- $B_{THRES}$  is the RAG-agreed threshold biomass level below which more stringent rules for calculating the TAC apply,  $B_{THRES} = 0.48$ .
- $B_{LIM} = 0.4 B_0$
- $F_{TARG} = 0.15 \text{ year}^{-1}$
- $F_{LIM} = F_{TARG}$

# Separating TIB, TVH and Processor catch records from Docket-Book Data – 2017 Update

*Robert Campbell<sup>1</sup> and Dean Pease<sup>2</sup>*

1. *CSIRO Oceans and Atmosphere Flagship, Melbourne*
2. *Australian Fisheries Management Authority, Thursday Island*

December 2017

## 1. Introduction

The Torres Strait Seafood Buyers and Processors Docket Book (TDB01) was used in the Torres Strait Tropical Rock Lobster Fishery (the fishery) principally to record the catch and effort for fishers operating in the TIB sector of the fishery. The Docket Book (TDB01) was replaced on 1 December 2017 by the mandatory Torres Strait Catch Disposal Record (TDB02). This report recommends data rules that should be applied to the historical Docket Book (TDB01) data to accurately determine the traditional inhabitant boat (TIB) sector catch.

In principle, the completed Docket Book form was a receipt given to the fisher landing the catch by the processor to which the lobsters are sold. Due to the receipt-like nature of the Docket-Book the reported catches can also be reported in other formats, including the Torres Strait Tropical Rock Lobster Fishery Daily Fishing Log (TRL04). Catches sold between processors can also sometimes be recorded in the Docket-Book. Reporting of TVH catches and catch sold between processors means that duplicate catch records are created resulting in some degree of uncertainty and difficulty in ascertaining the true total catch taken by the TIB sector of the fishery.

Several mechanisms have been introduced to help identify duplicate catch records included in the Docket-Book data. First, there is a specific field on the Docket-Book which asks whether the fisher (identified by the data label SELLER-NAME) has recorded their catch elsewhere. Where this has occurred, the seller is requested to identify where the catch has been recorded (the data label is called the RELATED-LOG). For example, TVH sellers would report that the catch has been recorded in the TRL04 logbook, while sellers identified as processors may indicate that the catch has been recorded in the TDB01 docket-book. In such instances these duplicate catch records can be separated from the TIB sector catch data. Where the RELATED-LOG field is null it is interpreted that the catch data has not been recorded elsewhere and the catch data is related to the TIB sector. However, there are a range of other entries in this field, for example the Torres Strait Hand Collectable Daily Fishing Log (HC01), the Torres Strait Hand Collectable Catch Disposal Record (HC02), Torres Strait Finfish Daily Fishing Log (TSF01), NSS BESI, etc..

Second, around 2006 an additional field (SELLER-TYPE) was added to the Docket-Book data to indicate whether the seller is a TIB or TVH sector licence holder or a processor. This field is used to identify and remove duplicate TVH catch records and duplicate records of catch sold between processors. It was based on linking the SELLER-NAME on the Docket-Book to the SELLER-TYPE (TIB, TVH or processor) in a Microsoft Excel look-up table. However, the list of SELLER-NAMES and SELLER-TYPES is now out of date, and together with the fact that the SELLER-NAMES are often misspelt or a nick-name is used, the SELLER-TYPE most often remains unknown. This reduces the utility of this data field to identify the SELLER-TYPE.

Using both the SELLER-TYPE and RELATED-LOG fields defined above, together with the vessel symbol (e.g. the symbol for most TVH vessels start with an 'F'), it should be possible to identify and remove non-TIB catch records and duplicate catch records from the Docket-Book data. Together with the two data fields identified above, the following fields are also used in this analysis:

1. LOG-TYPE: identifies where the data was originally recorded (for example; TDB01, TRL04, HC01, HC02, TSF01).



2. SELLER-TYPE (S-TYPE): identifies seller-type (TIB, TVH or processor).
3. RELATED-LOG: identifies the other logbook where the catch has been recorded
4. VESSEL-TYPE: identifies the type of vessel. This is a data field added by CSIRO to identify vessels with a symbol also listed in the TVH logbook data (denoted TVH-Vessel) and vessels with a symbol beginning in 'F' but not in the TVH logbook data (denoted F-Symbol).
5. CLIENT-NAME: identifies the business purchasing the catch being sold by the fisher.
6. RECORD-NUMBER: identifies the unique record number of the Docket-Book form relating to the landed catch sold by a fisher on a given day.

This document outlines the data analysis undertaken and the Data-Rules identified to assign a DATA-TYPE (TIB, TVH or Processor) to each Docket-Book record. In particular, the analysis proceeds by investigating the data utilizing the information in each of the data fields listed and defined above. A summary of all Docket-Book data currently held by CSIRO classified according to the combination of several of the data fields listed above is shown in Table 2.

## 2. Log-Type

The LOG-TYPE field identifies the source of the data and the five log-types listed in Table 1 relate to the data sources:

DocketBook	: based on catch recorded in the TDB01 Docket-Book and provided annually by AFMA as separate Operations and Catch data-sets.
Combined	: based on catch recorded in the TDB01 Docket-Book and provided by AFMA as a single combined Operations and Catch table prior to 2012.
LogBook	: based catch recorded in the TRL04 Log-Book but subsequently identified as TIB catch.
PEARL	: aggregate annual catch only data provided by Pearl Islands Seafood Pty Ltd for the years 2013 to 2016.
TORRES	: aggregate annual catch only data provided by Torres Straits Seafood Pty Ltd for 2016.

### *TIB vessels using TVH-logbook*

The data listed in Table 1 includes 713 records which are related to large TIB vessels which recorded their catch in the TRL04 logbook. This occurred for a period of time because some TIB operators believed the TRL04 logbook was mandatory, though they later became aware reporting for TIB is currently voluntary, until the *Torres Strait Fisheries Act 1984* is amended to require the TIB sector to report. A listing of these vessels is provided in Table 1. These records are assigned the DATA-TYPE='TIB' under Data-Rule #1.

Table 1. Listing of TIB vessels where catch has been recorded in the TRL04 logbook.

LOG-TYPE	VESSEL	N-RECORDS	MIN-YR	MAX-YR
LogBook	BI173	83	2011	2013
LogBook	FXAY	305	2000	2010
LogBook	TRAWQ348	57	2014	2015
LogBook	TRAWQ456	21	2012	2012
LogBook	TRAWQ458	179	2012	2013
LogBook	TRAWQ460	68	2012	2013
Total		713		

### *Data Not Recorded in Docket-Book*

Between 2013 and 2016 two processors reported aggregate annual catch data by a Microsoft Excel spreadsheet, as these catches were not being recorded in the TDB01 Docket-Book. Each client reported the catch for tailed and whole lobsters separately, so that for each year that this data was provided two data records were added to the Docket-Book data. These records are assigned the DATA-TYPE='TIB' under Data-Rule #2.

Table 2. Classification of Docket-Book data held by CSIRO classified according to several related data fields defined in the text. Note: N-RECORDS is the number of unique RECORD-NUMBERS associated with each set of data.

LOG-TYPE	SELLER-TYPE	RELATED-LOG	VESSEL-TYPE	N-RECORDS
Combined	PRC	TDB01		95
Combined	PRC	TRL04		3
Combined	PRC			39
Combined	TIB			115
Combined	TVH	TRL04	F_SYMBOL	13
Combined	TVH	TRL04	TVH VESSEL	204
Combined	TVH	TRL04		146
Combined	TVH		TVH VESSEL	6
Combined	TVH			166
Combined	U	OTHER	TVH VESSEL	1
Combined	U	OTHER		46
Combined	U	PEARL ISLAND		3
Combined	U	TDB01		44
Combined	U	TRL04	TVH VESSEL	1
Combined	U	TRL04		15
Combined	U		F_SYMBOL	360
Combined	U		TVH VESSEL	94
Combined	U			34,656
DocketBook	PRC	TDB01		61
DocketBook	PRC	TRL04	TVH VESSEL	25
DocketBook	PRC	TRL04		16
DocketBook	PRC		TVH VESSEL	1
DocketBook	PRC			11
DocketBook	TIB	TDB01		10
DocketBook	TIB	TRL04		6
DocketBook	TIB			3,886
DocketBook	TVH	TDB01 : TRL04	TVH VESSEL	1
DocketBook	TVH	TRL04	F_SYMBOL	10
DocketBook	TVH	TRL04	TVH VESSEL	90
DocketBook	TVH	TRL04		149
DocketBook	TVH		F_SYMBOL	1
DocketBook	TVH		TVH VESSEL	10
DocketBook	TVH			536
DocketBook	U	TDB01	TVH VESSEL	7
DocketBook	U	TDB01		233
DocketBook	U	TRL04	F_SYMBOL	15
DocketBook	U	TRL04	TVH VESSEL	505
DocketBook	U	TRL04		293
DocketBook	U		TVH VESSEL	41
DocketBook	U			8,483
DocketBook				1
LogBook	TIB	TRL04		713
PEARL	TIB			8
TORRES	TIB			2
TOTAL				51,121

### 3. Seller-Type

Of the data records not yet assigned a DATA-TYPE i.e. (Log-Type either Docket-Book or Combined in Table 1) there are four different SELLER-TYPES:

- PRC : Seller/catch associated with Processor
- TVH : Seller/catch associated with TVH sector
- TIB : Seller/catch associated with TIB sector
- U : Unknown (i.e. left blank)

#### *Processor, PRC*

Based on the information provided above, records where SELLER-TYPE is a processor (PRC) relate to catches sold between different processors and therefore should be considered to be duplicate catch records in the Docket-Book data. A summary of the 251 records where SELLER-TYPE = 'PRC' is provided in Table 3. A majority of these records (200, or 80%) indicate that the catch has been recorded in another format, which is to be expected if these are catches being sold between processors (and therefore duplicate records). However, if this is the case then why a vessel-name is listed against several of these records remains unclear. Furthermore, it can be noted that of the nine SELLER-NAMES listed three correspond to personal names (Joseph Dai, Miroslav Vaculka and Richard Wilfred Bowie). A check indicates that Joseph Dai is a TIB fisher, Richard Bowie is a processor (Argun Seafood Pty Ltd) based on Badu Island, while Miroslav Vaculka works on TVH vessel. As such all records in Table 3 were considered to be duplicate catch records (assigned to the DATA-TYPE='PRC' under Data-Rule #3 except for: i) those associated with Joseph Dai (n=1) which were assigned to the DATA-TYPE='TIB' under Data-Rule #3A, and ii) those associated with Miroslav Vaculka (n=6) which were assigned to the DATA-TYPE='TVH' under Data-Rule #3B. For the 244 records listed in Table 3 and designated as processor records, a listing of the associated Clients (c.f. Table 4) indicates that in all cases the catches were sold to another processor.

Table 3. Summary of Docket-Book data where SELLER-TYPE='PRC'. (Note, S-TYPE=SELLER-TYPE, MIN-YR=first year in data, MAX-YR=last year in data)

SELLER-NAME	LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
ARGUN SEAFOODS PTY LTD	DocketBook	PRC	TDB01			27	2015	2017
	DocketBook	PRC				6	2014	2014
CAPE YORK ICE AND TACKLE	Combined	PRC	TDB01			2	2010	2010
JOSEPH DAI	DocketBook	PRC				1	2014	2014
LENREX PTY LTD	Combined	PRC				3	2010	2010
	DocketBook	PRC	TDB01			5	2012	2016
	DocketBook	PRC				1	2012	2012
	DocketBook	PRC	TRL04	FVWJ	TVH VESSEL	25	2013	2015
M G KAILIS PTY LTD	DocketBook	PRC	TRL04			10	2013	2015
	DocketBook	PRC		FVWJ	TVH VESSEL	1	2013	2013
MIROSLAV VACULKA	DocketBook	PRC	TRL04			5	2015	2015
	DocketBook	PRC				1	2015	2015
PEARL ISLAND SEAFOODS PTY LTD	DocketBook	PRC	TDB01			29	2016	2017
	DocketBook	PRC	TRL04			1	2017	2017
RICHARD WILFRED BOWIE	Combined	PRC	TDB01	BI115		2	2007	2007
	Combined	PRC	TDB01			85	2007	2010
	Combined	PRC	TRL04			3	2007	2010
	Combined	PRC		BI115		4	2007	2008
	Combined	PRC				23	2007	2010
TRADEWINDS SEAFOODS	DocketBook	PRC				2	2012	2016
	Combined	PRC	TDB01			6	2010	2010
	Combined	PRC				9	2010	2010
TOTAL						251		

Table 4. Listing of the Clients associated with SELLER-TYPE='PRC' records listed in Table 3 and designated as processor records.

SELLER-NAME	CLIENT-NAME	N-RECORDS
ARGUN SEAFOODS PTY LTD	KAILIS BROS PTY LTD	6
	M G KAILIS PTY. LTD.	27
CAPE YORK ICE AND TACKLE LENREX PTY LTD	PEARL ISLAND SEAFOOD	2
	KAILIS BROS PTY LTD	1
M G KAILIS PTY LTD	M G KAILIS PTY. LTD.	7
	PEARL ISLAND SEAFOOD	1
	M G KAILIS PTY. LTD.	36
PEARL ISLAND SEAFOODS PTY LTD	KAILIS BROS PTY LTD	15
	M G KAILIS PTY. LTD.	15
RICHARD WILFRED BOWIE	ARGUN SEAFOODS PTY LTD	2
	PEARL ISLAND SEAFOOD	111
	RICHARD WILFRED BOWIE	2
	TANALA SEAFOODS	4
TRADEWINDS SEAFOODS	PEARL ISLAND SEAFOOD	15
TOTAL		244

### *Business Names*

A check of the list of all SELLER-NAMES in the Docket-Book data indicates the existence of nineteen other business-names which may be associated with a processor but where the SELLER-TYPE has not been recorded as a processor (i.e. has either been reported as TIB, TVH or left blank). A summary of the Docket-Book data related to the 823 records for these other businesses is provided in Table 5 (note, this is not a list of all businesses in the fishery). It is acknowledged that individual fishers may operate under a business name, in which case the data listed in Table 5 may relate to catches sold by fishers instead of catches on-sold by processors (as was the case with the data listed in Table 3). Indeed, if the former situation applies to these data then the SELLER-TYPE field should indicate which sector of the fishery each set of records belongs. However, unfortunately 95% of the records listed in Table 5 are associated with an unknown SELLER-TYPE, with the remaining 5% associated with a TVH SELLER-TYPE. On the other hand, the majority (61%) of related records (and 61% of the associated catch) summarized in Table 5 indicate that the catch has been recorded in the TRL04 logbook, while 38% of records (and 35% of the catch) is associated with a TVH vessel.

Some checks were first undertaken on the three businesses listed in Table 5 which were also listed in Table 3 (Argun Seafoods Pty Ltd, Pearl Islands Seafood Pty Ltd and Tradewinds Seafoods Pty Ltd). As the SELLER-TYPE associated with these three businesses in Table 5 is unknown, it remains uncertain as to whether the catch records are processor-to-processor trading and therefore should be treated as duplicate catch records.

First, for Argun Seafoods Pty Ltd, the associated SELLER-TYPE is listed as unknown (i.e. was left blank) for all records up until July 2014 while after this time the SELLER-TYPE is listed as PRC for all records. To be consistent with the data handling practices (as recorded in these latter years) all records associated with Argun Seafoods Pty Ltd data were considered duplicate records and were therefore assigned to the DATA-TYPE='PRC' under Data-Rule #3. This assumes that before June 2014 the SELLER-TYPE field was left blank instead of 'PRC' (c.f. Table 3). This assumption is supported by the fact that the client for all 26 records is MG Kailis Pty Ltd which indicates a processor-to-processor transaction (c.f. Table 6).

Second, for Pearl Islands Seafood Pty Ltd there is TDB01 data for the years 2012 to 2017. For the years 2012-15 the associated SELLER-TYPE was left blank while for the years 2016-17 the SELLER-TYPE is listed as PRC. Assuming that all records should have been labeled 'PRC' for all years (for consistency as above for the other processors), the 1,689 records associated with Pearl Islands Seafood Pty Ltd in Table 4 were assigned the DATA-TYPE='PRC' under Data-Rule #3. Again, this assumption is supported by the fact that the client for all 231 records is MG Kailis Pty Ltd which indicates a processor-to-processor transaction (c.f. Table 6).

Table 5. Summary of Docket-Book data where SELLER-NAME is identified as a business but SELLER-TYPE!= 'PRC'. (Note, S-TYPE= Seller-Type).

SELLER-NAME	LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
ARGUN SEAFOODS PTY LTD	DocketBook	U	TDB01			21	2012	2014
	DocketBook	U				5	2012	2014
BARRIER REEF LIVE CRAYS	DocketBook	TVH	TDB01 : TRL04	FVWJ	TVH VESSEL	1	2012	2012
	DocketBook	TVH	TRL04	FVWJ	TVH VESSEL	17	2012	2012
	DocketBook	TVH	TRL04			6	2012	2013
CIEJAM PTY LTD	DocketBook	U	TDB01			2	2016	2016
	DocketBook	U	TRL04	FRJP	TVH VESSEL	3	2015	2015
	DocketBook	U	TRL04	FVFD	TVH VESSEL	11	2014	2015
	DocketBook	U	TRL04			34	2014	2017
DIAKEN PTY LTD	DocketBook	TVH	TRL04	FQNQ	TVH VESSEL	3	2012	2012
	DocketBook	TVH	TRL04	FXHP	TVH VESSEL	7	2012	2012
	DocketBook	TVH		FQNQ	TVH VESSEL	1	2012	2012
	DocketBook	U	TDB01	FQNQ	TVH VESSEL	3	2012	2012
	DocketBook	U	TDB01	FXHP	TVH VESSEL	1	2014	2014
	DocketBook	U	TDB01			3	2016	2017
	DocketBook	U	TRL04	FQNQ	TVH VESSEL	71	2012	2015
	DocketBook	U	TRL04	FXHP	TVH VESSEL	66	2012	2017
	DocketBook	U	TRL04			54	2012	2017
	DocketBook	U		FQNQ	TVH VESSEL	1	2012	2012
	DocketBook	U		FXHP	TVH VESSEL	1	2013	2013
	DocketBook	U				1	2014	2014
E-FISHIENT PTY LTD	DocketBook	U	TDB01			1	2016	2016
	DocketBook	U	TRL04	FXVK	TVH VESSEL	30	2012	2017
	DocketBook	U	TRL04	FYGN	TVH VESSEL	2	2015	2017
	DocketBook	U	TRL04			32	2012	2017
	DocketBook	U		FXVK	TVH VESSEL	1	2012	2012
	DocketBook	U				1	2014	2014
EPAR INVESTMENTS PTY LTD	Combined	U				2	2010	2010
F N Q FISHERIES PTY LTD	DocketBook	U	TRL04	FVWJ	TVH VESSEL	1	2017	2017
	DocketBook	U	TRL04	FXVC	F_SYMBOL	13	2014	2015
	DocketBook	U	TRL04			26	2014	2017
HENJONVAL PTY LTD	Combined	U		BI173		2	2011	2011
	Combined	U		BI179		1	2011	2011
	Combined	U				1	2011	2011
	DocketBook	U	TRL04	BI173		2	2012	2012
	DocketBook	U	TRL04			2	2012	2012
	DocketBook	U				3	2012	2012
LUKEHURST LIVE LOBSTER PTY LTD	DocketBook	U	TRL04			2	2016	2016
N.U.C.H PTY LTD	Combined	TVH	TRL04			1	2004	2004
NATHAN STAN SEAFOODS	Combined	U				1	2006	2006
ORNATUS MARINE PRODUCTS PTY LTD	DocketBook	U	TRL04	FRJP	TVH VESSEL	10	2012	2012
	DocketBook	U	TRL04			2	2012	2012
PEARL ISLAND SEAFOODS PTY LTD	DocketBook	U	TDB01			144	2012	2015
	DocketBook	U	TRL04			8	2013	2015
	DocketBook	U				79	2012	2014
RUFF N TUFF FISHING PTY LTD	DocketBook	U	TRL04	FZAP	TVH VESSEL	12	2012	2013
	DocketBook	U	TRL04			1	2012	2012
TK FISHERIES	DocketBook	U	TRL04	TRAWQ460		3	2012	2012
	DocketBook	U	TRL04			7	2013	2016
	DocketBook	U		TRAWQ460		8	2012	2013
	DocketBook	U				18	2012	2015
TORRES CRAYS PTY LTD	DocketBook	U	TRL04	FVFD	TVH VESSEL	32	2012	2014
	DocketBook	U	TRL04			8	2012	2013
	DocketBook	U		FVFD	TVH VESSEL	3	2012	2013
TRADEWINDS SEAFOODS	Combined	U	TDB01			3	2010	2010
	Combined	U				3	2010	2010
VANIKO MARINE PRODUCTS	DocketBook	U	TDB01	FWDZ	TVH VESSEL	3	2014	2014
	DocketBook	U	TRL04	FRJP	TVH VESSEL	1	2012	2012
	DocketBook	U	TRL04	FWDZ	TVH VESSEL	22	2012	2014
	DocketBook	U	TRL04	FWED	F_SYMBOL	2	2012	2012
	DocketBook	U	TRL04	FZAT	TVH VESSEL	5	2013	2013
	DocketBook	U	TRL04			8	2012	2014
	DocketBook	U		FWDZ	TVH VESSEL	2	2012	2012
WAKAID CORAL SEAS CO PTY LTD	Combined	TVH				2	2010	2010
	Combined	U				1	2010	2010
TOTAL						823		

Table 6. Listing of the Clients associated with the Docket-Book records where SELLER-NAME is identified as a business but SELLER-TYPE!=‘PRC’. (c.f. Table 5).

SELLER-NAME	CLIENT-NAME	N-RECORDS	MIN-YR	MAX-YR
ARGUN SEAFOODS PTY LTD	M G KAILIS PTY. LTD.	26	2012	2014
BARRIER REEF LIVE CRAYS	M G KAILIS PTY. LTD.	24	2012	2013
CIEJAM PTY LTD	KAILIS BROS PTY LTD	10	2016	2017
	M G KAILIS PTY. LTD.	40	2014	2016
DIAKEN PTY LTD	KAILIS BROS PTY LTD	16	2016	2017
	M G KAILIS PTY. LTD.	196	2012	2016
E-FISHIENT PTY LTD	KAILIS BROS PTY LTD	11	2016	2017
	M G KAILIS PTY. LTD.	56	2012	2016
EPAR INVESTMENTS PTY LTD	PEARL ISLAND SEAFOOD	2	2010	2010
F N Q FISHERIES PTY LTD	KAILIS BROS PTY LTD	8	2016	2017
	M G KAILIS PTY. LTD.	32	2014	2016
HENJONVAL PTY LTD	TORRES STRAITS SEAFOOD	7	2012	2012
		4	2011	2011
LUKEHURST LIVE LOBSTER PTY LTD	TORRES STRAITS SEAFOOD	2	2016	2016
N.U.C.H PTY LTD	M G KAILIS PTY. LTD.	1	2004	2004
NATHAN STAN SEAFOODS	PEARL ISLAND SEAFOOD	1	2006	2006
ORNATUS MARINE PRODUCTS PTY LTD	M G KAILIS PTY. LTD.	12	2012	2012
PEARL ISLAND SEAFOODS PTY LTD	M G KAILIS PTY. LTD.	231	2012	2015
RUFF N TUFF FISHING PTY LTD	M G KAILIS PTY. LTD.	13	2012	2013
TK FISHERIES	TORRES STRAITS SEAFOOD	36	2012	2016
TORRES CRAYS PTY LTD	M G KAILIS PTY. LTD.	43	2012	2014
TRADEWINDS SEAFOODS	PEARL ISLAND SEAFOOD	6	2010	2010
VANIKO MARINE PRODUCTS	M G KAILIS PTY. LTD.	40	2012	2014
	TORRES STRAITS SEAFOOD	3	2012	2012
WAKAID CORAL SEAS CO PTY LTD	PEARL ISLAND SEAFOOD	3	2010	2010
TOTAL		823		

Third, for Tradewinds Seafoods Pty Ltd, there is data only for the year 2010. During this year, the associated SELLER-TYPE is listed as PRC for all records up until 8-July while after this time and until the end of October the SELLER-TYPE is listed as unknown (i.e. was left blank). The SELLER-TYPE is again listed as PRC for December. Again, for consistency throughout this year all records associated with Tradewinds Seafoods Pty Ltd data were seen as being duplicate processor records and were therefore assigned to the DATA-TYPE=‘PRC’ under Data-Rule #3. Again, this assumes that Records with the SELLER-TYPE field that were left blank have been corrected to ‘PRC’ for several months in 2010 (c.f. Table 5). Again, this assumption is supported by the fact that the client for all 6 records is Pearl Islands Seafood Pty Ltd which indicates a processor-to-processor transaction (c.f. Table 6).

For the three processors listed above a total of 263 records (and 568,808 kg of associated catch) are attributed to processor trading (cf. Table 7).

For the other sixteen businesses listed in Table 5, a check of license information found that the records associated with the nine business names Barrier Reef Crays, Daiken, E-Fishient, EPAR Investments, FNQ Fisheries, Ornatus, Ruff-N-Tuff, Torres Crays and Vaniko Marine are associated with the TVH sector and as such the associated records for these businesses were assigned the DATA-TYPE=‘TVH’ under Data-Rule #4A.

An additional check indicated that for the nine businesses listed above each had a least one set of records listed in Table 5 where either the SELLER-TYPE or VESSEL-TYPE was listed as TVH whilst for most records (98.9%) the CLIENT was either MG Kailis Pty Ltd or Kailis Bros Pty Ltd (c.f. Table 6). A check through the other seven business names listed in Table 5 indicated that such a co-association of SELLER\_TYPE, VESSEL\_TYPE or CLIENT was only associated with two other business names: CIEJAM Pty Ltd and N.U.C.H Pty Ltd. Accordingly, it was decided that all records associated with these two businesses should also be identified as TVH and accordingly were assigned the DATA-TYPE=‘TVH’ under Data-Rule #4A.

Table 7. Allocation of Docket-Book data where Seller-Name is a Business but Seller-Type!=‘PRC’.

i) PROCESSOR

SELLER-NAME	LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
ARGUN SEAFOODS PTY LTD	DocketBook	U	TDB01			21	2012	2014
	DocketBook	U				5	2012	2014
PEARL ISLAND SEAFOODS PTY LTD	DocketBook	U	TDB01			144	2012	2015
	DocketBook	U	TRL04			8	2013	2015
	DocketBook	U				79	2012	2014
TRADEWINDS SEAFOODS	Combined	U	TDB01			3	2010	2010
	Combined	U				3	2010	2010
TOTAL						263		

ii) TVH Sector

SELLER-NAME	LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
BARRIER REEF LIVE CRAYS	DocketBook	TVH	TDB01 : TRL04	FVWJ	TVH VESSEL	1	2012	2012
	DocketBook	TVH	TRL04	FVWJ	TVH VESSEL	17	2012	2012
	DocketBook	TVH	TRL04			6	2012	2013
CIEJAM PTY LTD	DocketBook	U	TDB01			2	2016	2016
	DocketBook	U	TRL04	FRJP	TVH VESSEL	3	2015	2015
	DocketBook	U	TRL04	FVFD	TVH VESSEL	11	2014	2015
	DocketBook	U	TRL04			34	2014	2017
DIAKEN PTY LTD	DocketBook	TVH	TRL04	FQNN	TVH VESSEL	3	2012	2012
	DocketBook	TVH	TRL04	FXHP	TVH VESSEL	7	2012	2012
	DocketBook	TVH		FQNN	TVH VESSEL	1	2012	2012
	DocketBook	U	TDB01	FQNN	TVH VESSEL	3	2012	2012
	DocketBook	U	TDB01	FXHP	TVH VESSEL	1	2014	2014
	DocketBook	U	TDB01			3	2016	2017
	DocketBook	U	TRL04	FQNN	TVH VESSEL	71	2012	2015
	DocketBook	U	TRL04	FXHP	TVH VESSEL	66	2012	2017
	DocketBook	U	TRL04			54	2012	2017
	DocketBook	U		FQNN	TVH VESSEL	1	2012	2012
	DocketBook	U		FXHP	TVH VESSEL	1	2013	2013
	DocketBook	U				1	2014	2014
E-FISHIENT PTY LTD	DocketBook	U	TDB01			1	2016	2016
	DocketBook	U	TRL04	FXK	TVH VESSEL	30	2012	2017
	DocketBook	U	TRL04	FYGN	TVH VESSEL	2	2015	2017
	DocketBook	U	TRL04			32	2012	2017
	DocketBook	U		FXK	TVH VESSEL	1	2012	2012
	DocketBook	U				1	2014	2014
EPAR INVESTMENTS PTY LTD	Combined	U				2	2010	2010
F N Q FISHERIES PTY LTD	DocketBook	U	TRL04	FVWJ	TVH VESSEL	1	2017	2017
	DocketBook	U	TRL04	FXK	F_SYMBOL	13	2014	2015
	DocketBook	U	TRL04			26	2014	2017
N.U.C.H PTY LTD	Combined	TVH	TRL04			1	2004	2004
ORNATUS MARINE PRODUCTS PTY LTD	DocketBook	U	TRL04	FRJP	TVH VESSEL	10	2012	2012
	DocketBook	U	TRL04			2	2012	2012
RUFF N TUFF FISHING PTY LTD	DocketBook	U	TRL04	FZAP	TVH VESSEL	12	2012	2013
	DocketBook	U	TRL04			1	2012	2012
TORRES CRAYS PTY LTD	DocketBook	U	TRL04	FVFD	TVH VESSEL	32	2012	2014
	DocketBook	U	TRL04			8	2012	2013
	DocketBook	U		FVFD	TVH VESSEL	3	2012	2013
VANIKO MARINE PRODUCTS	DocketBook	U	TDB01	FWDZ	TVH VESSEL	3	2014	2014
	DocketBook	U	TRL04	FRJP	TVH VESSEL	1	2012	2012
	DocketBook	U	TRL04	FWDZ	TVH VESSEL	22	2012	2014
	DocketBook	U	TRL04	FWED	F_SYMBOL	2	2012	2012
	DocketBook	U	TRL04	FZAT	TVH VESSEL	5	2013	2013
	DocketBook	U	TRL04			8	2012	2014
	DocketBook	U		FWDZ	TVH VESSEL	2	2012	2012
TOTAL						507		

iii) TIB Sector

SELLER-NAME	LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
HENJONVAL PTY LTD	Combined	U		BI173		2	2011	2011
	Combined	U		BI179		1	2011	2011
	Combined	U				1	2011	2011
	DocketBook	U	TRL04	BI173		2	2012	2012
	DocketBook	U	TRL04			2	2012	2012
	DocketBook	U				3	2012	2012
LUKEHURST LIVE LOBSTER PTY LTD	DocketBook	U	TRL04			2	2016	2016
NATHAN STAN SEAFOODS	Combined	U				1	2006	2006
TK FISHERIES	DocketBook	U	TRL04	TRAWQ460		3	2012	2012
	DocketBook	U	TRL04			7	2013	2016
	DocketBook	U		TRAWQ460		8	2012	2013
	DocketBook	U				18	2012	2015
WAKAID CORAL SEAS CO PTY LTD	Combined	TVH				2	2010	2010
	Combined	U				1	2010	2010
TOTAL						53		

For the eleven businesses identified as TVH a total of 507 records (and 1,009,847 kg of associated catch) were attributed to the TVH catch (cf. Table 7).

Of the remaining five business-names listed in Table 5, the records for Henjonval Pty Ltd and TK Fisheries were selected as being associated with the TIB sector as the vessels associated with these records are TIB vessels (c.f. Table 2). Until further checking can be undertaken the records associated with the businesses Lukehurst Live Lobster Pty Ltd, Nathan Stan Seafoods and Wakaid Coral Sea Pty Ltd were also associated with the TIB sector. As such the associated records for these businesses were assigned the DATA-TYPE='TIB' under Data-Rule #4B. Note, unlike the records associated with businesses identified previously as being TVH, for the five businesses identified as being TIB no records had a VESSEL-TYPE listed as TVH (all are blank) nor was the CLIENT listed as either MG Kailis Pty Ltd or Kailis Bros Pty Ltd (the CLIENT associated with all records was either Pearl Islands Seafood Pty Ltd or Torres Straits Seafood Pty Ltd). Furthermore except for two records, the SELLER-TYPE was also not listed as TVH.

For the five businesses identified as TIB a total of 53 records (and 30,240 kg of associated catch) were attributed to the TIB catch (cf. Table 7).

#### *Seller-Type=TVH*

Where SELLER-TYPE='TVH' it is understood that the related catch is from the TVH sector of the fishery and therefore the catch reported in the Docket-Book should be considered as duplicates of TRL04 logbook reported catch. In such instances one would expect the RELATED-LOG field should indicate that the catch has been recorded in the TRL04 logbook.

A summary of the 1,294 records (associated with a catch of 211,606 kg) where SELLER-TYPE = 'TVH' (and DATA-TYPE remains unassigned) is provided in Table 8. As there are a large number (99) of distinct SELLER-NAMEs associated with this data they are not shown. Several things can be noted. First, while the RELATED-LOG field indicates that the catch has also been recorded in the TRL04 logbook for 45% of these records (and 78% of the corresponding catch), this field has been left blank for 55% of the records (and 22% of the corresponding catch). Second, not all the vessels listed are TVH-vessels (i.e. correspond to a vessel listed in the TVH logbook database). The non-TVH vessels represent 78% of the records (and 53% of the corresponding catch) listed in Table 8. Docket-Book records where the SELLER-TYPE is listed as TVH and the RELATED-LOG are listed as TRL04, and the listed vessel is also a known TVH vessel should be interpreted as TVH catches (and therefore seen as duplicates to the catches recorded on the TRL04 logbook). However, it remains less certain as to which sector the other catches should be associated where these fields are either left blank or provide contradictory information (e.g. the SELLER-TYPE is listed as TVH or the RELATED-LOG is listed as TRL04 but the listed vessel is a TIB vessel). If it is reported as a TIB vessel, and this can be verified, then it should be TIB catch. Nevertheless, until this uncertainty can be clarified all records where the SELLER-TYPE is listed as TVH and the VESSEL-TYPE is identified as a TVH vessel were designated as TVH catches. As such the 282 associated records (and the 100,400 kg of associated catch) were assigned the DATA-TYPE='TVH' under Data-Rule #5A.

A further check was undertaken of all remaining records (i.e. where the DATA-TYPE remains unassigned) where the VESSEL-TYPE is designated as a TVH vessel. A summary of the 368 corresponding records is provided in Table 9. Apart from one record, the RELATED LOG is listed as TRL04 or is blank. As above, all records (and the 90,670 kg of associated catch) were also assigned the DATA-TYPE='TVH' under Data-Rule #5A.



Table 8. Summary of Docket-Book data where Seller-Type='TVH' and DATA-TYPE is null.

LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
Combined	TVH	TRL04	FSKR	TVH VESSEL	16	2005	2008
Combined	TVH	TRL04	FUPJ	TVH VESSEL	2	2005	2005
Combined	TVH	TRL04	FVFD	TVH VESSEL	1	2004	2004
Combined	TVH	TRL04	FVGU	TVH VESSEL	6	2005	2007
Combined	TVH	TRL04	FVGX	TVH VESSEL	102	2006	2008
Combined	TVH	TRL04	FVGZ	F_SYMBOL	1	2005	2005
Combined	TVH	TRL04	FWAV	TVH VESSEL	1	2004	2004
Combined	TVH	TRL04	FWCB	TVH VESSEL	15	2004	2008
Combined	TVH	TRL04	FWDZ	TVH VESSEL	3	2007	2007
Combined	TVH	TRL04	FXAY	F_SYMBOL	12	2004	2007
Combined	TVH	TRL04	FXEV	TVH VESSEL	6	2004	2005
Combined	TVH	TRL04	FXHP	TVH VESSEL	1	2005	2005
Combined	TVH	TRL04	FXTN	TVH VESSEL	26	2004	2008
Combined	TVH	TRL04	FYFL	TVH VESSEL	23	2004	2007
Combined	TVH	TRL04	FYGN	TVH VESSEL	1	2004	2004
Combined	TVH	TRL04	HPF	TVH VESSEL	1	2005	2005
Combined	TVH	TRL04	TRAWQ117		1	2008	2008
Combined	TVH	TRL04	TRAWQ166		1	2007	2007
Combined	TVH	TRL04	TRAWQ259		5	2008	2008
Combined	TVH	TRL04	TRAWQ373		2	2010	2010
Combined	TVH	TRL04	TRAWQ432		1	2010	2010
Combined	TVH	TRL04			135	2004	2010
Combined	TVH		BI181		1	2010	2010
Combined	TVH		FWAV	TVH VESSEL	6	2004	2005
Combined	TVH		MAB038		2	2010	2010
Combined	TVH		TDU063		1	2010	2010
Combined	TVH		TRAWQ166		19	2010	2010
Combined	TVH		TRAWQ168		1	2009	2009
Combined	TVH		TRAWQ178		1	2010	2010
Combined	TVH		TRAWQ232		1	2010	2010
Combined	TVH		TRAWQ258		1	2010	2010
Combined	TVH		TRAWQ267		4	2010	2010
Combined	TVH		TRAWQ273		1	2010	2010
Combined	TVH		TRAWQ282		7	2010	2010
Combined	TVH		TRAWQ329		2	2010	2010
Combined	TVH		TRAWQ373		15	2010	2010
Combined	TVH		TRAWQ381		2	2010	2010
Combined	TVH		TRAWQ398		2	2010	2010
Combined	TVH		TRAWQ429		1	2010	2010
Combined	TVH		TRAWQ430		1	2010	2010
Combined	TVH		TRAWQ432		10	2010	2010
Combined	TVH				92	2006	2010
DocketBook	TVH	TRL04	FRJP	TVH VESSEL	1	2012	2012
DocketBook	TVH	TRL04	FSML	TVH VESSEL	2	2013	2013
DocketBook	TVH	TRL04	FXYC	F_SYMBOL	10	2012	2012
DocketBook	TVH	TRL04	FXYK	TVH VESSEL	14	2013	2013
DocketBook	TVH	TRL04	FYGN	TVH VESSEL	25	2012	2013
DocketBook	TVH	TRL04	FZAL	TVH VESSEL	16	2012	2017
DocketBook	TVH	TRL04	FZAM	TVH VESSEL	1	2014	2014
DocketBook	TVH	TRL04	FZAP	TVH VESSEL	3	2013	2017
DocketBook	TVH	TRL04	FZAP-3	TVH VESSEL	1	2017	2017
DocketBook	TVH	TRL04	TRAWQ258		1	2012	2012
DocketBook	TVH	TRL04	TRAWQ348		10	2013	2014
DocketBook	TVH	TRL04	TRAWQ458		4	2012	2013
DocketBook	TVH	TRL04			128	2012	2017
DocketBook	TVH		40215		1	2015	2015
DocketBook	TVH		6772		1	2014	2014
DocketBook	TVH		FSML	TVH VESSEL	2	2013	2013
DocketBook	TVH		FWCB	TVH VESSEL	1	2012	2012
DocketBook	TVH		FWED	F_SYMBOL	1	2012	2012
DocketBook	TVH		FXYK	TVH VESSEL	1	2013	2013
DocketBook	TVH		FZAL	TVH VESSEL	3	2013	2014
DocketBook	TVH		FZAP	TVH VESSEL	1	2017	2017
DocketBook	TVH		FZAT	TVH VESSEL	1	2013	2013
DocketBook	TVH		MDW109		5	2012	2012
DocketBook	TVH		TRAWQ		1	2012	2012
DocketBook	TVH		TRAWQ003		3	2012	2012
DocketBook	TVH		TRAWQ117		4	2012	2012
DocketBook	TVH		TRAWQ129		1	2012	2012
DocketBook	TVH		TRAWQ259		7	2012	2014
DocketBook	TVH		TRAWQ320		2	2012	2012
DocketBook	TVH		TRAWQ329		7	2012	2015
DocketBook	TVH		TRAWQ348		3	2013	2013
DocketBook	TVH		TRAWQ429		1	2012	2012
DocketBook	TVH		TRAWQ458		1	2013	2013
DocketBook	TVH		TRAWQ468		1	2013	2013
DocketBook	TVH				498	2012	2017
TOTAL					1294		

Table 9. Summary of Docket-Book data where VESSEL-TYPE='TVH vessel' and DATA-TYPE is null.

LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
Combined	U	OTHER	FXTN	TVH VESSEL	1	2004	2004
Combined	U	TRL04	FWCB	TVH VESSEL	1	2004	2004
Combined	U		FRJP	TVH VESSEL	1	2010	2010
Combined	U		FSKR	TVH VESSEL	7	2007	2007
Combined	U		FUPJ	TVH VESSEL	13	2004	2006
Combined	U		FVGU	TVH VESSEL	6	2006	2006
Combined	U		FVGX	TVH VESSEL	34	2007	2008
Combined	U		FWAV	TVH VESSEL	8	2004	2004
Combined	U		FWCB	TVH VESSEL	7	2004	2008
Combined	U		FWDZ	TVH VESSEL	1	2007	2007
Combined	U		FXEV	TVH VESSEL	6	2005	2007
Combined	U		FXTN	TVH VESSEL	10	2006	2008
Combined	U		FYFL	TVH VESSEL	1	2004	2004
DocketBook	U	TRL04	FQNQ	TVH VESSEL	5	2013	2013
DocketBook	U	TRL04	FSML	TVH VESSEL	1	2013	2013
DocketBook	U	TRL04	FWCB	TVH VESSEL	3	2012	2012
DocketBook	U	TRL04	FXTN	TVH VESSEL	16	2012	2013
DocketBook	U	TRL04	FYFL	TVH VESSEL	80	2012	2014
DocketBook	U	TRL04	FZAL	TVH VESSEL	15	2012	2014
DocketBook	U	TRL04	FZAM	TVH VESSEL	87	2012	2014
DocketBook	U	TRL04	FZAP	TVH VESSEL	27	2012	2014
DocketBook	U	TRL04	FZAP-3	TVH VESSEL	5	2017	2017
DocketBook	U		FQNQ	TVH VESSEL	1	2013	2013
DocketBook	U		FSML	TVH VESSEL	2	2013	2013
DocketBook	U		FXTN	TVH VESSEL	7	2013	2014
DocketBook	U		FYFL	TVH VESSEL	6	2014	2014
DocketBook	U		FZAL	TVH VESSEL	2	2013	2013
DocketBook	U		FZAM	TVH VESSEL	12	2012	2014
DocketBook	U		FZAP	TVH VESSEL	3	2013	2014
TOTAL					368		

#### *Seller-Type=TIB*

A summary of the 4,017 records where SELLER-TYPE = 'TIB' (and DATA-TYPE remains unassigned) is provided in Table 10. There are 140 distinct SELLER-NAMEs associated with this data. For 97% of the records (and 94% of the catch) there is no further information in the RELATED-LOG or other vessel fields. Where additional vessel information is available (101 records) all listed vessels are TIB vessels. However, there are 6 records where the RELATED-LOG is designated as TRL04 (though the vessel type remain unknown). As noted earlier, there are instances where TIB vessels have recorded catches in the TRL04 logbook (c.f. Table 2), and so it remains plausible that these 6 records may relate to the TIB sector. Given the available information, all 4,107 records (with an associated catch of 154,348 kg) listed in Table 9 were assigned the DATA-TYPE='TIB' under Data-Rule #5B.

Table 10. Summary of Docket-Book data where Seller-Type='TIB' and DATA-TYPE is null.

LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
Combined	TIB		TRAQQ127		1	2010	2010
Combined	TIB		TRAQQ166		71	2010	2010
Combined	TIB		TRAQQ258		24	2010	2010
Combined	TIB		TRAQQ259		3	2010	2010
Combined	TIB		TRAQQ358		1	2010	2010
Combined	TIB				15	2010	2010
DocketBook	TIB	TDB01			10	2016	2016
DocketBook	TIB	TRL04			6	2016	2017
DocketBook	TIB		TRAQQ488		1	2015	2015
DocketBook	TIB				3,885	2013	2017
TOTAL					4,017		

*Seller-Type=U, Unknown*

Finally, a summary of the 43,644 records (associated with a catch of 2,066,925 kg) where SELLER-TYPE = 'U' for unknown (and DATA-TYPE remains unassigned) is provided in Table 11. Unlike the previous summaries the vessel symbol field is not included due to the large number of distinct vessel symbols (644) in this data. As the SELLER-TYPE field does not allow a designation of these records, additional analyses and checks were undertaken as described below.

Table 11. Summary of Docket-Book data where Seller-Type='U' and DATA-TYPE is null.

LOG-TYPE	S-TYPE	RELATED-LOG	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
Combined	U	OTHER	F_SYMBOL	46	2004	2007
Combined	U	PEARL ISLAND		3	2004	2004
Combined	U	TDB01		41	2004	2010
Combined	U	TRL04		15	2010	2011
Combined	U			360	2004	2007
Combined	U			34,645	2004	2011
DocketBook	U	TDB01		62	2014	2016
DocketBook	U	TRL04		104	2012	2017
DocketBook	U			8,368	2012	2017
TOTAL				43,644		

#### 4. Related Log

As noted earlier, when the RELATED-LOG field has been completed this indicates that the catch recorded in the Docket-Book has been recorded in another format, for example the TRL04 logbook, or another TDB01 docket book. Again, where this occurs one needs to check that a double-counting of the corresponding catch does not occur.

*TRL04*

A summary of the 430 records where the RELATED-LOG = 'TRL04' (and the DATA-TYPE remains unassigned) is provided in Table 12. Again, several things can be noted. First, 72% of all records

Table 12. Summary of Docket-Book data where Related-Log='TRL04' and DATA-TYPE is null. Vessels highlighted yellow are known TIB vessels which also recorded catch in the TRL04 Logbook..

LOG TYPE	SELLER	RELATED LOG	VESSEL	VES TYPE	N-RECORDS	MIN_YR	MAX_YR
Combined	TVH	TRL04	FVGZ	F_SYMBOL	1	2005	2005
Combined	TVH	TRL04	FXAY	F_SYMBOL	12	2004	2007
Combined	TVH	TRL04	TRAWQ117	F_SYMBOL	1	2008	2008
Combined	TVH	TRL04	TRAWQ166		1	2007	2007
Combined	TVH	TRL04	TRAWQ259		5	2008	2008
Combined	TVH	TRL04	TRAWQ373		2	2010	2010
Combined	TVH	TRL04	TRAWQ432		1	2010	2010
Combined	TVH	TRL04			135	2004	2010
Combined	U	TRL04	CN088		1	2011	2011
Combined	U	TRL04	CN123		1	2011	2011
Combined	U	TRL04	TRAWQ258		1	2010	2010
Combined	U	TRL04	TRAWQ326		1	2010	2010
Combined	U	TRL04	TRAWQ373		1	2010	2010
Combined	U	TRL04	TRAWQ432		1	2010	2010
Combined	U	TRL04	TRAWQ437		1	2010	2010
Combined	U	TRL04	WI068		1	2010	2010
Combined	U	TRL04	WI104		1	2011	2011
Combined	U	TRL04			6	2010	2011
DocketBook	TVH	TRL04	FXYC	F_SYMBOL	10	2012	2012
DocketBook	TVH	TRL04	TRAWQ258	F_SYMBOL	1	2012	2012
DocketBook	TVH	TRL04	TRAWQ348		10	2013	2014
DocketBook	TVH	TRL04	TRAWQ458		4	2012	2013
DocketBook	TVH	TRL04			128	2012	2017
DocketBook	U	TRL04	130212		1	2012	2012
DocketBook	U	TRL04	BI173		3	2012	2013
DocketBook	U	TRL04	CN114		1	2012	2012
DocketBook	U	TRL04	TRAWQ258		4	2012	2012
DocketBook	U	TRL04	TRAWQ299		3	2012	2012
DocketBook	U	TRL04	TRAWQ348		1	2015	2015
DocketBook	U	TRL04	TRAWQ458		3	2013	2013
DocketBook	U	TRL04			88	2012	2017
TOTAL					430		

(and 71% of the corresponding catch) indicate that the SELLER-TYPE='TVH' (with the remainder being unknown). However, the vessel information associated with these records indicates that none of the records is associated with a known TVH vessel. Second, a number of vessels which are known to have active (or expired) TIB licenses are highlighted in yellow. As these vessels are also listed in Table 2 as being larger TIB vessels which recorded their catch in the TRL04 logbook, the associated data listed in Table 12 for these vessels was checked to endure that the data is not a duplicate of what is recorded in the TRL04 logbook. A check indicates that there are no common dates between the two sets of data and so the catches included in the Docket-Book data are assumed to be in addition to those recorded in the TRL04 logbook. Third, apart from the 21 records associated these three TIB vessels an additional 28 records are also associated with known TIB vessels (as the vessel symbol begins with the letters TRAWQ, CN, WI). Finally, a check of the SELLER\_NAME associated with the vessel symbol '130212' indicates that this is a TIB catch record. As such the 50 records listed in Table 12 associated with known TIB vessels were assigned the DATA-TYPE='TIB' under Data-Rule #6A.

For the other 381 records listed in Table 12 while the RELATED-LOG field indicates that the catch was also reported in the TRL04 logbook (and for 75% of records that the Seller-Type was TVH), nevertheless there is little addition information on which to allocate these records. There is no information on the vessel for 357 of these records while the VESSEL-TYPE is listed as an F-vessel for 23 records. Further analysis is required.

#### *Other Entries*

A summary of the 152 records where Related-Log is either 'TDB01', 'Pearl Island' or some other non-null entry ('NSS BESI', 'TSF01', 'TSF01:TSSB', 'Yam Island', 'T.I.', '13', '9') is provided in Table 13. The following can be noted. First, the SELLER-TYPE for all records is Unknown. Second, 68% of all records (and 84% of the related catch) is associated with records where the RELATED-LOG='TDB01'. An examination of the SELLER-NAMES associated with these records indicates that they are associated with 34 individual personal names. Third, most records where the RELATED-LOG is shown as 'OTHER' occurred during 2004 (except for two records where RELATED-LOG= 'TSF01' in 2005 and 2007). In all instances these records are associated with a SELLER-NAME which is an individual personal name and the three listed vessels are TIB vessels. Finally, the vessels associated with the records where the RELATED-LOG is shown as 'Pearl Island' are also all TIB vessels. Given these findings, all 152 records listed in Table 13 were assigned the DATA-TYPE='TIB' under Data-Rule #6B.

Table 13. Summary of Docket-Book data where Related-Log='TDB01' or some other non-null entry. (Note S-TYPE=Seller-Type).

LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
Combined	U	OTHER	BI013		2	2004	2004
Combined	U	OTHER	CN050		1	2004	2004
Combined	U	OTHER	YKE106		1	2004	2004
Combined	U	OTHER			42	2004	2007
Combined	U	PEARL ISLAND	CN012		1	2004	2004
Combined	U	PEARL ISLAND	CN023		1	2004	2004
Combined	U	PEARL ISLAND	TRAWQ272		1	2004	2004
Combined	U	TDB01			41	2004	2010
DocketBook	U	TDB01	CN084		1	2014	2014
DocketBook	U	TDB01			61	2014	2016
TOTAL					152		

#### *Related-Log=Null*

Finally, a summary of the 44,074 records (with 2,046,320 kg of associated catch) where the RELATED-LOG is Null (and DATA-TYPE remains unassigned) is provided in Table 14. Again, as for Table 11 the vessel name field is not included due to the large number of distinct vessel symbols (648), though the vessel symbol remains unknown for 71% of these records. There is also a large number (1043) of distinct SELLER-NAMES associated with these records. It is noted that 1.6% of the records are

Table 14. Summary of Docket-Book data where Related-Log is Null (and the DATA-TYPE is null).

LOG-TYPE	S-TYPE	RELATED-LOG	VES_TYPE	N-RECORDS	MIN-YR	MAX-YR
Combined	TVH			164	2006	2010
Combined	U		F_SYMBOL	360	2004	2007
Combined	U			34,645	2004	2011
DocketBook	TVH		F_SYMBOL	1	2012	2012
DocketBook	TVH			536	2012	2017
DocketBook	U			8,368	2012	2017
TOTAL				44,074		

associated with a SELLER-TYPE which is TVH, while the SELLER-TYPE is not assigned to the remainder of records. Where the SELLER\_TYPE=TVH or the VESSEL-TYPE=F-Symbol the records were left unassigned. However, the 75,235 records (with 1,978,133 kg of related catch) where both the SELLER\_TYPE and the VESSEL-TYPE are null (the latter indicating either an unknown vessel symbol or a TIB vessel) were assigned a DATA-TYPE='TIB' under Data-Rule #6C.

## 5. Vessel-Type

VESSEL-TYPE is a field that has been added to indicate whether the vessel-symbol listed on the Docket-Book corresponds to a vessel listed in the TVH database (known as a TVH Vessel), and if not whether the vessel-symbol begins with the letter 'F' (as this usually indicates a TVH vessel). If neither of these is the case the VESSEL-TYPE is left blank.

### TVH Vessel

There are 986 records (associated with 24 distinct vessel symbols and a catch of 791,443 kg) in the Docket-Book data where VESSEL-TYPE='TVH Vessel'. A summary for these data is not displayed, as all these records have already been assigned the DATA-TYPE='TVH' under Data-Rules #3, #4A and #5A. While all vessels have a symbol beginning with the letter 'F' (as this corresponds to most vessels in the TVH database, though some TVH vessel symbols are different, e.g. HPF) only 32% of the records (and 19% of the corresponding catch) indicate that the SELLER-TYPE is 'TVH'. Nevertheless, 84% of all records (and 93% of the corresponding catch) indicate that the Docket-Book data is also associated with the RELATED-LOG TRL04. Such an association is to be expected if the catch data relates to the TVH sector of the fishery.

### F-Symbol

A summary of the 384 records where VESSEL-TYPE='F-Symbol' (and DATA-TYPE remained unassigned) is provided in Table 15. Again, several things can be noted. First, 6% of all records (and 42% of the corresponding catch) indicate that the Docket-Book data is also associated with the RELATED-LOG TRL04, while the same records (except for 1) also indicate that the SELLER-TYPE

Table 15. Summary of Docket-Book data where VES-Type='F-Symbol' and DATA-TYPE is Null. Vessels highlighted yellow are TIB and vessels highlighted in green are TVH.

LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
Combined	TVH	TRL04	FVGZ	F_SYMBOL	1	2005	2005
Combined	TVH	TRL04	FXAY	F_SYMBOL	12	2004	2007
Combined	U		FSYE	F_SYMBOL	1	2004	2004
Combined	U		FVHA	F_SYMBOL	6	2004	2004
Combined	U		FXAY	F_SYMBOL	43	2004	2007
Combined	U		FXJG	F_SYMBOL	1	2004	2004
Combined	U		FXZS	F_SYMBOL	281	2004	2007
Combined	U		FYSE	F_SYMBOL	25	2004	2006
Combined	U		FYTQ	F_SYMBOL	3	2004	2005
DocketBook	TVH	TRL04	FXYC	F_SYMBOL	10	2012	2012
DocketBook	TVH		FWED	F_SYMBOL	1	2012	2012
TOTAL					384		

is 'TVH'. Second, vessels which are believed to be either TIB or TVH vessels are highlighted in yellow and green respectively. The two vessels FVGZ and FXAY are unknown TVH distinguishing symbols that reported a TVH SELLER-TYPE and TRL04 RELATED-LOG. It is possible that the data entry for these records was misspelt, or that the records were incorrectly coded to the TVH sector. However, a further check of the SELLER-NAMEs associated with these records indicate that they are TIB. It is possible that they were working on a TVH vessel for a period of time and also worked on a TIB dinghy in between trips on the TVH vessel. Note, the vessels FXYC and FWED were designated as TVH under Data-Rule #4A (c.f. Table 7-ii). Given these results, all records associated in Table 15 (except for vessels FWED and FXYC) were assigned the DATA-TYPE='TIB' under Data-Rule #7A and the records for vessels FWED and FXYC were assigned the DATA-TYPE='TVH' under Data-Rule #7B.

## 6. Unassigned Records

As described in the previous sections, a number of Data-Rules have been constructed to designate the status of the various data records currently held in the Docket-Book data. These data rules have been constructed based on information in the following data fields: LOG-TYPE, SELLER-TYPE, RELATED-LOG and VESSEL-TYPE. However, where specific information in these fields is missing, it remains difficult to ascertain the status of the corresponding data.

A summary of the 357 records (with 68,402 kg of related catch) which have yet to be assigned a Data-Type is displayed in Table 16. All records indicate that the catch has also been reported on the RELATED-LOG TRL04, though as the VESSEL-NAME remains unknown there is little additional information on which to assign the DATA-TYPE. An additional analysis was therefore undertaken by utilizing the SELLER-NAME associated with each record. The assumption was that where the SELLER-NAME had previously only been aligned with a single DATA-TYPE, then any unassigned records for the same SELLER-NAME would also assigned the same DATA-TYPE. Where the DATA-TYPE assigned previously for a given SELLER-NAME was not unique (i.e. 'PRC', 'TIB', or 'TVH') then further checks would need to be undertaken.

Table 16. Summary of Docket-Book data remaining unassigned to a DATA- STATUS after application of the data rules listed in the document. (Note S-TYPE=Seller-Type).

LOG-TYPE	S-TYPE	RELATED-LOG	VESSEL	VES-TYPE	N-RECORDS	MIN-YR	MAX-YR
Combined	TVH	TRL04			135	2,004	2010
Combined	U	TRL04			6	2,010	2011
DocketBook	TVH	TRL04			128	2,012	2017
DocketBook	U	TRL04			88	2,012	2017
TOTAL					357		

After undertaking the above analysis the following four groups of records were identified:

- i) Sellers previously associated with only the Data-Type='TVH' (25 records),
- ii) Sellers previously associated with only the Data-Type='TIB' (99 records),
- iii) Sellers previously associated with both Data-Types (216 records),
- iv) Sellers not previously listed (17 records).

A summary listing of these records is given in Table 17. Those records where the SELLER-NAME was associated with a unique previous DATA-TYPE (i.e. groups i and ii above) were assigned the corresponding DATA-TYPE under Data-Rule #8A and #8B respectively (124 records in total).

For those records where the SELLER-NAME was not associated with a unique previous Data-Type (i.e. groups iii and iv above) a further check was undertaken using the public register of Torres Strait licenses. This register was used to identify fishers holding a license associated with a vessel listed in the TVH database. As a result of this and other checks, and the determination under Data-Rule #3B, those records where the SELLER-NAME was included in the following list (Michael Kingdon, Tom Kingdon, Ty Kingdon, Sharn C Duff, Geoffrey D McKenzie, Luke S Dillon, Matthew S Bruce, Phillip J Hughes, Ryan Hughes and Miroslav Vaculka) were assigned the DATA-TYPE='TVH' under Data-Rule #8C and all remaining records were assigned the DATA-TYPE='TIB' under Data-Rule #8D.

Table 17. Division of remaining unassigned records after checking previous assigned SELLER-NAMES. (Note S-Type= Seller-Type).

i) TVH Data-Type

SELLER-NAME	S-TYPE	RELATED-LOG	N-RECORDS
DOMENIKO KARL DROTINI	TVH	TRL04	4
KARZY PHENGPRASEUTH	TVH	TRL04	2
LEVI KRIS	TVH	TRL04	1
LINDSAY DAVID PEARCE	U	TRL04	5
TRENT S BUTCHER	TVH	TRL04	9
WADE DUFF	TVH	TRL04	4
TOTAL			25

ii) TIB Data-Type

SELLER-NAME	S-TYPE	RELATED-LOG	N-RECORDS
AUGUSTINUS A TITASEY	TVH	TRL04	7
BENJAMIN CARLOS MOORE	TVH	TRL04	3
	U	TRL04	3
CAMERON PAUL BENJAMIN	TVH	TRL04	2
COREY WARD	TVH	TRL04	1
DARRYL FRANK	TVH	TRL04	5
DEN GAGAI	TVH	TRL04	1
DENNIS RICHARDS	U	TRL04	1
EDDIE MURDE	U	TRL04	1
FRANCIS ANTHONY HUGHES	TVH	TRL04	3
FRED DANIEL MILLS	TVH	TRL04	1
GAVIN FRANK LEROY MOSBY	U	TRL04	1
GESA WILLIAM JOSEPH	TVH	TRL04	2
GRAHAM KYOZO HIRAKAWA	TVH	TRL04	8
GUYAI ECCLES NEWIE	TVH	TRL04	1
HUNIG DARUA	TVH	TRL04	2
JAMAHL TAMWOY	U	TRL04	1
JAMES MILLS	U	TRL04	1
JIM AHMATT	TVH	TRL04	1
JOE HIRAKAWA	TVH	TRL04	24
JOHN SAUB	U	TRL04	1
JORDAN ASSAN	U	TRL04	1
JORDAN SAMPSON	TVH	TRL04	2
JOSEPH THOMAS KING	U	TRL04	1
KEIJI BOWIE	U	TRL04	1
KENNETH JAMES MCKENZIE	TVH	TRL04	11
MICHAEL MASIE MOSBY	U	TRL04	1
MICHAEL STEWART YAMASHITA	TVH	TRL04	1
MORGAN JIM DANIEL	U	TRL04	1
NGUKIS DIDIMESH ASSE	U	TRL04	1
NICHOLAS SAMUKI PEARSON	U	TRL04	1
OSKAR LEWANDROWSKI	U	TRL04	2
PEO HENRY ZITHA	TVH	TRL04	3
SIMON FREDRICK NAAWI	TVH	TRL04	1
	U	TRL04	1
YACOBA WENA	U	TRL04	1
TOTAL			99

iii) No Previous Data-Types

SELLER-NAME	S-TYPE	RELATED-LOG	N-RECORDS
BANKS ROBINSON	TVH	TRL04	1
CONAHARY HIKAKOWA	TVH	TRL04	1
DANNY PRYCE	U	TRL04	1
EDDIE BOWIE	U	TRL04	1
JAMIE SINCLAIRE	U	TRL04	1
JOHN BAKER	TVH	TRL04	1
KINGSLEY JAMES TABUA	TVH	TRL04	1
MITCHELL KINGDON	U	TRL04	1
NELSON SOKI	TVH	TRL04	3
PETER JOHN CHIARELLI	U	TRL04	1
ROBERT MAST	TVH	TRL04	1
SHARN COHN DUFF	TVH	TRL04	1
TOM KINGDON	U	TRL04	2
WESLEY HAMON MATENGA	TVH	TRL04	1
TOTAL			17

iv) Mixed Data-Types

SELLER-NAME	S-TYPE	RELATED-LOG	N-RECORDS
ABDOULLA LENA PETROV	TVH	TRL04	1
ANDREW DARUA	U	TRL04	8
CHARLES MARTIN	TVH	TRL04	10
CHRISTOPHER DARUA	TVH	TRL04	3
DEREK WALTER JOHN BRANK	TVH	TRL04	7
EDWIN JOHN CLARK	TVH	TRL04	3
GEOFFREY DONALD MCKENZIE	U	TRL04	14
	TVH	TRL04	21
JACKSON DARRYL AHWANG	TVH	TRL04	1
JIMMY ATZENI	U	TRL04	9
JOSEPH PAUL BIN JUDA	TVH	TRL04	4
JUSTIN GILLIES	U	TRL04	1
KARA DAVE WARE	TVH	TRL04	1
LUKE S DILLON	TVH	TRL04	21
	U	TRL04	6
MATTHEW STEWART BRUCE	U	TRL04	10
	TVH	TRL04	29
MICHAEL JAMES LLOYD	TVH	TRL04	1
MICK GILLIS	U	TRL04	1
MIROSLAV VACULKA	U	TRL04	2
OMAR BIN DORAH	TVH	TRL04	1
OWEN DORANTE	U	TRL04	1
PALA RUBU	TVH	TRL04	8
PALCON SARPE SAMAI	TVH	TRL04	1
PHILEMON ANSEY	TVH	TRL04	2
PHILLIP J HUGHES	TVH	TRL04	12
RICHARD EDGAR BILLY	TVH	TRL04	3
ROBERT EDWARD NEWIE	U	TRL04	1
ROBERT JOHN MAST	TVH	TRL04	1
ROBERT LESLIE SLYNEY	U	TRL04	2
RYAN A HUGHES	TVH	TRL04	8
STANLEY LAWRENCE ANSEY	TVH	TRL04	1
	U	TRL04	1
THOMAS FRANCIS FUJII	TVH	TRL04	14
TIBAU TOBY	TVH	TRL04	1
TY KINGDON	U	TRL04	6
TOTAL			216

## 7. Seller-Name

Application of Data-Rules #1-8D resulted in all 51,121 Docket-Book records being assigned one of the following three DATA-TYPES: 1. 'PRC', 2. 'TVH' or 3. 'TIB.' However, a final check was undertaken to check the uniqueness of the SELLER-NAME and DATA-TYPE.

First, a check was undertaken of those SELLER-NAMES identified as TVH license holders based on referral to the public register of Torres Strait licenses but currently assigned the DATA-TYPE='TIB'. Based on this check, 68 records (all previously assigned under Data-Rule #6C, #8B or #8D) associated with the following SELLER-NAMES (Kenneth J McKenzie, Like S Dillon, Matthew S Bruce, Phillip J Hughes, Ryan Hughes, Trent S Butcher and Wade Duff) were updated and re-assigned the DATA-TYPE='TVH' under Data-Rule #9A.

Second, a check was undertaken of those SELLER-NAMES identified as TVH license holders based on other information but currently assigned a DATA-TYPE='TIB'. Based on this check, an additional 24 records associated with the SELLER-NAMES (Michael G Bruce, Geoffrey D McKenzie, Ty Kingdon and Miroslav Vaculka) were updated and re-assigned the DATA-TYPE='TVH' under Data-Rule #9A.

Third, similar check of SELLER-NAMES identified as TIB license holders but currently assigned a DATA-TYPE='TVH' resulted in 3 records associated with the SELLER-NAME (Kris Levi) updated and re-assigned the DATA-TYPE='TIB' under Data-Rule 9B.

Finally, after completing the previous updates, a check was undertaken to ascertain whether each SELLER-NAME had been assigned to a unique DATA-TYPE. Of the 1,105 unique SELLER-NAMES listed in the Docket-Book data (note, this list may contain misspelt names), all records associated with the majority (1,056, 95.4%) of SELLER-NAMES were found to be associated with a unique DATA-



TYPE (i.e. 'PRC', 'TIB', or 'TVH'), while 49 (4.4%) of SELLER-NAMES were associated with two DATA-TYPES. A summary listing of these latter dual-assigned records is given in Table 18. In total there are 4,422 Docket-Book records associated with these 49 SELLER-NAMES with a corresponding 181.0 tonnes of catch (with 27.2 tonnes assigned to the TVH and 153.9 tonnes assigned to the TIB respectively) covering all years from 2004 to 2017.

Whether or not each SELLER-NAME should only be assigned to a unique DATA-TYPE remains unknown as it may be possible for a fisher to participate in each sector of the fishery. It is noted that of the SELLER-NAMES with dual DATA-TYPES, all were assigned to the DATA-TYPE='TVH' by Data-Rule 5A (c.f. Tables 8 & 9) which is based on the information that the vessel listed on the Docket-

Table 18. Listing by Seller-Name, of the Data-Rule, number of records and whole weight associated with the 51 Seller-Names associated with dual DATA-TYPE.

SELLER-NAME	DATA-RULE AND DATA-TYPE							Number Records
	DR-5A	DR-5B	DR-6A	DR-6B	DR-6C	DR-7A	DR-8D	
	TVH	TIB	TIB	TIB	TIB	TIB	TIB	
ABDOULLA LENA PETROV	23	0	0	0	23	0	1	36
ALLAN MURPHY GARNIER	3	0	0	0	502	0	0	401
ANDREW DARUA	3	0	0	0	195	0	19	85
BILLY MOSES GULIGO	5	89	0	0	293	2	0	132
BRIAN NAMAI	8	0	0	0	8	0	0	7
CAIN ARTHUR DOYLE MAROU	4	0	0	0	61	0	0	35
CHARLES MARTIN	9	0	0	0	620	0	20	296
CHRISTOPHER DARUA	8	0	0	0	1	0	6	11
DAMAL BIN DORAHO	1	0	0	0	2	0	0	2
DEAN JUSTIN SALAM	13	0	0	0	365	0	0	216
DEREK WALTER JOHN BRANK	8	11	0	0	151	0	12	123
EDWIN JOHN CLARK	21	0	0	0	27	0	5	34
ENOCK CHARLIE	1	0	0	0	31	0	0	30
EVARDUS KAISE	5	0	0	1	502	0	0	183
FAAFETAI NONA	2	0	0	0	438	0	0	174
HALEY ARTHUR BAIRA	1	0	0	0	5	0	0	6
JACKSON DARRYL AHWANG	9	13	0	0	55	0	2	44
JERRY SONGORO	2	151	0	0	392	0	0	240
JIMMY ATZENI	31	0	0	0	22	0	22	35
JOEL KAITAP AUDA	1	0	0	0	3	0	0	4
JOHN JOSEPH SABATINO	2	0	0	0	79	0	0	50
JOSEPH PAUL BIN JUDA	8	0	0	0	59	0	8	51
JULIUS JACK SOROGO	3	0	0	3	29	0	0	27
JUSTIN GILLIES	16	0	0	0	2	0	2	9
KARA DAVE WARE	1	0	0	0	10	0	1	12
MICHAEL GUY BRUCE	23	0	0	0	3	0	0	12
MICHAEL JAMES KEANE	16	6	0	0	51	0	0	48
MICHAEL JAMES LLOYD	11	0	0	0	1	0	1	9
MICK GILLIS	6	0	0	0	5	0	3	5
OLLIE ROBERT DEWIS	10	5	0	0	291	6	0	164
OMAR BIN DORAHO	1	0	0	0	1	0	1	3
OWEN DORANTE	3	0	0	0	462	0	2	260
PALA RUBU	41	739	0	0	688	2	11	591
PALCON SARPE SAMAI	1	0	0	0	2	0	1	3
PAUL SAYLOR	3	0	0	0	11	0	0	13
PHILEMON ANSEY	2	0	0	0	0	1	2	5
RICHARD ALTON NEWIE	8	0	0	0	17	0	0	14
RICHARD EDGAR BILLY	3	0	0	0	30	0	7	21
ROBERT CHARLES PEDDELL	2	0	0	0	477	0	0	247
ROBERT EDWARD NEWIE	41	0	0	0	89	0	3	62
ROBERT JOHN MAST	1	12	0	0	2	0	1	6
ROBERT LESLIE SLYNEY	36	0	0	0	4	0	4	17
RON SAILOR	1	0	0	0	19	0	0	11
ROY KIRK PEARCE	17	0	0	0	77	0	0	56
SCOTTY G RONSON	2	0	0	0	2	0	0	2
STANLEY LAWRENCE ANSEY	138	0	9	0	306	0	5	230
THOMAS FRANCIS FUJII	136	410	4	0	325	7	27	394
THOMAS GAMIA	3	0	0	0	4	0	0	3
TIBAU TOBY	1	0	0	0	1	0	1	3
TOTAL	694	1,436	13	4	6,743	18	167	4,422

Book was a TVH vessel. If one assumes that the vessel listed on the Docket-Book is correct, then it would appear that all SELLER-NAMEs listed in Table 18 have at some time sold catch caught as part of a TVH operation. As noted previously, there are situations where a TIB seller will work on a TVH vessel for a number of weeks and then decide to leave and work on a TIB dinghy or work in between TVH trips. However, also associated with these same SELLER-NAMEs are 86 vessels listed on the Docket-Book which are assigned to the TIB component of the fishery. Note, only 25% of the records (and 32% of the associated catch) listed in Table 18 have a vessel symbol listed on the corresponding Docket-book record. Until this situation can be further clarified, the DATA-TYPE of each record was maintained.

## 8. Data for Processor ‘A’

As mentioned previously in Section 2, between 2013 and 2016 two processors provided aggregate annual data rather than recording the landed catch in the TDB01 Docket-Book. These records are assigned the DATA-TYPE=‘TIB’ under Data-Rule #2. However, for one of these processors (called processor ‘A’ in the following) a check of the Docket-Book data for these years indicated that there were records where the Client was listed as this processor (c.f. Table 19).

Before 2012 the annual catch estimated from the Docket-Book records where processor ‘A’ was listed as a Client and the assigned DATA-TYPE=‘TIB’ was generally between 89% and 147% of the average catch received during the period 2004-11. (Note, to avoid reporting the actual catch weight, all catches are represented as the percentage of the average catch during this period). However, Docket-Book receipts decreased substantially (averaging 13% of the catch received in 2004-11) during the period 2013-16 when Aggregate Catch data were provided by the processor directly to AFMA. Nevertheless, adding together the Docket-Book receipts and the Aggregate Catch during these four years indicates that the annual total catch was generally within the range (i.e. between 72% and 138%; average of 107%) of the average annual catch during period 2004-11. However, it remains unknown whether the Docket-Book data for the years 2013-16 are also contained in the Aggregate Data. If they are, then these catches should be removed as duplicates. Further work is required to clarify this.

Finally, it can also be noted that the total catch sold to processor ‘A’ and assigned to the TIB fishery in 2012 is very small: only 7% of the average during 2004-11. This suggests that the Docket-Book data is likely to be incomplete and that perhaps Aggregate Data for this year still needs to be obtained from this processor. Further work is also required to clarify this.

Table 19. Annual summary of total catch (expressed as a percentage of the average catch over the years 2004-11) assigned to processor ‘A’ as (i) the Client in the Docket-Book data where the DATA-TYPE=‘TIB’, or (ii) added as additional aggregate data provided by AFMA (and initially received from this processor).

	Docket-Book	Aggregate	TOTAL
YEAR	Data	Data	
2004	147%	0%	147%
2005	108%	0%	108%
2006	47%	0%	47%
2007	116%	0%	116%
2008	107%	0%	107%
2009	91%	0%	91%
2010	95%	0%	95%
2011	89%	0%	89%
2012	7%	0%	7%
2013	4%	68%	72%
2014	6%	82%	88%
2015	36%	95%	130%
2016	7%	131%	138%
2017	45%	0%	45%



## 9. Data-Rules for assigning Data-Type to Docket-Book data

As noted in the Introduction, use of the RELATED-LOG field on the Docket-Book and the creation of the SELLER-TYPE field by AFMA both have utility in helping to identify duplicate catch records in the Docket-Book data. For example, if a seller has been designated as a TVH SELLER-TYPE (and the corresponding vessel as a TVH-Vessel) and the catch has also been reported in the TRL04 logbook then the data listed in the Docket-Book can be interpreted as a duplicate of a catch record associated with the TVH sector. However, as detailed in the previous sections for a large number of records the information within these two fields (i.e. SELLER-TYPE and RELATED-LOG) is missing (unknown) or some of the information is contradictory (e.g. the vessel associated with a TVH seller is not listed in the TVH database).

Given this uncertainty, it is considered prudent to identify a number of data rules for classifying the data as either TIB sector, TVH sector or trading of catch between processors. Once these rules are established, and unless new information comes to hand, they can then be used consistently each year for this task so that new data rules are not created each year on an 'ad-hoc' basis. Based on the analysis outlined in this report, the annual allocation of Docker-Book records currently held by CSIRO, and the associated catch to either the TIB or TVH sectors of the fishery or between processors, is shown in Table 20.

The corresponding DATA-RULES identified in the analysis for allocating each Docket-Book record with a specified DATA\_TYPE are listed in Table 21, while a summary, by year, of the number of the number of records and catch associated with each of the DATA-RULES are listed are shown in Tables 22a&22b.

Table 20 Annual summary of (a) the number of records and (b) the corresponding catch associated with each of the DATA-TYPES identified in the data-rules listed in the text.

(a) Number of Records					(b) Whole Weight (tonnes)				
YEAR	TIB	TVH	PRC	TOTAL	YEAR	TIB	TVH	PRC	TOTAL
2004	4651	51	0	4702	2004	232	9	0	241.03
2005	6671	43	0	6714	2005	359	12	0	370.01
2006	4085	28	0	4113	2006	147	2	0	148.82
2007	5939	73	19	6031	2007	259	4	14	278.43
2008	4870	111	52	5033	2008	184	4	33	222.39
2009	3635	0	0	3635	2009	144	0	0	143.86
2010	3026	3	72	3101	2010	141	1	49	190.73
2011	2958	0	0	2958	2011	200	0	0	201.17
2012	1352	252	78	1682	2012	137	315	203	654.19
2013	938	262	92	1292	2013	91	296	150	536.24
2014	2523	245	85	2853	2014	137	225	168	530.76
2015	2475	124	64	2663	2015	121	110	125	355.91
2016	2806	60	30	2896	2016	118	172	162	452.67
2017	3228	160	15	3403	2017	107	127	64	296.92
Total				51,076	Total				4623.13

Table 21. Listing of the Data-Rules used in assigning a DATA-TYPE for each record within the Dock-Book data.

RULE	DATA-TYPE	DATA-RULE	N-RECORDS	WHOLE WEIGHT
1	TIB	Records where large TIB vessels recorded their catch in the TVH-TL04 logbook	713	92,800
2	TIB	Annual aggregate data provided by processors in lieu of data not recorded in TB01 Docket-book	10	346,357
3	Processor	Docket-Book records where is Seller-Type = 'PRC'. Also includes data for Pearl Island Seafoods, Argun Seafoods and Trdewinds Seaffods where Seller-Type is Unknown.	507	967,954
3A	TIB	Docket-Book records where is Seller-Type = 'PRC' and Seller-Name='Joseph Dai'	1	10
3B	TVH	Docket-Book records where is Seller-Type = 'PRC' and Seller-Name='Miroslav Vaculka'	6	454
4A	TVH-Business	Docket-Book records where is Seller-Name is a business name associated with the TVH fishery.	507	1,009,847
4B	TIB-Business	Docket-Book records where is Seller-Name is a business name associated with the TIB fishery.	53	30,240
5A	TVH	Unassigned Docket-Book records where is Seller-Type in ( 'TVH' , 'U') and the Vessel-Symbol is identified as a TVH vessel.	648	190,662
5B	TIB	Unassigned Docket-Book records where is Seller-Type = 'TIB'	4,017	154,348
6A	TIB	Unassigned Docket-Book records where is Related-Log = 'TRL04' and the Vessel-Symbol is a TIB vessel	50	14,079
6B	TIB	Unassigned Docket-Book records where is Related-Log != 'TRL04'	152	24,917
6C	TIB	Unassigned Docket-Book records where is Related-Log = 'U' and Vessel-Symbol is null (i.e. not TVH or F-Symbol)	43,642	2,003,964
7A	TIB	Unassigned Docket-Book records where is Vessel-Type = 'F-Symbol' and Vessel-Symbol not in ('FXYC', 'FWED').	373	38,909
7B	TVH	Unassigned Docket-Book records where is Vessel-Type = 'F-Symbol' and Vessel-Symbol in ('FXYC', 'FWED').	11	18,486
8A	TVH	Unassigned Docket-Book records where is Vessel-Symbol is not null and is considered a TIB vessel	24	20,890
8B	TIB	Unassigned Docket-Book records where is Seller-Name is uniquely associated with either the TIB or TVH fishery.	88	10603.38
8C	TVH	Unassigned Docket-Book records where is Seller-Name is not assigned under 8A or 8B and known TVH Seller	125	25659.17
8D	TIB	Unassigned Docket-Book records where is Seller-Name is not assigned under 8A, 8B or 8C	100	9700.61
9A	TVH	Re-assignment of Docket-Book records where Seller-Name associated with owner of a known TVH vessel	91	10888.87
9B	TIB	Re-assignment of Docket-Book records where Seller-Name associated with owner of a known TIB vessel	3	256
			51,121	4,971,025

Table 22a Annual summary of the number of records associated with each of the DATA-RULES identified in the data-rules listed in the text.

YEAR	DR_1	DR_2	DR_3	DR_3A	DR_3B	DR_4A	DR_4B	DR_5A	DR_5B	DR_6A	DR_6B	DR_6C	DR_7A	DR_7B	DR_8A	DR_8B	DR_8C	DR_8D	DR_9A	DR_9B	TOTAL
Sector	TIB	TIB	PRC	TIB	TVH	TVH	TIB	TVH	TIB	TIB	TIB	TIB	TIB	TVH	TVH	TIB	TVH	TIB	TVH	TIB	
2004	0	0	0	0	0	1	0	50	0	0	46	4428	115	0	0	39	0	23	0	0	4,702
2005	0	0	0	0	0	0	0	43	0	0	0	6513	151	0	0	0	0	7	0	0	6,714
2006	0	0	0	0	0	0	1	26	0	0	1	3958	84	0	2	11	0	30	0	0	4,113
2007	0	0	19	0	0	0	0	73	0	1	5	5894	23	0	0	5	0	10	0	1	6,031
2008	114	0	52	0	0	0	0	111	0	6	0	4746	0	0	0	2	0	1	0	1	5,033
2009	95	0	0	0	0	0	0	0	0	0	6	3534	0	0	0	0	0	0	0	0	3,635
2010	62	0	72	0	0	2	3	1	115	9	32	2796	0	0	0	5	0	3	0	1	3,101
2011	9	0	0	0	0	0	4	0	0	3	0	2940	0	0	0	1	0	1	0	0	2,958
2012	167	0	78	0	0	164	15	50	0	13	0	1151	0	11	13	4	12	2	2	0	1,682
2013	175	0	92	0	0	94	12	147	33	14	0	696	0	0	9	4	4	4	8	0	1,292
2014	32	0	85	1	0	92	10	137	87	3	2	2378	0	0	0	4	6	6	10	0	2,853
2015	25	0	64	0	6	69	5	0	338	1	28	2062	0	0	0	4	23	12	26	0	2,663
2016	0	0	30	0	0	48	3	0	1497	0	32	1269	0	0	0	4	8	1	4	0	2,896
2017	0	0	15	0	0	37	0	10	1947	0	0	1276	0	0	0	5	72	0	41	0	3,403
Total																					51,076

Table 22b Annual summary of the corresponding catch (whole weight, tonnes) associated with each of the DATA-RULES identified in the data-rules listed in the text.

YEAR	DR_1	DR_2	DR_3	DR_3A	DR_3B	DR_4A	DR_4B	DR_5A	DR_5B	DR_6A	DR_6B	DR_6C	DR_7A	DR_7B	DR_8A	DR_8B	DR_8C	DR_8D	DR_9A	DR_9B	TOTAL
Sector	TIB	TIB	PRC	TIB	TVH	TVH	TIB	TVH	TIB	TIB	TIB	TIB	TIB	TVH	TVH	TIB	TVH	TIB	TVH	TIB	
2004	0	0	0	0	0	3	0	6	0	0	3	207	19	0	0	1	0	2	0	0	241.03
2005	0	0	0	0	0	0	0	12	0	0	0	345	12	0	0	0	0	2	0	0	370.01
2006	0	0	0	0	0	0	1	1	0	0	0	138	5	0	1	1	0	2	0	0	148.82
2007	0	0	14	0	0	0	0	4	0	0	2	251	3	0	0	2	0	1	0	0	278.43
2008	10	0	33	0	0	0	0	4	0	0	0	174	0	0	0	0	0	0	0	0	222.39
2009	8	0	0	0	0	0	0	0	0	0	2	134	0	0	0	0	0	0	0	0	143.86
2010	6	0	49	0	0	1	3	0	6	0	17	108	0	0	0	1	0	0	0	0	190.73
2011	1	0	0	0	0	0	2	0	0	0	0	197	0	0	0	0	0	0	0	0	201.17
2012	29	0	203	0	0	258	5	22	0	5	0	97	0	18	12	1	4	0	1	0	654.19
2013	34	0	150	0	0	174	8	109	2	7	0	40	0	0	9	0	3	0	1	0	536.24
2014	2	0	168	0	0	186	6	31	3	2	0	124	0	0	0	0	4	0	4	0	530.76
2015	1	0	125	0	0	103	5	0	11	0	1	101	0	0	0	1	5	1	2	0	355.91
2016	0	0	162	0	0	170	1	0	67	0	1	48	0	0	0	1	2	0	0	0	452.67
2017	0	0	64	0	0	115	0	1	66	0	0	40	0	0	0	1	8	0	3	0	296.92
Total																					4,623.1

<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>MEETING No. 21 12- 13 December 2017</b>
<b>Draft TRL Fishery Harvest Strategy</b>	<b>Agenda Item For Discussion and Advice</b>

## RECOMMENDATIONS

1. **NOTE** that the Torres Strait Tropical Rock Lobster Working Group (TRLWG) considered the draft TRL Harvest Strategy at its meeting on 25 & 26 July 2017 (meeting number 6).
2. **NOTE** the TRLWG recommended that further work be undertaken by the TRLWG and TRLRAG to examine possible options for 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.
3. **DISCUSS** and **PROVIDE ADVICE** on the likely monitoring and assessment requirements to support a management trigger under the harvest strategy as the stock approaches the limit reference point. This advice should include as far as possible, the likely costs of any additional monitoring and/or assessment work.

## KEY ISSUES

4. The Torres Strait Tropical Rock Lobster Working Group (TRLWG) considered the draft TRL Harvest Strategy at its meeting on 25 & 26 July 2017 (**Attachment A**).
5. The Working Group recommended that further work be undertaken by the Working Group 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.
6. Some TRLWG members recommended that the reduction of catch under the draft harvest strategy as the stock biomass move towards the limit reference point should not be uniform across the TIB and TVH sectors. Rather, a trigger point should be included in the draft HS before the limit reference point, at which point priority is given for fishing to the TIB sector over the TVH sector.

7. The Working Group Fisheries Economist noted another option might be to restrict the Fishery to free dive only if a certain trigger point was reached.
8. To assist the TRLWG further examine the cost and benefits of such an approach against objectives of the *Torres Strait Fisheries Act 1984*, RAG advice is sought 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.
9. A copy of the draft harvest strategy is at **Attachment B**.

## BACKGROUND

10. The draft TRL Harvest Strategy was developed in consultation with the RAG over its last three meetings (meeting no. 18 on 23 August 2016; meeting no. 19 on 13 December 2016 and meeting no. 20 on 4-5 April 2017).
11. The draft TRL Harvest Strategy was developed to take 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 RAG industry members to maintain stock abundance at recent levels (2005-2015) (RAG, 31 March 2016).
12. The RAG recommended harvest strategy objectives that place greater emphasis on the importance of the Fishery for traditional way of life and livelihood of traditional inhabitants. 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.



- 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.
- The agreed  $B_{LIM}$  is more precautionary than the default proxy HSP  $B_{LIM}$ .
- c. Implement rebuilding strategies, if the spawning stock biomass is assessed to fall below  $B_{LIM}$  in two successive years.
13. The TRLWG considered the draft TRL Harvest Strategy at its meeting on 25 & 26 July 2017 (meeting number 6). Having regard for the comments by members the Working Group:
- **Recognised** that the draft harvest strategy is:
    - designed to inform management decisions for the Torres Strait TRL Fishery;
    - is based on robust fishery independent survey data and stock assessment process;
    - treats the TRL Fishery as a single stock;
    - does not take into account recreational catches on the basis of TRLRAG advice that catches are likely low; and
    - has been subject to rigorous performance testing by the TRLRAG.
  - **Recognised** that whilst there may be uncertainty in the level of connectivity between the east coast and Torres Strait TRL stocks, the draft TRL harvest strategy uses the best available data including annual fishery independent survey data, to recommend annual total allowable catches. Future work such as the recently funded larval advection modelling project is likely to improve our understanding of stock connectivity overtime.
  - **Requested (Action Item 4)** the following be presented at the next TRLWG meeting: a) an overview of the current understanding of stock connectivity between the east coast and the Torres Strait TRL Fishery; and b) the basis for the Queensland east coast TAC.
  - **Recommends** that work should continue to examine whether there are cost-effective options for improving estimates of recreational catches in the region;
  - **Recommends** that the PZJA work closely with both the Queensland and PNG Governments to ensure complementary management arrangements are adopted in the event that the TRL stock biomass falls below the limit reference point.

- **Recommends** that further work be undertaken by the TRLWG and TRLRAG 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.

## **ATTACHMENTS**

- A. Torres Strait Tropical Rock Lobster Working Group meeting record number 6, 25-26 July 2017.
- B. Draft Torres Strait Tropical Rock Lobster Fishery Harvest Strategy.

# Torres Strait Tropical Rock Lobster Working Group

Meeting Record 6

25 & 26 July 2017

In-session meeting

Note all meeting papers and record available on the PZJA webpage:

[www.pzja.gov.au](http://www.pzja.gov.au)



**Australian Government**

**Australian Fisheries Management Authority**

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## Meeting participants

### Members

Name	Position	Declaration of interest
Alexander Morison	Chair	Nil Member of other MAC's and RAG's.
Dean Pease	AFMA Executive Officer	Nil
Selina Stoute	AFMA Member	Nil
John Ramsay <sup>1</sup>	TSRA Member	Nil
Tom Roberts	Queensland Fisheries	Nil
Darren Dennis	Independent Scientific Member	Nil Previously involved in research projects
Aaron Tom	Industry Member	Wishes to own his own fishing boat and employ crew.
Mark David	Industry Member	TIB licence holder
Terrence Whap	Industry Member	Nil
Luke Dillon <sup>2</sup>	Industry Member	TVH licence holder
Mark Dean <sup>3</sup>	Industry Member	TVH operator
Daniel Takai <sup>4</sup>	Industry Member	Pearl Island Seafood, Tanala Seafood and TIB licence holder
Ian Liviko	(PNG NFA)	Nil
Sevaly Sen	Fisheries Economist	Conducts various FRDC research projects relevant to AFMA fisheries.

1: not in attendance for Agenda Item 4.

2: attended day one only.

3: attended day one and until 11am on day two.

4: attended day two only.

## Observers

Name	Position	Declaration of interest
Jerry Stephen	TSRA Deputy Chair TSRA Fisheries Portfolio	TIB licence holder, Native title holder of Ugar.
Charles David	TSRA	Nil
Mariana Nahas	TSRA	Nil
Thomas Namoa	Industry	TIB licence holder
Graham Hirakawa	Industry	TIB licence holder
Maluwap Nona	Chairperson Malu Lamar	TIB licence holder
Harry Nona	Industry	TIB licence holder
Phil Hughes	Industry	TVH licence holder
Brett Arlidge	Industry	General Manager M G Kailis Pty Ltd, holder of TVH licences

<sup>1</sup> Attended the meeting on day two only.

## Action items and recommendations

### Action Items

Number	Action
1.	Malu Lamar (RNTBC) to provide the Working Group with maps of home reefs for Torres Strait Island communities.
2.	AFMA to provide the objectives of the <i>Fisheries Management Act 1991</i> and the <i>Torres Strait Fisheries Act 1984</i> to Working Group members and observers.
3.	Malu Lamar (RNTBC) to provide AFMA with a written proposal for any further proposed amendments to the <i>Torres Strait Fisheries Act 1984</i> .
4.	The following be presented at the next TRLWG meeting: a) an overview of the current understanding of stock connectivity between the Queensland East Coast and the Torres Strait TRL Fisheries; and b) the basis for the Queensland east coast TAC.

## Recommendations

Number	Action
1.	Work should continue to examine whether there are cost-effective options for improving estimates of recreational catches in the region
2.	The PZJA work closely with both the Queensland and PNG Governments to ensure complimentary management arrangements are adopted in the event that the TRL stock biomass falls below the limit reference point.
3.	Further work be undertaken by the TRLWG and TRLRAG to examine possible options for 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.

## Agenda Item 1 - preliminaries

### 1.1 & 1.2 Apologies / adoption of agenda / declaration of interest

Apologies were received from two industry members. Phillip Ketchell was an apology for the entire meeting and Daniel Takai for day one only. The Working Group also noted an apology from Patrick Mills, Chairperson of the Torres Strait Fisher's Association who was planning to attend the meeting as an Observer.

The Working Group adopted the agenda with no changes and noted written advice from Phillip Ketchell would be tabled at Agenda Item 4.

The Chair noted that there could be potential conflicts of interest for members and observers when providing information and advice on some agenda items. These conflicts should be tabled by members and observers. The Chair noted that the Working Group is a consultative forum of the PZJA that provides advice on the management of the TRL Fishery. The Working Group is not a decision making body.

#### *Representation at meetings*

One industry observer noted that the representative for Kaiwalagal (the inner cluster of islands including Thursday Island and Horn Island) had been absent from a number of TRL Resource Assessment Group (RAG) and Working Group meetings. As a result, local industry feel they are not being adequately represented at TRLRAG and Working Group meetings. Preferably proxies should attend if a members cannot.

The AFMA member noted that members are expected to attend meetings and that every effort is made to ensure meeting dates correspond with the availability of members. AFMA will continue to work with members to ensure they can participate and where necessary, confirm whether they are able to continue in the role. Proxies are not used however observers are welcome to attend meetings.

The AFMA member noted the consultative forum representatives were nominated at a meeting on Horn Island in 2015 comprising over 60 stakeholders from across the region. With current appointments due to end this financial year, AFMA welcomes advice on alternative processes for nominating members.

One member raised concern with being referred to as an industry member rather than an island cluster representative. The AFMA member noted that future records can make clear the cluster group from which each member was nominated.

The Chair noted that representatives are bound by Fisheries Management Paper Number One (**Attachment A**) and the role of members is to act in the best interest of the Fishery rather than to advocate for a specific sector of the Fishery. The Chair noted that if there are different views of members they are recorded in the meeting record.

### 1.3 Action items from previous meetings

The Working Group noted progress against action items from previous meetings. The list of action items and progress is provided in **Attachment B**.



### ***Recreational fishing rules***

The Working Group noted an update on the recreational fishing rules for TRL that apply in the Torres Strait Protected Zone as detailed in the paper provided (**Action Item 9**).

Some members noted that the amount of recreational catch is unknown and that work should be undertaken to estimate the recreational take of TRL. The QDAF member noted that a Queensland recreational fishing survey had been undertaken, however there was only one respondent for the Torres Strait and therefore the data provided could not be considered sufficient to be representative of all recreational fishing in the region.

### ***Working Group membership***

The Chairperson for Malu Lamar (RNTBC) stated that Malu Lamar will not support any recommendation from the Working Group unless Malu Lamar (RNTBC) is recognised as a formal member of the group.

The Working Group noted advice that AFMA was progressing both Malu Lamar's and the TSRA Fisheries Portfolio member's request to become a member on all PZJA consultative forums.

## **Agenda Item 2 - updates**

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### **2.1 Industry**

The Working Group noted the following updates provided by industry members and observers:

- Catches have been generally down however there has been some improvement in the months of June and July. The sand inundation of reefs surrounding Mabuiag including Beka Reef have started to clear and seagrass coverage around this area is increasing. The average size of TRL is slightly larger compared to last year.
- Catches around the inner cluster (Thursday Island) have been poor all season. It has not been worthwhile to use a big boat (primary/tender operation). Instead it has been more feasible to fish locally by dinghy.
- It is difficult for members to pass on the information of the RAG and Working Group meetings because the information is complex and the language used in meetings can be difficult to translate to something that is easy to understand and can be shared with fishers.
- Fishers from Iama are again reporting that hookah diving on top of the reef at Warrior and Dungeness reefs is continuing and this has an impact on the local Iama free dive fishers.

### ***Fishing community home reefs***

The Working Group noted advice from some industry members that communities continue to see transferrable vessel holder (TVH) operators diving their home reefs. This is of great concern to the communities and shows that the 'gentlemen's agreements' are not effective.

The Malu Lamar (RNTBC) Chairperson stated that home reefs should not be dived by the TVH sector and should be left for the local TIB fishers of that community. Malu Lamar (RNTBC) is currently undertaking a project to map the home reefs of Torres Strait communities and will work with the TVH sector to develop new agreements.

The Working Group noted and welcomed advice from both the Malu Lamar Chairperson and TVH industry members that they will work collaboratively with each other to develop agreements to address community concerns. It was noted that any such agreements could be the basis for an industry code of practice.

The AFMA member noted that upon request, AFMA could support future industry discussions by adjusting industry member travel arrangements alongside PZJA consultative forum meetings.

**Action Item 1:** Malu Lamar (RNTBC) to provide the Working Group with maps of home reefs for Torres Strait Island communities once finalised.

## 2.2 AFMA

The Working Group noted the updates provide by the AFMA member as detailed the agenda paper provided. The Working Group discussed the following updates:

### *Legislative amendments – Torres Strait Fisheries Act 1984*

The PZJA has approved for AFMA to request legislative drafters to prepare draft amendments to the *Torres Strait Fisheries Act 1984*, including to allow for mandatory reporting by the TIB sector in the form of a daily fishing log. The drafting will provide the basis for consultation with the communities, industry members and the PZJA consultative forums.

- One industry observer noted that daily fishing logs may not be supported by the TIB sector, and it is preferred for reporting to be mandatory for seafood buyers and processors. TIB fishers don't want complicated rules, they just want to go fishing.
- One industry member suggested that a survey should be sent to each TIB licence holder questioning whether they support or do not support the introduction of mandatory daily fishing logs for the TIB sector.
- The Chairperson for Malu Lamar (RNTBC) noted that mandatory daily fishing logs for the Hand Collectable Fishery targeting bech de mer (BDM) would help support industry to develop the fishery. The Chairperson noted that some species are at risk of overfishing and that accurate catch reporting will be important for the sustainable management of the Fishery.
- The Fisheries Portfolio Member advised that the TIB sector will be discussing these issues in the near future, the sector should create another forum to consider these issues as a collective group and take relevant matters to the PZJA for consideration.

### *Amendment to the Commonwealth Fisheries Management Act 1991*

Amendments to the Commonwealth *Fisheries Management Act 1991* have been proposed to require AFMA to have regard to interests of indigenous and recreational fishers.

The Chairperson for Malu Lamar (RNTBC) requested that a similar review be undertaken of the *Torres Strait Fisheries Act 1984* to check that the interests and recognition of indigenous fishers in the Torres Strait is consistent with the *Fisheries Management Act 1991*.

**Action Item 2:** AFMA to provide the objectives of the *Fisheries Management Act 1991* and the *Torres Strait Fisheries Act 1984* to Working Group members and observers.

**Action Item 3:** Malu Lamar (RNTBC) to provide AFMA with a written proposal for any further proposed amendments to the *Torres Strait Fisheries Act 1984*.

## 2.3 QDAF

The Working Group noted the Queensland Governments *Sustainable Fisheries Strategy* as detailed in the agenda paper and the following updates from the QDAF member:

- Queensland Boating and Fisheries Patrol has undertaken a recruitment round for 20 more fisheries patrol officers for Queensland;
- the Queensland East Coast Tropical Rock Lobster Working Group is likely to be re-established; and
- the Queensland East Coast TRL Fishery has had a very good season with the total allowable catch (195 tonnes) likely to be fully caught by 1 August 2017. Note on 7 September 2017 193.6 t of the 195 t TAC was taken.

## 2.4 TSRA

The Working Group noted the updates below provided by the TSRA member.

### *TSRA New Zealand study tour*

- The TSRA recently visited New Zealand to learn about the Maori experiences with managing their traditional and commercial fishing interests;
- The TSRA Board will be briefed on the outcomes of the study tour at its meeting in September 2017;
- TSRA is planning to convene a Fisheries Symposium with stakeholders following the TSRA Board meeting to discuss both the study tour and how the TIB may benefit from the Maori experience. The TSRA Portfolio Member noted October or November would be suitable for industry members because it is during the Fishery closure;
- The TSRA can provide resources to establish community economic zones throughout the Torres Strait but ultimately it is up to Traditional Owners to determine how long this process will take.

### *Additional Government funding for TSRA*

- The TSRA has been successful with recent funding bids for the region. The TSRA will receive \$16.75 million in new funding this financial year. Of that amount \$6 million is to be used for a landing jetty on Prince of Wales with the remainder (\$10.75 million) to be used to buyback fishing licences and invest in fisheries infrastructure.
- TSRA has commissioned an audit of fisheries infrastructure across all Torres Strait Island communities. The audit will identify what infrastructure is needed and how money should be invested to support development of fisheries in the region. Infrastructure needs will be considered broadly and could be anything including fuel bowsers, upgrading or building processing facilities and live holding tanks.

### *Expression on interest to lease TRL TVH licence held by TSRA*

- The TSRA Board has agreed to lease-out one of the TVH primary/tender licence packages recently purchased by the TSRA for the 2017/18 fishing season. Expressions of interest will be sought with only Traditional Inhabitants being eligible to apply in the first instance.
- In making its decision the TSRA Board considered three options: (1). lease back to the TVH sector; (2). lease only to the traditional Inhabitants; and (3): retire the licence package. Leasing to a traditional inhabitant would give the licence holder the flexibility to crew the fishing boat with non-traditional inhabitants.
- One industry observer advised that he did not support the leasing-out of the TVH licence. Instead, in his view, the TVH licence should be retired.

## **2.5 Malu Lamar (RNTBC)**

The Working Group noted the following updates from the Malu Lamar (RNTBC) Chairperson:

- in his capacity as Malu Lamar Chairperson, he had also been invited by the TSRA to attend the New Zealand study tour to meet with the Maori and learn from their fisheries experiences. The Maori agreed to provide assistance to Torres Strait Islanders in developing Torres Strait Fisheries;
- Malu lamar is aiming to establish a company two months from now;
- it is Malu Lamar's aim to empower TIB fishers across the board; and
- Malu lamar is looking forward to engaging with MG Kalis Pty Ltd and others and noted how the New Zealand Iwi work collaboratively across all sectors.

## Agenda Item 3 - TRL Harvest Strategy

The Working Group noted the final draft TRL Harvest Strategy recommended by the TRL Resource Assessment Group (TRLRAG) as detailed in the Agenda Item paper and presented by the AFMA Executive Officer. A summary of the presentation is provided below.

### *Draft TRL harvest strategy recommended by the TRLRAG*

- The draft Harvest Strategy (HS) sets out the pre-agreed management actions needed to achieve the Fishery objectives. The HS uses an empirical harvest control rule (eHCR) to determine a recommended biological catch (RBC).
- The major differences between the draft HS compared to the current interim Harvest Strategy are:
  - The draft HS uses an eHCR to calculate the RBC, while the interim HS uses an annual stock assessment to calculate the RBC. The draft HS applies a stock assessment on a three year cycle to review and evaluate performance of the eHCR and check the status of the resource.
  - The draft HS has a suite of pre-agreed decision rules that are designed to maintain the stock on average at the target biomass reference point ( $B_{TARG}$ ) and to rebuild the stock if it breaches the biomass limit reference point ( $B_{LIM}$ ) in two successive years. The draft HS  $B_{TARG}$  and  $B_{LIM}$  are more precautionary than the default Commonwealth Harvest Strategy Policy reference points.
  - The draft HS objectives have been developed to (a) place greater emphasis on the importance of the Fishery to the traditional way of life and livelihood of traditional inhabitants; and (b) maintain the stock on average at a target biomass level equal to recent years (2005-2015).
- The eHCR uses a regression of the 5 last year's data for the pre-season survey index of abundance of juvenile 1+ TRL (weighting 70%); newly recruited 0+ TRL (weighting 10%); the catch per unit effort (CPUE) indices for the TIB sector (weighting 10%) and CPUE indices for the TVH sector (weighting 10%).
- The draft HS decision rules 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.
- Based on the decision rules, there are four alternative possible scenarios that may occur under the application of the eHCR. Graphic representations of the four scenarios were presented to the Working Group (**Attachment C**).

### Comments and advice from Working Group members

#### 1. *Impacts of the East Coast TRL Fishery on the robustness of the harvest strategy*

- Concerns were raised by some members that the impacts of the east coast fishery are not properly taken into account in the harvest strategy. Specifically the impact from how much is caught and when. With the east coast fishery season opening a month earlier (January) concerns were raised that the fishery may be having a bigger impact on spawning by catching berried females.
- Some members raised concerns that if the Torres Strait TRL Fishery is closed because it breaches the limit reference point ( $B_{LIM}$ ) in two successive years then the Queensland East Coast TRL Fishery and the Papua New Guinea TRL Fishery should also be closed. It was recommended by some member that the PZJA write to the Queensland Minister requesting that they close the east coast fishery in the event that the Torres Strait fishery has to be closed.
- Some members noted that the Torres Strait Fishery is the only fishery conducting fishery independent surveys to determine the status of the resource and estimate a TAC. Some members remain concerned that the East Coast TAC is not based on good science.

- The QDAF member advised that an East Coast TRL Harvest Strategy will be developed as part of the Queensland Government's recently announced reform process.
- The AFMA member noted that the PZJA works with both the PNG Government and QDAF to develop complementary arrangements including Harvest Strategies. For the purposes of the Protected Zone, AFMA will formally seek support from the PNG-National Fisheries Authority on the Harvest Strategy through the Australia and PNG Fisheries Bilateral process under the Treaty.
- The Working Group noted that TRL is a shared stock with the QLD East Coast Fishery however the level of connectivity is uncertain. Irrespective of this uncertainty however the Working Group noted that the pre-season survey provides good data on the level of recruitment to the Torres Strait TRL Fishery and that the Harvest Strategy is designed to use these data to inform the management of the TRL Fishery.
- The Working Group further noted that the recently AFMA funded CSIRO larval advection project is aimed at providing updated information on TRL larval recruitment patterns for the Torres Strait.

2. *Potential for measures to be added as Limit Reference Point is approached to limit impacts on the TIB sector.*

- Some Working Group members recommended that the reduction of catch under the draft harvest strategy as the stock biomass move towards the limit reference point should not be uniform across the TIB and TVH sectors. Rather, a trigger point should be included in the draft HS before  $B_{LIM}$  at which point priority is given for fishing to the TIB sector over the TVH sector the TVH sector.
- The Fisheries Economist noted: (1) that there would need to be an agreed HS objective if the TVH sector were to take a larger reduction in the TAC compared to the TIB sector; (2) another option might be to restrict the Fishery to free dive only if a certain trigger point was reached; (3) and that the objective of any triggers would need to be agreed.
- The Malu Lamar Chairperson noted that the report titled 'A fair share of the catch' interprets the order of priority for Torres Strait Fisheries as (1) traditional fishing; (2) community fishing and (3) commercial fishing. The Chairperson noted the report should be considered when developing management arrangements for the Fishery including the draft HS and a legal interpretation of the report and its findings is required.
- The Industry Member from the TVH sector advised they could not agree to any proposal to have different measures applied to the TVH sector until more detail could be provided. The industry member noted that they too needed to make a living.

- Some TIB representatives and observers noted that TVH operators have the option of operating under a dual licence with the East Coast while TIB operators are unlikely to be able to secure endorsement to operate on the East Coast should the TS fishery close.
- An industry observer commented that industry should be left to work through these issues directly with each other.
- The AFMA member noted that the draft harvest strategy takes into account importance of TRL as an important shared resource. Having regard for importance of the resource for traditional fishing the harvest strategy is set to maintain a relative large stock size (target biomass is  $B_{65}$ ). If the stock size reduces towards the limit reference point, then the harvest strategy process will recommend that the total catch be reduced so that the stock may build.

### 3. *Taking into account recreational catches*

- Some members questioned whether or not recreational catches were properly accounted for under the harvest strategy and sought advice on any plans to collect reliable estimates of recreational catches.
- The Working Group noted advice that TRLRAG did not recommend accounting for recreational catches at this time because overall catches are likely to be relatively low. One industry member did not support this assumption and considered recreational catches to be higher.
- The Working Group further noted advice that the FinFish Working Group has identified the need to examine whether there are cost-effective options for developing improved estimates of recreational catches in the future.
- The AFMA member noted that it is generally very costly to collect recreational catch data and so a risk based approach is generally required when accounting catches by that sector.

## Recommendation

Having regard for the comments by members the Working Group:

1. **Recognised** that the draft harvest strategy is:
  - designed to inform management decisions for the Torres Strait TRL Fishery;
  - is based on robust fishery independent survey data and stock assessment process;
  - treats the TRL Fishery as a single stock;
  - does not take into account recreational catches on the basis of TRLRAG advice that catches are likely low; and
  - has been subject to rigorous performance testing by the TRLRAG.



2. **Recognised** that whilst there may be uncertainty in the level of connectivity between the east coast and Torres Strait TRL stocks, the draft TRL harvest strategy uses the best available data including annual fishery independent survey data, to recommend annual total allowable catches. Future work such as the recently funded larval advection modelling project is likely to improve our understanding of stock connectivity overtime.
3. **Requested (Action Item 4)** the following be presented at the next TRLWG meeting:
  - a) an overview of the current understanding of stock connectivity between the east coast and the Torres Strait TRL Fishery; and b) the basis for the Queensland east coast TAC.
4. **Recommends** that work should continue to examine whether there are cost-effective options for improving estimates of recreational catches in the region;
5. **Recommends** that the PZJA work closely with both the Queensland and PNG Governments to ensure complementary management arrangements are adopted in the event that the TRL stock biomass falls below the limit reference point.
6. **Recommends** that further work be undertaken by the TRLWG and TRLRAG 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.

## Agenda Item 4 – TRL Management Plan

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The Working Group noted advice from the TSRA Fisheries Portfolio Member and Malu Lamar Chairperson that outcomes of the recent TSRA study tour to New Zealand needs to be shared and considered by the TIB sector before proceeding with a plan of management for the fishery. The Working Group however agreed for public consultation outcomes on the draft management plan to be tabled (Agenda Items 4.2, 4.3 and 4.4).

A further summary table was circulated at the meeting which was intended to aid discussion among members on the key issues raised in the public consultation process (**Attachment D**).

### 4.1 Revised Sectoral Provisional Allocations

The Working Group noted that the TSRA had purchased two TVH primary/tender licence applications. Based on the provisional allocations assigned to those licences, the revised sectoral allocations that could be made under a quota management plan if they were to be combined with the TIB quota unit allocation is: TIB sector 62.54 per cent and TVH sector 37.46 per cent.

## 4.2 TRL Plan Public Meeting Outcomes

The Working Group noted the outcomes of public consultation meetings on the proposed TRL Management Plan as detailed in the Agenda Item paper.

One industry member noted that some communities, for example Masig, have not been provided an opportunity to meet with the industry representative for that cluster, to discuss and formulate a position on the management plan to allow them to provide a formal submission.

## 4.3 TRL Plan Written Submissions

The AFMA member read out the apology letter from the industry member Phillip Ketchell, the letter states that the Torres Strait Fishers Association (TSFA) does not support the proposed draft TRL Management Plan (**Attachment E**).

The Working Group noted the written submissions received on the draft plan as detailed in the Agenda item paper.

## 4.4 Native Title Notification – Malu Lamar (RNTBC) Submission

The Working Group noted the native title notification response on the draft plan from Malu Lamar (RNTBC) based on the Agenda Item paper.

The Working Group did not review the full summary on issues raised in the Malu lamar submission noting advice from the Chairperson for Malu Lamar (RNTBC) that the TIB sector and industry members first need to reflect on the recent meetings held with the Maori's before progressing development of the proposed draft management plan.

A single Malu lamar recommendation was noted. That is for the draft plan to provide separate rights and interest between native title holders and traditional inhabitants. Persons who are not native title holders, particularly if their traditional inhabitant identity is derived from the amnesty list, should not be granted TIB licences.

The Chairperson of Malu Lamar (RNTBC) noted the approval process for the grant of traditional inhabitant boat (TIB) licence is out of date and needs to be reviewed. The approval to grant a TIB licence needs to be based on genealogy to determine if a person is eligible to hold the licence. The Chairperson noted that PNG 'amnesty people' and aboriginal people from Cape York are not defined as a Torres Strait Islander under Article 1 of the Torres Strait Treaty.

## 4.5 Consideration of the draft management plan following public consultation

The Working Group noted advice from the TSRA Fisheries Portfolio Member and Malu Lamar Chairperson that the recent New Zealand study tour provided attendees with greater insight to the benefits and opportunities of quota management and how Maori manage their quota entitlements.

In light of what was learnt from meetings with the Maori and concerns raised about the draft plan through the public consultation, the Fisheries Portfolio Member and Malu Lamar

Chairperson did not support any further discussion on the draft Plan until the TIB sector and native holders more broadly, first meet to consider how their quota entitlements might be managed in order to meet their aspirations from the fishery.

The Fisheries Portfolio Member advised that the TSRA Board will be considering the outcomes of the NZ study tour at its meeting in September and that a work plan will be devised for leading the further consultation with the TIB sector and Malu Lamar. The Fisheries Portfolio Member further advised that the additional consultation may be a two year process with the first TIB meeting possibly occurring in beginning in October to coincide with the TRL Fishery closure. The aim of the TIB sector meeting will be for the sector to gather an understanding of the benefits of the Maori model and to agree on a preferred TRL Fishery management approach for the TIB sector. Additionally the consultation process may also cover issues across all fisheries such as restrictive rules in the Beche de Mer Fishery (7m boat length limit, free dive only).

Some industry members noted that the TVH sector should be included in the discussions about the Maori fisheries model to facilitate their understanding of how it could benefit the Torres Strait and fishery as a whole.

Industry members (TVH included) supported setting aside further development of the draft TRL Management Plan until the Traditional Inhabitant sector has developed preferred options for managing their quota allocation.

## Other business – Malu Lamar reform proposal

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The Chairperson of Malu Lamar circulated a paper titled 'Torres Strait Fisheries Reform Proposal – Australian Government and Queensland Government Assistance Request, June 2014 (**Attachment F**) to Working Group members at the end of the first meeting day and requested that he be able to present the paper on day two. The Malu Lamar Chairperson sought that it be tabled as it was relevant to the TIB sector in considering future options for managing fishing entitlements, such as TRL quota units.

The Malu Lamar Chairperson did not describe the detail of the paper but instead sought general comment from the Working Group.

The AFMA member advised that the paper is likely to be of some assistance for discussions being planned for the traditional inhabitant sector and Malu Lamar (as advised under Agenda Item 4). The AFMA member noted that the stated Malu Lamar vision includes working in partnership with industry, including the TVH sector and initiatives being progressed such as leasing-back arrangements and drawing on the Maori experience.

The AFMA member further advised that whilst it is helpful to be informed of the Malu Lamar reform proposal it was beyond the terms of reference of the Working Group to provide advice on the steps recommended in the paper as they relate to agreements and funding arrangements requested between Governments.

The Malu Lamar Chairperson advised that native title owners have commercial rights and interest prior to colonisation and that these rights have been recognised by the High Court. Their understanding of the *Akiba Decision* is that native title owners own the resources and this must be recognised. Malu Lamar has no interest in continuing to participate in future working groups and instead will take the Government to court.

The TSRA Fisheries Portfolio member noted that it has been requested on number of occasions for Malu Lamar to become a member of the PZJA. The AFMA member advised that the PZJA has previously requested Malu Lamar to put its proposal in writing but has not yet received response.

Some industry members and observers confirmed their support for the Malu Lamar Chairpersons position, including Malu Lamar becoming a member of the PZJA.

The TSRA member recommended that a legal synopsis of the *Akiba Decision* be formally considered by the PZJA and the precise nature of native title rights determined by the decision be explain to the working groups.

The Malu Lamar Chairperson reiterated his disappointment with the Working Group failing to properly recognise their native title rights and left the meeting.

## **Section 5 – Proposed Future Management Arrangements**

Agenda items under section 5 *Proposed future management arrangements* were not discussed.

The Chair closed the meeting around 11am due to a lack of a quorum following the early departure of another industry member.

Section 5 agenda items were deferred to the next Working Group meeting. The Working Group noted that arrangements would be made out-of-session to reconvene as soon as possible.



Australian Government

Australian Fisheries Management Authority

# Torres Strait Tropical Rock Lobster Fishery

Working Draft

Harvest Strategy

December 2017

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## GLOSSARY

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### 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 <sub>0</sub>	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

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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)<sup>1</sup>. 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.
  - 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.
  - The agreed  $B_{LIM}$  is more precautionary than the default proxy HSP  $B_{LIM}$ .

<sup>1</sup> 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:

$$RBC_{y+1} = wt\_s1 \cdot (1 + s_y^{presurv,1}) \cdot \bar{C}_{y-4,y} + wt\_s2 \cdot (1 + s_y^{presurv,0}) \cdot \bar{C}_{y-4,y} \\ + wt\_c1 \cdot (1 + s_y^{CPUE,TVH}) \cdot \bar{C}_{y-4,y} + wt\_c2 \cdot (1 + s_y^{CPUE,TIB}) \cdot \bar{C}_{y-4,y}$$

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 than 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.

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<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>MEETING No. 21 12-13 December 2017</b>
<b>OTHER BUSINESS</b>	<b>Agenda Item 10 For DISCUSSION</b>

## **RECOMMENDATIONS**

1. That the RAG **NOMINATE** any further business for discussion.

<b>TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG)</b>	<b>MEETING No. 21 12-13 December 2017</b>
<b>DATE AND VENUE FOR NEXT MEETING</b>	<b>Agenda Item 11 For DISCUSSION</b>

## RECOMMENDATIONS

1. That the RAG **NOMINATES** a date and a venue for the next meeting.

## BACKGROUND

2. AFMA proposes the next meeting be held in March 2018 on Thursday Island to allow for consideration of the full stock assessment outcomes.