

Torres Strait Tropical Rock Lobster Resource Assessment Group Meeting 27

Meeting Record

10-11 December 2019

Thursday Island

Note all meeting papers and record available on
the PZJA webpage: 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	Chair/Director of Fishwell Consulting Pty Ltd and Olrac Australia (electronic logbooks). Chair/member of other RAGs and MACs. Conducts various AFMA and FRDC funded research projects including FRDC Indigenous Capacity Building project. Nil interests in TRL Fishery and no research projects in the Torres Strait. In 2019, delivered components of TSRA Induction Program for Traditional Inhabitant members on PZJA advisory committees. Full declaration of interests provided at Attachment A .
Georgia Langdon	AFMA Executive Officer	Nil.
Selina Stoute	AFMA member	Nil.
Allison Runck	TSRA member	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them.
Mark Anderson ^	TSRA member	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them.
Dr Andrew Penney	Scientific member	Research consultant (Pisces Australis) with potential interest in a wide range of fisheries research or management related projects. However, no current involvement in any research projects in the Torres Strait. No involvement and no pecuniary interest in any fishing activities in the Torres Strait or elsewhere. Appointed independent scientific member of TRL RAG, SE RAG and SPF RAG.
Dr Éva Plagányi	Scientific member	Lead scientist for PZJA funded TRL research projects conducted by CSIRO.
Aaron Tom \$	Traditional Inhabitant member	Traditional Inhabitant Gudumalulgal and TIB licence holder.
Harry Nona	Traditional Inhabitant member	Traditional Inhabitant Kaiwalagal and TIB licence holder
James Ahmat	Traditional Inhabitant member	Traditional Inhabitant Maluiagal and TIB licence holder.
James Billy	Traditional Inhabitant member	Traditional Inhabitant Kulkagal, TIB licence holder, Coxwains holder and free diver.

Name	Position	Declaration of interest
Brett Arlidge	Industry member	General Manager MG Kailis Pty Ltd. MG Kailis Pty Ltd is a holder of 5 TVH licences.
Dr Ray Moore	Industry member	Torres Strait Master Fisherman licence holder and East Coast TRL Fishery licence holder.
Natalie Couchman	Executive Officer	Nil.

Observers

Name	Position	Declaration of interest
John Glaister #	TRL Working Group Chair Acting chair of the RAG at start of Day 1	Member of Parks North, Chair of Northern Prawn Management Advisory Committee (NORMAC), Chair of the Torres Strait Prawn Management Advisory Committee (TSPMAC) and Chair of the TRL WG.
Yen Loban*	TSRA Board Member and TSRA Portfolio Member for Fisheries.	TIB licence holder and Councillor for Torres Shire.
Meremi Maina	PNG Industry operator	PNG exporter.
Robert Campbell	CSIRO	Nil pecuniary interests. Project staff for PZJA funded TRL research projects.
Mark Tonks	CSIRO	Nil pecuniary interests. Project staff for PZJA funded TRL research projects.
Judy Upston	CSIRO	Nil pecuniary interests. Project staff for PZJA funded TRL research projects.
Roy Deng	CSIRO	Nil pecuniary interests. Project staff for PZJA funded TRL research projects.
Kinam Salee	CSIRO	Project staff for PZJA funded TRL research projects; currently employed by Torres Straits Seafood Pty Ltd.
Lyndon Peddell	AFMA	Nil.
Suzannah Salam	Industry observer	Torres Straits Seafood Pty Ltd, TIB licence holder and lessee of TSRA TVH licence in 2017/18 fishing season.
Madeina David	TSRA observer	Employed by TSRA.

Acting Chair for agenda items 1 – 3.

^ Mark Anderson was the nominated TSRA member for the agenda items he was present for (Agenda Items 5, 6 and 7).

\$ Aaron Tom arrived at 11am on day 1 of the meeting

* Yen Loban arrived at 2pm on day 1 of the meeting

1 Preliminaries

1.1 Welcome and apologies

1. The meeting was opened in prayer at 9:45 am on Tuesday 10 December 2019.

2. Attendees were welcomed by an interim Chair, Dr John Glaister who chaired the meeting in the absence of Dr Ian Knuckey whose arrival was delayed. The Chair stated an Acknowledgement of Country and particularly welcomed the new Traditional Inhabitant members to the RAG.
3. Attendees at the RAG are detailed in the meeting participant tables at the start of this meeting record.
4. Apologies were received from Danielle Stewart (QDAF member), Les Pitt (Traditional Inhabitant Member, Kemer Kemer Meriam) and Maluwap Nona (Malu Lamar (Torres Strait Islanders) Corporation RNTBC), Chairperson.

1.2 Adoption of agenda

5. The draft agenda was adopted without change (**Attachment B**).

1.3 Declaration of interests

6. The Chair advised members and observers, that as provided in PZJA Fisheries Management Paper No. 1 (FMP1), all members of the RAG must declare all real or potential conflicts of interest in Torres Strait TRL Fishery at the commencement of the meeting. Where it is determined that a direct conflict of interest exists, the RAG may allow the member to continue to participate in the discussions relating to the matter but may also determine that, having made their contribution to the discussions, the member should retire from the meeting for the remainder of the discussions on that issue.
7. Declarations of interests were provided by each meeting participant. These are detailed in the meeting participant tables at the start of this meeting record.
8. The RAG followed a process whereby each group of members with similar interests were asked to leave the room to enable the remaining members to:
 - a) Freely comment on the declared interests;
 - b) Discuss if the interests precluded the members from participating in any discussions; and
 - c) Agree on any actions to manage declared conflicts of interests (e.g. the member may be allowed to participate in the discussions relating to the matter but not in the formulation of final advice).
9. Those members and observers holding a fishing licence, including the TSRA member were asked to leave the room. The remaining members agreed that although the excused members have conflicts of interest, their expertise is critical in the development of advice. It was also noted that there was no agenda item that favoured one licence holder over another. On this basis, it was agreed that the excused members be permitted to participate in discussions under all agenda items in the formulation of RAG recommendations.
10. All scientific or research members and observers were also asked to leave the room. The AFMA member reminded the RAG that when discussing potential research projects (particularly under agenda item 9 on the five year Research Plan, scientific members may have real or perceived conflicts of interest, however their expertise is highly valued in the development of RAG advice. On this basis, it was agreed that the scientific members be permitted to participate in discussions under all agenda items and the formulation of RAG recommendations.
11. The temporary Chair reminded the group about the importance of this process to ensure transparency and integrity of the advice from the RAG so that other stakeholders can have confidence in how the group operates.
12. The RAG agreed that all members and observers could be present for each of the agenda items.

1.4 Action items from previous meetings

13. The RAG noted the status of actions arising from previous TRLRAG, and where relevant, TRL Working Group (TRLWG) meetings (**Attachment C**).
14. The RAG noted that the final meeting record for TRLRAG 26 held on 5 February 2019 was finalised out of session following the closure of the comment period and circulated to members on 18 March 2019 and is also available on the PZJA website.
15. The RAG further discussed the following action items:
 - a) Action Item 1 – the RAG recommended this action item be transferred to the Working Group with no objections.
 - b) Action Item 2 – The RAG noted the draft document on management history of the TRL fishery is expected to be a living document and get updated over time. The RAG further noted AFMA's intention to make the document public to provide stakeholders with an understanding of when and why certain controls or management measures were introduced. Industry member Dr Ray Moore noted that there are still several outstanding management decisions missing from the draft document.

Action

AFMA to liaise with Dr Ray Moore to seek additional information for inclusion in the draft TRL fishery management history document.

- c) Action Item 7 – The RAG noted PNG-NFA had provided PNG catch data for the current fishing season up until the end of August and that AFMA continues to work closely with PNG NFA to obtain catch records for the remaining months (December 2018, September-November 20219).
- d) Action Item 9 – Industry member Brett Arlidge advised that MG Kailis had submitted TRL tails for heavy metal analysis. The analysis did not detect any issues with the samples provided.

1.5 Out-of-session correspondence

16. The RAG noted out of session correspondence on RAG matters since the previous meeting.

2 Updates from members

2.1 Industry members

17. The RAG noted updates provided by industry members and observers on the performance of the TRL fishery during the 2018-19 season and at the very start of the 2019-20 season, in particular:
 - a) The 2019/20 season crayfish sizes are mostly medium sized 1+ with more crayfish on the Eastern side of the Torres Strait, central area and around Tudu Island. This time last year the crayfish were notably larger in the Western reefs around Mabuiag.
 - b) Kulkalgal communities had a slower start to the season with fishers collecting 13-20 crayfish per day. Water temperatures are reportedly cool and catch rates are expected to increase later in the month following the full moon.
 - c) An industry observer noted that PNG fisheries are experiencing some localised depletion in PNG waters due to having only a limited area of waters to fish. He added that the industry would benefit from cross-endorsement of free diving operators, stating that free divers are struggling to compete with hookah divers in PNG. Catch during the 2018/19 season was notably better than the past 2-3 years however crayfish sizes seem to be getting smaller.

- d) A TVH industry member noted that although only 10 days in to the new season, it is possibly the best start to the season in December experienced since around 2011. He agreed with other industry members and observers that crayfish sizes are mostly smaller, new recruits with approximately 70-80 per cent of animals under 1kg. He noted that there appears to be more crayfish around, particularly in the central areas and Warrior Reef, which aligns with the preliminary survey results.
- e) The Queensland East Coast TRL fishery experienced their worst 2019 season since quota was introduced with only 56 per cent of the TAC caught, compared with the past 4-5 years that have been 95-100 per cent caught. It is not known yet exactly what caused the poor season. One theory suggested that the 2019 season almost aligns with three years after significant bleaching event on East Coast in 2016. East Coast sizes were smaller than usual this season. The Queensland TRL Harvest Strategy is under development and there are preliminary discussions about undertaking a stock assessment for the fishery. It is expected that Fisheries Queensland will perform the assessment, in liaison with CSIRO to maintain links with Torres Strait assessment.

2.2 Scientific members

- 18. The CSIRO scientific member provided a brief update on the Food and Agriculture Organisation (FAO) International Fisheries Symposium held in Rome from 18 – 21 November 2019 where Dr Eva Plagányi presented on Adapting fisheries management for proactive, climate-ready dependent societies and economies, featuring some of the work she undertakes in the Torres Strait.
- 19. Dr Plagányi added that it would be beneficial to have some Traditional Inhabitant members attend an upcoming conference, noting that there is the World Fisheries Congress in Adelaide, 11-15 October 2020 followed by the International Lobster Symposium in Perth, 18-23 October 2020. The RAG noted that CSIRO are seeking funding to support the attendance of at least one Traditional Inhabitant member from the Torres Strait to attend either conference.
- 20. The RAG also noted and congratulated Traditional Inhabitant member Mr Rocky Stephen who has been accepted to present a scientific abstract on his collaborative work on sea cucumber stock enhancement at the Marine Socio-Ecological Systems (MSEAS) Symposium in Japan, May 2020.

2.3 Government agencies

- 21. The RAG noted an update provided by an AFMA compliance officer and the AFMA member regarding management initiatives relevant to the TRL Fishery, in particular:

Compliance outcomes for the 2018-19 fishing season

- a) AFMA took over the Torres Strait Fisheries Domestic Compliance Program on 1 July 2018 from the Queensland Boating and Fishing Patrol. To increase capacity in this area, AFMA has since recruited a third officer to assist with the increase in work load in delivering both domestic and foreign compliance functions that is largely intelligence and risk-based intelligence.
- b) AFMA fisheries officers work closely with the support of the Australian Border Force, Royal Australian Navy, Queensland Water Police, TSRA Rangers and PNG National Fisheries Authority.
- c) A number of formal warnings were issued to TRL operators for relatively minor breaches. Two matters were referred to the Commonwealth Director of Public Prosecutions (CDPP) for consideration, with a further two current matters pending.
- d) In addition, AFMA have also conducted a number of stakeholder / community / one-on-one meetings aimed at increasing education and awareness of compliance related issues and to foster voluntary compliance with fisheries regulations. Recently, AFMA has

undertaken targeted patrols ahead of the TRL season opening based on reports of product stockpiling, with no breaches of regulations incurred.

- e) The RAG noted that it is not a fisheries officer's role in deciding whether cases should be pursued through to prosecution. AFMA fisheries officers collect evidence and build a case to meet the evidentiary requirements for the AFMA Operational Management Committee to consider whether cases are progressed further to the CDPP.

22. Industry members raised a number of compliance concerns relating to the use of "pony bottles" (small air cylinders) to undermine the hookah closure. There was also concern about potential quota evasion and frustration that no compliance action is being undertaken to address the issues. Industry also expressed a desire for additional compliance presence in Moon Passage with increased fishing activity being observed by fishers on North Warrior, potentially encroaching on Australian fishery waters.

23. AFMA reminded members that any suspected illegal, unregulated or unreported (IUU) fishing activities should be reported to AFMA and that where possible, taking photos and collecting additional evidence to support such reports is encouraged.

Review of TRL quota unit allocation to the Traditional Inhabitant sector

- a) The TRL Management Plan requires the PZJA to review the allocation of quota units to the Traditional Inhabitant (TIB) sector within two years of the Management Plan commencement (30 November 2020). At the commencement of the quota system on 1 December 2019, the TSRA will hold quota units on behalf of the Traditional Inhabitant sector.
- b) Separate to the allocation review to be undertaken by the PZJA, the TSRA is working with stakeholders to establish an independent, non-profit entity to manage community-owned commercial fishery assets under the Fisheries Regional Ownership Framework project (FROF project). The TSRA is working to have the entity established by 1 July 2020.
- c) Without excluding other options, in undertaking the review the PZJA may consider the following options in accordance with s17(2) of the Management Plan:
 - i. allocating quota units to a non-government legal entity that represents Traditional Inhabitants;
 - ii. allocating quota units to individual Traditional Inhabitants directly; and
 - iii. a combination of the options above
- d) At its meeting on 19 November 2019 the PZJA agreed in principle that the review of allocation be undertaken by an independent allocation advisory panel (IAAP) in accordance with the policy and procedural framework outlined within Fisheries Management Paper 2 (FMP2). The PZJA directed the PZJA Standing Committee to provide draft Terms of Reference (ToR) for an IAAP, including its membership and process to the PZJA by April 2020 that that PZJA can confirm this in principle decision.

24. The RAG noted concerns raised by some members and observers that while the PZJA review process is supported, some communities feel that PZJA decisions often do not reflect the views of communities. Extensive consultation has already been undertaken on this issue and it may appear to stakeholders like those views have not been taken into account.

25. The RAG noted further updates from AFMA including:

- a) Ongoing efforts for AFMA and PNG National Fisheries Authorities to agree on a process for finalising catch sharing arrangements for the 2019-20 fishing season, including subject to further stakeholder consultation, the preferred arrangement for utilising Australia's cross-endorsement allocation within PNG's waters. That is, to not seek cross-endorsement but rather pursue a preferential entitlement arrangement under Article 25 of the *Torres Strait Treaty*.

- a) As of 1 December 2019, the TRL fishery is now operating under a quota management system following the allocation of quota units in accordance with the *Torres Strait Fisheries (Quotas for Tropical Rock Lobster (Kaiar)) Management Plan 2018*.
- b) At its meeting on 8 October 2019, the PZJA agreed to release a draft policy on the issue of development permits used for training purposes in all Torres Strait fisheries. The draft policy is expected to be released before the end of the year.
- c) AFMA is continuing to progress draft amendments to the *Torres Strait Fisheries Act 1984* (the Act) and *Torres Strait Fisheries Regulations 1985* (the Regulations) as resources and priorities permit. AFMA have experienced delays to the project due to the Federal Election, competing Australian Government legislative priorities and limited internal resources. Noting the need for improved catch reporting however, AFMA is aiming to work with stakeholder to develop a strategy to encourage a level of voluntary logbook reporting by TIB Fishers.

26. The RAG noted a brief summary of QDAF activities relevant to the TRL Fishery:

- a) On 1 September 2019, QDAF introduced a range of changes to their fisheries regulations including:
 - i. Aligning the southern and northern recreational possession limit for TRL to 5 for all Queensland waters.
 - ii. Sea cucumber and TRL are 2 of 9 identified priority black-market species and therefore have a two times possession limit enforced for boats (10 per boat).
 - iii. Vessel tracking requirements will apply to all commercial fishing vessels (primaries and tenders) from 1 January 2020
- b) A second round of regulator changes are proposed to be implemented in late 2019. Proposed changes that will affect the Queensland East Coast TRL Fishery largely relating to licence and fishing authority arrangements, primary and tender attendance and operations.

27. The RAG Chair arrived at 11:00am and thanked the interim chair for filling in as a result of his delayed flight.

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

- a) The TSRA convened a fisheries science and leadership workshop in May 2019 for PZJA Traditional Inhabitant members with members having since delivered presentations to their relevant clusters during October and November 2019, with Kaiwalgal cluster consultations scheduled for early 2020.
- b) As part of a project aimed at increasing the value of Torres Strait seafood products through improvements in the supply chain and branding, the TSRA has recently released an Exporters handbook aimed at providing industry with information on seafood markets, branding, requirements and certifications for export and e-commerce opportunities.
- a) TSRA recently visited all communities to consult on the membership and design of the Entity (a company limited by guarantee), which is on track to be established by 1 July 2020. The TSRA will be convening a fisheries summit in April 2020 to further consult on the entity.

There are now new support packages available through the TSRA Economic Development Program for outer-island infrastructure for up to 18 months. Additionally, 90 traineeships have been secured from the QLD State Government to increase participation in commercial fishing activities. The first community targeted is Erub, with other communities to be rolled out over the next two years.

2.4 PNG National Fisheries Authority

29. No update was provided as a PNG National Fisheries Authority representative was not in attendance.

2.5 Native Title

30. No update was provided as a Malu Lamar (Torres Strait Islanders) Corporation RNTBC representative was not in attendance.

3 RAG data sub-group meeting

31. The RAG considered an overview of the outcomes of the first TRL RAG data sub-group meeting held on 18 June 2019.

32. The sub-group considered a range of issues previously identified by the RAG and provided advice on improvements and refinements to the fishery-dependent data currently collected as well as additional data required to improve the assessment and management of the TRL fishery.

33. A summary of short-term and longer-term recommendations provided by the sub-group is outlined below:

Issue	Short term recommendations
TRL04 logbook	Amend data fields to better capture time spent fishing (dive time underwater) and searching Amend data fields to better capture number of fishers (divers) Add data fields to capture tender location data and average dive depth Add data fields for reporting discards
TDB02 CDR	Amend data fields to better capture time spent fishing (dive time underwater) and searching Continue to work with the TIB sector to improve voluntary reporting of spatial data and consider alternative methods to collecting this data Add data fields for reporting discards
Other	Align the survey and TDB02 CDR strata CSIRO to give further consideration to change to selectivity/grading underwater Undertake an industry survey to collect information about changes to fishing power factors

Issue	Longer term recommendations
TRL04 logbook	Legislative amendments to require the TIB sector to complete TRL04 logbooks
Other	Consider technology that records fine scale data on time spent underwater e.g. dive watches VMS units on all tenders and dinghies

34. The RAG thanked the sub-group for their work and appreciated their recommendations.

35. The RAG stated that education and awareness with fishers should continue in relation to the voluntary data section of the TBD02 CDRs, driven by AFMA and with the support of PZJA traditional inhabitant members and the TSRA.

36. The RAG also acknowledged the inconsistency between how vessels and/or sectors are providing data across various fields (in particular 'Hours-Fished' on TRL04, and 'number of fishers' on TBD02) and that efforts should be focussed streamlining industry understanding of how data fields should be completed, to ensure they are consistent and as accurate as possible.

37. **Having regard for further data sub-group advice on specific logbook amendments, the RAG recommended that AFMA continue to pursue legislative amendments to require the TIB sector to complete logbooks.** Several traditional inhabitant members also expressed support for the voluntary catch and effort section of the TDB02 CDRs to be mandatory.
38. **Noting the outcomes of the first data sub-group meeting, the RAG recommended the data sub-group continue to convene, and undertake the following next steps to:**
- a) **recommend draft amendments to the TDB02 CDR and TRL04 logbook to improve fishing effort data and spatial information;**
 - b) **assess the impacts of logbook amendments on the CPUE series;**
 - c) **advise on improvements to PNG data inputs;**
 - d) **advise on possible alignment of survey strata and logbook regions;**
 - e) **recommend strategies to improve voluntary reporting via the TDB02 CDR; and,**
 - f) **develop a draft data plan for the TRL fishery to clearly detail the plan for collecting the data/information needed to support fishery assessments and management decisions.**

Action

That AFMA clarify with TVH licence holders as soon as practicable that the 'Hours-Fished' field on TRL04 logbooks should be completed based on time spent underwater.

4 Catch and effort analyses for the 2018-19 fishing season

39. The RAG considered an update on total reported catches for Australia and PNG and the following catch and effort presentations (**Attachment D**) by Dr Robert Campbell, CSIRO Scientific Observer, for the Australian TRL Fishery for the 2018-19 season:
- a) Total seasonal effort and other operation characteristics in the Torres Strait Rock Lobster Fishery – 2019 Update; and,
 - b) Use of TVH and TIB catch and effort data to construct an Annual Abundance Index for Torres Strait Rock Lobster.
40. Data informing the analyses is drawn from the following sources:
- a) TRL04 daily fishing logbook – mandatory for all TVH licence holders only;
 - b) TDB01 docket book – voluntary for all licence holders, no longer in use; and
 - c) TDB02 Catch Disposal Record – mandatory for all licence holders, replaced the TDB01 docket book as of 1 December 2017.

Total seasonal effort and other operational characteristics in the Torres Strait Rock Lobster Fishery – 2019 Update

- a) Catch by season: in the 2018/19 season was the first season to have interim sectoral catch shares based on the quota allocation splits between the TIB and TVH sector. Total reported catch for fishery was 415.6 tonnes, with 259.7 tonnes caught in the TIB sector, and 155.9 caught in the TVH sector.
- b) Catch by month: catches across the fishery were the highest in the month of March, with January catches the lowest throughout the season.

TVH Sector:

- a) Catch by method and process: after several seasons of little change, almost all of the catch (approximately 98 per cent) landed by the TVH sector was reported as 'whole' lobsters in 2019, which is a substantial difference from 2018 season (which was approximately 85 per cent).

- b) Catch and effort by area: in 2017/18 fishing season almost 50 per cent of the fishing effort was reported in Northern section, however in 2018/19, the effort has shifted further east (Warrior, Northern and Warraber) which is consistent with industry reports provided at the start of the meeting (based on location of the primary vessel). A TVH industry member noted that the extent of dories fishing further from the primary vessel has increased over time as fishing area has expanded to deeper waters.
- c) Catch by Hours-Fished: in 2019, a higher proportion of catch (35 per cent) was taken in sets with more than 6 hours. The RAG noted the need to differentiate between time searching, and time in the water fishing as a standard measure of fishing effort and that it had been advised by members there could be a difference in the way fishers were reporting this field.
- d) Total effort: overall, there is a small increase (approximately 11 per cent) in fishing effort (total hours) compared to the 2017/18 fishing season.

TIB Sector:

- a) Data coverage: The overall coverage of voluntary effort data in the TDB02 books this season has declined from last season. Area-Fished was not reported for approximately 34 per cent of all TDB02 records (an increase from 20 per cent in 2018), days fished was not reported for 30 per cent of records, and number of fishers/divers not reported on 29 per cent of records (increased from 25 per cent in 2018). The incompleteness of these effort data fields increases uncertainty in the CPUE analysis for the TIB sector.
- b) Catch by method, form and area: percentage of total catch taken by hookah has increased while freediving catches have decreased. The percentage of total catch taken as whole lobster has increased slightly from the 2017/18 season, with the percentage of tailed catch making up about 20 per cent of the catch. Approximately 45 per cent of reported catch did not report Area-Fished, with almost 20 per cent of catch reported from "Thursday Island", 8 per cent from "Badu" and 8 per cent from "Mabuiag".
- c) Catch by effort: during the 2017/18 and 2018/19 seasons there has been an increase (from approximately 25 per cent to 35 per cent) in the proportion of trips with length greater than 1 day compared to previous years, however this does not take account of what proportion of the day is actually spent diving/fishing. The number of days fished in 2018/19 is the highest since 2008.
- d) Total effort: approximately 7,000 days fished was estimated in the 2018/19 season in the TIB sector
- e) Number of sellers (individual fishers): Decrease in the number of distinct sellers in the fishery each season; 2004 around 400 sellers, compared with 2019 with approximately 285.

Use of TVH and TIB catch and effort data to construct an Annual Abundance Index for Torres Strait Rock Lobster

TVH Sector:

41. The TVH CPUE trends were standardised to assess the effects of month, area, method, vessel, proportion of tails, Southern Oscillation Index and moon-phase. Data from February to September 2019 was included in the time-series analysis.
- a) CPUE is relatively constant across the eight month data period. CPUE is generally highest during February, June and July (20-21 per cent higher than the CPUE in September), while March, April and May the CPUE is 15-16 per cent higher, and 11 per cent higher during August.
 - b) CPUE on average, was lowest in Mr Adolphus, Eastern TS, and Mabuiag and highest in Kirkaldie, Warraber and Central areas with little variation across the various models.
 - c) The greatest effects on standardised CPUE were from *fishing method* and *proportion of tails*. Across all models, the standardised CPUE for hookah fishing is found to be around

17 per cent higher than for free diving, and generally, relative CPUE increased as the proportion of tails increased within the catch.

- d) There is substantial variation in the standardised CPUE across the 48 vessels included in the models, however the relative effect of each vessel is less sensitive to the model used. Across all models, the relative fishing power across the fleet varies more than three-fold of the standard vessel effects.
- e) The influence of the Southern Oscillation Index (SOI) appears to be driving decreasing CPUE with negative values of SOI, and increasing CPUE with positive values of SOI. This indicates that oceanographic conditions may have had some influence on the high CPUEs experienced in fishery in 2011.
- f) CPUE is lowest during days near a full moon and also low around a new moon, while CPUE is highest mid-way between these two phases (i.e. around the first and last quarters). During this latter period CPUE is around 30-35 per cent higher than at the time of a full moon.

42. Diver skill and experience is a primary influence on CPUE. The analysis shows a strong vessel effect (primary vessels only) however there is little understanding of the interchange of divers between primary vessels throughout the season.

43. Diver names have been made available for analysis however were not included in this year's standardisation process. This is because there were over 1,500 diver names/combinations which requires significant effort to clean up the dataset so that it can be used in the analysis.

Annual TVH Abundance Indices:

44. Six General Linear Models (GLMs) were considered for the analysis of the TVH CPUE as a standardised index of stock abundance. Using the results from each GLM, an annual abundance index was constructed based on the standardised CPUE

- a) Relative to nominal CPUE, each of the standardised indices is similar but is higher at the start of the time-series and lower after 2012. 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.
- b) The change in the influence of the *Proportion-Tails* effect correlates with the shift from the catch being all tails to now being predominately whole, which decreases CPUE, 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.
- c) 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. The small effect of Area-Fished likely demonstrates industry's ability to fish where the stock is occurring and fishing in 'hot spots' of catch.

45. Overall, there is no major variation in recent years between standardised and nominal TVH CPUE indices. Vessel-effect (as a proxy for diver experience/skill) and percentage of tails are having the greatest influence on the indices and principal drivers of divergence between nominal and standardised catch rates.

46. **The RAG agreed to retain the "Int-1" GLM model as the TVH CPUE index in the eHCR and the stock assessment.**

Action

AFMA and CSIRO to work closely with industry to develop an index or key of diver names and 'clean up' the data diver name dataset to feed in to the next seasons' CPUE standardisation.

TIB Sector

47. The TIB CPUE trends were standardised to assess the effects of season, month, seller-island as a proxy for Area-Fished, fishing-method, proportion of tails in catch, Southern Oscillation Index and moon-phase and included data from December through to September, excluding records for 2013.
48. CPUE for the TIB sector is defined as the whole weight of landed lobsters over the number of days fished.
- a) Due to limited data available with the Area-Fished field filled in, seller (or fisher), address was used as a proxy for where fishing is likely to occur.
 - b) There are a number of differences between Nominal and Standardised CPUE indices. These changes are believed to be due to shifts in the percentage of the catch which are processed as tailed or whole lobsters and changes in fishing efficiency. There are also substantial differences between indices with and without area-effect.
 - c) Relative CPUE between months is seen to increase at the start of the season from December to March then remain relatively stable before declining during August and then reaching a seasonal low during September (~15 per cent less than at the start of the season).
 - a) Relative CPUE varies considerably between the various areas (Seller-Islands) included in the models. There is also considerable variation in the relative effect for a particular area between the different models. However, the uncertainty over the Area-Fished effect in these models needs to be taken into consideration.
 - b) The relative CPUE of each fishing method also shows some differences across all models. For the two models without the Island-effect included, the CPUE for hookah fishing is found to be around 24% higher than for both free diving and lamp fishing, and 8% higher than for mixed fishing, while for the models with the Island-effect included, the CPUE for hookah fishing is found to be around 33% higher than for free diving.
 - c) The relative CPUE across models without the Island-effect included, 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.
 - d) Of the two environmental effects, the results indicate that high negative values of the SOI (i.e. strong El Nino conditions) tend to marginally increase CPUE while the influence of high positive values of the SOI (i.e. strong La Nina conditions) is less clear. This result is different from that found when analysing the TVH data.
 - e) The influence of Moon-Phase on CPUE is seen to be similar across all models, and while displaying a degree of variability (higher for the two models including the Island-effect) indicates a bi-modal distribution across the days between successive full moons similar to that found with the TVH analysis. CPUE is lowest during days near a full and new moon, while CPUE is highest mid-way between these two phases (i.e. around the first and last quarters).

Annual TIB Abundance Indices:

- a) Relative to the nominal index, each of the standardised indices display a number of substantive shifts, generally being lower than the nominal index over the first half of the time-series and higher than the nominal index during the second half (i.e. since 2012).
- b) The influence on the seasonal index is seen to be greatest for the Proportion-Tails effect, and the decreasing trend observed over time is correlated with the shift from the catch being predominantly tails to now being predominantly whole lobsters, with the latter process type decreasing CPUE.
- c) The other effect having a substantive influence on the annual index is the Seller effect, and while displaying a variable influence over time the influence of this effect has increased in recent seasons resulting in an increase in catch rates. This indicates that there has been an increase in the relative fishing efficiency of Sellers in recent seasons,

which when accounted for in the standardising model leads to a decrease in the standardised CPUE.

- d) The influence of the Seller effect in recent seasons therefore explains the divergence seen between the standardised indices based on the Main and Seller models during this period.
- e) The annual influence of the other effects included in the standardising models is seen to be negligible, likely due to the fact that there has been no systematic shift in the relative degree of fishing within each level of these effects over time.

49. Comparison with other indices:

- a) 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.

50. Sensitivity Runs:

- b) Additional model runs were performed to investigate the sensitivity of the calculated abundance index to (i) changes in the data fitted to the models, and (ii) changes in the *Area-effect*.
- c) Differences to the indices based on the sensitivity runs of the fitted models are seen to be generally minor in comparison to the 'base case', however for the models including an *Area-effect* there is a higher degree of variation between indices.

51. The RAG agreed to use the “Seller” GLM model as the TIB CPUE index in the eHCR and the stock assessment.

52. The RAG noted that while the TIB-based indices have the potential to capture the major trends in stock abundance, they likely lack the detail required to track finer inter-annual trends in abundance. 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.

53. A scientific member noted that additional data from both sectors can potentially provide some social indicators for the fishery (i.e. fisher experience, participation, equity, spatial distribution of people in communities). Previous work undertaken in 2011 on social indicators may be a useful starting point to review these data. AFMA expressed support for examining these indicators to assist the TRL Working Group to understand and measure the impacts of management changes.

Action

The RAG to refer back to an earlier CSIRO report from 2011 on social indicators in the Torres Strait TRL fishery to help identify what indicators may be useful in understanding management changes in future.

Action

That the RAG (or RAG Data Sub-Group) determine whether there are better measures of effort in the fishery (hours vs days; time spent travelling, searching and actively fishing), and clarifying “number of fishers/divers” on TDB02 catch disposal record book.

Total reported catch for Australian and PNG fisheries for the 2018-19 fishing season

54. The RAG noted a summary of the Australian and PNG catch data for the 2018/19 fishing season:

- a) Australian Torres Strait TRL Fishery: as reported through the mandatory fish receiver system (FRS), the reported landed catch for the Fishery for the period 1 December 2018 – 30 September 2019 was 415, 835 kilograms. This equates to 84.03 per cent of Australia’s 494,850 kilogram total allowable catch (TAC).
- b) PNG TRL Fishery: the preliminary reported catch for the Fishery taken from the Torres Strait Protected Zone (TSPZ) for the period 1 January – 31 August 2019 is 86,560

kilograms, with a further 32,923 kilograms reported from outside the TSPZ. The catch inside the TSPZ equates to 90.03 per cent of PNG's 96,150 kilogram TAC for 2019. The RAG noted some doubt as to what areas PNG had designated as "outside but near areas" of the TSPZ for the TRL fishery. Stocks within the "outside but near area" are included as part of the Protected Zone fishery.

55. The RAG discussed the reported PNG Catch data, noting that it is difficult for PNG to provide the most recent month's data (November) for a December RAG meeting. Some industry members and observers suggested that PNG National Fisheries Authority reported catches are likely underestimated (approximately 186 tonnes based on unverified import catch reports; and an estimated 10 tonnes of catches sold domestically in PNG) however this could not be confirmed until the final year's complete data was available. Because total catch is a critical input to the eHCR, the RAG considered options for obtaining or estimating a more accurate catch figure for total PNG catches, including the possible use of verified import data provided by industry.
56. The RAG noted that AFMA's strong preference was to use official figures provided by PNG NFA and that AFMA would continue work with NFA to ensure any outstanding data was made available.
57. After receiving an overnight update from NFA on PNG TRL Catches, which included an additional two months of data (September and October 2019) but still missing December 2018 and November 2019 catches (**Attachment E**), the RAG discussed further ways in which the missing month's catches could be best estimated.
58. The RAG considered two options;
 - a) using an average of reported months catch (Jan – October 2018) equating to approximately 14 tonnes per month to fill in the missing catches for December 2018 and November 2019, or;
 - b) using industry provided import data as a scalar to estimate the missing months' data to investigate whether that makes a difference on the overall total reported catches by NFA, noting this may also provide a lower estimate than what industry had reported to the RAG (estimated to be approximately 200 tonnes for the season).
59. The RAG agreed to accept that average catches may be an underestimate but with no other appropriate methodology available for input in to the 2019-20 RBC eHCR process, the RAG agreed to use the NFA total catch figures (from both inside and outside the TSPZ). The adequacy of the simple averaging method, when compared to a median or other statistic, can be reviewed when all the 2019 reported catch data are known.
60. **Recognising that the NFA catch by month figures may not align with higher estimates of industry import data, the RAG agreed to assume an average catch (based on NFA provided figures) to apply to December 2018 and November 2019 missing months, being 13,921 kg each month. Thus, they agreed to a catch of 167,000 kg be used as the PNG total catch in the eHCR.**

5 Results of the 2019 pre-season survey

61. The RAG considered a presentation provided by Mark Tonks, CSIRO Scientific observer detailing the preliminary results of the 2019 pre-season survey (**Attachment F**):
 - a) The pre-season diver survey was conducted between 11-21 November 2019 aboard the "*Wild Blue*" and CSIRO dive tender. The survey was undertaken by four divers, Mark Tonks, Nicole Murphy, Kinam Salee and Steve Edgar, with a combined experience of 27 TRL surveys.
 - b) Dive transects were conducted at 77 repeat pre-season sites, starting in an easterly direction to utilise stronger currents for deeper dives and be in the shallower western Torres Strait when currents were weakest.
 - c) The pre-season TRL surveys provide indices of abundance for recruiting age lobsters (age 1+) and recently-settled lobsters (age 0+), abundance indices by stratum (region)

and length-frequency and sex ratios. At the time of the survey, most older lobsters (age 2+) have migrated and those that remain are mostly remnant males.

d) At each survey site:

- i. Two divers swim with the current to complete a 500m transect, covering 2m each;
- ii. Lobsters are counted for each age-class and collected where possible;
- iii. Habitat is assessed (i.e. substrate type and biota);
- iv. Temperature/depth profiles are collected; and,
- v. lobsters are measured (TW), sex determined and datasheets completed.

e) Age 1+ counts and index:

- i. The 2019 survey showed higher counts on the eastern side which were generally consistent between sites. This is a difference from the 2018 survey which demonstrated good recruitment throughout the fishery, but higher counts along the western side.
- ii. The 2019 survey index is up from 2018 and is the highest recorded since 2005 (**Attachment G, Figure 1**).
- iii. Reef Edge, Kirkaldie, Buru and South East strata had the highest indices.
- iv. High standard error for Buru and Reef Edge due to high count variability between sites and smaller standard error for Kirkaldie and South East indicating more similar counts between sites.
- v. In 2019, all strata other than TI Bridge recorded high indices relative to other surveys.

f) Age 0+ counts and index:

- i. The 2019 survey showed typical settlement mostly on western side of the survey area with the highest counts recorded south of Long Reef, east of Mabuia.
- ii. 2019 0+ index marginally up on the 2018 index, however it was not significantly different 2006, 2007, 2015, 2016 and 2018 (**Attachment G, Figure 2**).
- iii. TI Bridge index higher than the other stratum with high variability between sites.
- iv. 2019 0+ indices showing similar regional recruitment trends compared to previous surveys, however lower index for Mabuia and higher for TI Bridge stratum.

g) Size frequency and sex ratio:

- i. 2019 modal size of Age 1+ lobsters has decreased compared to last pre-season (2018).
- ii. Length frequency of 2019 lobsters is similar to most surveys.
- iii. Sex ratio was typically around 1:1 with 45 per cent of lobsters measured were male.

h) Habitat changes and temperature data:

- i. Percentage cover of seagrass is considerably down in 2019.
- ii. Minor sand incursions observed at two sites north of Mabuia.

62. In consideration of the cause of habitat changes, the RAG questioned whether it is possible for industry to carry small temperature loggers at certain periods throughout the year to aid in tracking seasonal temperature trends in addition to the single survey data point each season.

63. A traditional inhabitant industry member noted that over the past 18 months, the number of dugongs in the Torres Strait has increased dramatically, which may be impacting on the level of sea grass. It is assumed that there is a net movement of dugongs from the mainland waters, up in to the Torres Strait. Other industry members also noted observations of "white sand" with anecdotal evidence of declining seagrass coverage.

64. On behalf of the RAG, the Chair acknowledged and thanked the CSIRO team for the significant level of work undertaken to complete the survey and within a matter of weeks, analyse and report on the survey results in time for the RAG meeting.

6 Recommended Biological Catch

65. The RAG considered advice by the Scientific Member Dr Éva Plagányi on the RBC for the 2019/20 fishing season as derived through the application of the empirical harvest control rule (eHCR) under the final TRL harvest strategy (presentation at **Attachment H**), as detailed in agenda item paper 6, *Torres Strait tropical rock lobster (TRL) Panulirus ornatus empirical Harvest Control Rule (eHCR) Recommended Biological Catch (RBC) for 2020*.

66. For information, AFMA first summarised the TRL TAC setting process. In chronological order, the key steps to setting a TAC in the TRL fishery are:

- a) Mid November – TRL Fishery pre-season survey conducted by CSIRO;
- b) 1 December – Australian TRL fishery opens under a 200 tonne interim TAC;
- c) Mid-December – TRL RAG provides advice on a RBC;
- d) Mid-December – TRL WG provides advice on a global TAC;
- e) Mid-January – Global TAC endorsed by the PZJA;
- f) End-January – Australia and PNG agree on the global TAC and how it is to be shared, included cross-endorsement; and,
- g) End-February – Australian TAC is increased to final amount.

67. The RAG noted the following general overview of the eHCR:

- a) The newly adopted Torres Strait tropical rock lobster *Panulirus ornatus* (TRL) fishery Harvest Strategy uses an empirical (data-based) Harvest Control Rule (eHCR) to rapidly provide a Recommended Biological catch (RBC) using catch, survey indices and CPUE data inputs and is designed to dampen variability in the TAC. The eHCR-derived RBC can therefore be expected to be less variable than the stock assessment-based RBC.
- b) The eHCR is applied in December and outputs a RBC for the following year. This formula is the multiple of the average annual catch over the last 5 years (582.6 tonnes; using available catch from TIB, TVH, PNG) and a statistic which measures the relative performance of the fishery based on the following five data inputs:
 - i. Pre-season survey recruiting lobster (1+) standardised relative numbers (70%);
 - ii. Pre-season survey recently-settled lobster (0+) standardised relative numbers (10%); and,
 - iii. nominal CPUE for TIB sector (10%); and,
 - iv. standardised CPUE for TVH sector (using data available up until end of October) (10%).
- c) The eHCR indicates that if the overall performance of the fishery is improving then the RBC will increase, while if the overall performance of the fishery is decreasing then the RBC will also decrease. Over the long-term the eHCR should maintain the stock around the target biomass level (B_{65}) under the agreed Harvest Strategy. Different weightings are applied to the four abundance indices included in the relative performance statistic used in the eHCR, based on extensive testing to compare performance of alternative weightings and also considering the information content and reliability of each series, as well as a preference expressed by the stakeholders to use a portfolio approach in determining the RBC.

68. A number of alternative CPUE increase/decrease scenarios were investigated by CSIRO to explore potential impact on RBC calculations that might arise if the representativeness of the 2019 CPUE data has changed as a result of the introduction of quota management. The

sensitivity testing showed that the eHCR-derived RBC is fairly robust to uncertainty in CPUE. The RAG consider this outcome to be expected because the eHCR is based on medium-term (5 years) trend in all indices, plus the contributions of the trends in the CPUE indices are small (10 per cent) relative to the weight accorded to the fishery independent pre-season survey (70 per cent).

69. The RAG noted that the different CPUE standardisation scenarios had little impact on the overall CPUE indices and eHCR outputs. Although CPUE data only informs on an index of abundance of 2+ spawning lobsters that is critically important to the longer term view of sustainability to ensure enough lobsters are left to breed and replenish the fishery in three years' time. Without the mid-season survey, the 2+ index derived from TIB and TVH CPUE is also critical to inform on spawning stock status relative to agreed reference points to understand where the stock is fluctuating around the target level; or if the spawning biomass falls below the limit.
70. When examining recent trends in eHCR indices, both the TIB CPUE and TVH CPUE indices showed very positive slopes. The pre-season 1+ survey showed a slightly positive trend, while the pre-season survey 0+ trend was generally flat with a slightly negative slope (**Attachment I, Figure 3**).
71. When comparing CPUE from both TIB and TVH sectors with the 2018 model estimated biomass, the results suggest that the two CPUE indices show similar trends over the recent period. When comparing longer term CPUE and model-estimated commercially available lobster biomass trends (based on fitting to survey data), there are indications that the CPUE does not drop as steeply as the stock biomass in estimated low abundance years. This is considered most likely due to a hyperstability effect.
72. The eHCR can be described as:

$$eHCR = \text{Log of slopes; all indices (pre1+, pre0+, CPUE_TVH, CPUE_TIB from past 5 years) with default weightings (0.7, 0.1, 0.1, 0.1) x average catch}$$

73. Noting the updated and agreed PNG catch figures, the final inputs in to the eHCR were as follows:

Catch Total	TIB	TVH	PNG	TS Total
2019	259.7	155.9	167.0	582.6

	TVH model	TIB model	TIB CPUE (10% weighting)	TVH CPUE (10% weighting)	1+ Survey Index (70% weighting)	0+ Survey Index (10% weighting)	RBC
Base Case	Int-1	Seller	1.26	1.01	1.92	6.77	582.1

74. The RAG further noted that in converting an RBC to a TAC, other sources of mortality (including both Torres Strait and PNG traditional catch and recreational catch) must be considered. Acknowledging that traditional and recreational catches do occur throughout the fishery, these estimates are assumed to be relatively low and constant through time relative to the commercial catch. Given that estimates of these catches are not included as inputs in to the eHCR or the stock assessment, the RAG Scientific members advised that it is not appropriate to then discount those catches from the RBC in the final TAC calculations and advice.
75. **In accordance with the TRL Harvest Strategy, using the above eHCR inputs, the RAG recommended an RBC value of 582.1 tonnes for the 2019-20 season with no deduction of catches taken by non-commercial fishing sectors.**

7 Preliminary stock assessment results

76. The RAG noted that a stock assessment was undertaken during 2019 for two reasons: 1) it followed one of the lowest periods of recruitment in the fishery; and 2) it precedes a significant management change in the fishery with the implementation of the Management Plan and the move to quota allocation.
77. The RAG noted that in accordance with the TRL Harvest Strategy, a recommended biological catch value is to be calculated each fishing season by applying the eHCR, however:
- a) If the updated stock assessment indicates the eHCR recommended RBCs are outside the revised ranges tested by management strategy evaluation (MSE), RBCs are to be set using an annual stock assessment until a revised eHCR has been agreed, after which the revised eHCR is applied; and
 - b) If the updated stock assessment does not indicate any need for revision of the eHCR, the stock assessment continues on a three year cycle, unless triggered to occur by a decision rule.
78. The RAG considered a presentation provided by Dr Èva Plagányi, CSIRO Scientific member detailing the preliminary results of the 2019 stock assessment update which incorporates catch and effort data for the 2018-19 fishing season and the results of the November 2019 pre-season survey (**Attachment J**).
- a) Summary of assessment model - the stock assessment uses an Age Structured Production Model (ASPMs) which corresponds to Statistical Catch-at-Age Analysis (SCAA) as the data fitted included catch-at-age information. This is a widely used approach for provided TAC advice with associated uncertainties. The output of the assessment is a RBC (with confidence intervals) for each year. The model is an integrated assessment that takes into account all available sources of information. This includes:
 - i. Pre-season survey data (10 years with a gap in the time series);
 - ii. Mid-year survey data 1989-2014; 2018;
 - iii. Catch statistics from all sectors in the Torres Strait
 - iv. Length frequency data (Australia and PNG catches);
 - v. CPUE data from TVH sector;
 - vi. CPUE data from TIB sector; and,
 - vii. Historical information.
 - b) Model 'Reference Case' Specifications:
 - i. Fixed steepness $h=0.7$;
 - ii. Fixed hyperstability parameters CPUE (TVH 0.75) (TIB 0.5);
 - iii. Midyear survey index – use index after applying mixture model to separate cohorts;
 - iv. Preseason survey index – use as Reference MYO (mid-year only) series and same series as in Nov 2017 without the additional 5 sites added;
 - v. CPUE TVH – “Int-1” standardised series;
 - vi. CPUE TIB – “Seller” standardised series; and,
 - vii. Estimate additional variance (A.V.) parameters for Preseason 0+ index for all years except most recent, to account for process error.
 - c) Preliminary Results of the Reference Case:
 - i. The reference case model adequately fits to the observed pre-season survey index for 1+ lobsters, however there is a larger error associated with the 0+ index

which means the model gives much less weight in trying to fit to the observed 0+ index;

- ii. The reference case model also fits well to both previous benchmark surveys and the 1+ and 2+ indices from mid-year surveys;
- iii. Stock recruitment residuals are roughly evenly distributed;
- iv. Fishing mortality estimates are close to the harvest strategy target level of 0.15, however with revised PNG catch figures the F statistic will be closer to the target value;
- v. Overall, the stock assessment results indicate that the TRL spawning biomass $B(2019)^{sp}$ is approximately 93% of relative unfished biomass $B(1973)^{sp}$, which is well above the agreed target reference point of 65 per cent unfished biomass under the harvest strategy (**Attachment K, Figure 4**). The RAG noted that the biomass can be expected to fluctuate due to the natural variability of the stock. The RAG was reminded that the agreed target reference point is relatively higher compared with other Australian fisheries and guidance under the Commonwealth Harvest Strategy Policy. This was deliberately designed to meet the objectives of the TRL fishery and protect the traditional way of life, and livelihoods of traditional inhabitants in the Torres Strait;
- vi. The model estimated a stock biomass $B(2019)^{sp}$ of 4,467 tonnes; and,
- vii. The 2019-20 season RBC output from the stock assessment is 766 tonnes.

79. The RAG noted that under the Harvest Strategy, another stock assessment will not be conducted for three years, meaning a biomass depletion statistic will not be updated until the next stock assessment.

80. **In accordance with the TRL Harvest Strategy, the RAG agreed that:**

- a) **The pre-season survey limit was not triggered;**
- b) **The eHCR RBC appears to remain within the revised ranges tested by management strategy evaluation (MSE);**
- c) **The updated stock assessment does not indicate any need for revision of the eHCR; and**
- d) **The application of the eHCR should continue unchanged and be applied to provide the RBC for the 2019/20 fishing year.**

8 Interactions between the TRL fishery and other species

81. The RAG noted an overview of the preliminary findings of interactions with tropical rock lobster in other fisheries in the Torres Strait and the ecological interactions between TRL and other species in the Torres Strait noting in particular:

- a. the summary of observer data and anecdotal reports of TRL interactions in the Australian Torres Strait Prawn Fishery (TSPF) and Papua New Guinea (PNG) prawn trawl fishery; and
- b. the concerns expressed by communities during recent community visits regarding interactions (both positive and negative) between TRL and coral trout.

TRL interactions with prawn fisheries

82. The RAG noted that the Torres Strait Prawn Fishery has a number of management measures in place that reduces the potential level of interactions with TRL. Specifically:

- a) under the *TSPF Management Plan 2009* trawl boats in the TSPF are prohibited from taking, processing or carrying TRL or TRL products; and,

b) there are extensive spatial closures in the TSPF which overlap with key TRL Fishery grounds (**Attachment L**).

83. The RAG noted that discards of TRL are not required to be recorded in the TSPF logbook (NP16) but it is a condition of TSPF licences that licence holders carry an AFMA scientific observer when required to do so, to collect fishery independent scientific data. The AFMA Observer Program in the TSPF aims to observe 2.6% of actual days fished in a given TSPF season. The average annual number of days fished from 2007 to 2018 in the TSPF is 2,654 days.
84. The RAG noted a preliminary analysis based on available observer data indicates that since 2007, a total of 2,807 individual lobsters were sampled by the AFMA observer program, providing length, sex, weight, fate (discarded/retained) and life status data collection.
85. Of these samples, approximately 99 per cent of discarded lobsters in an observed trip were recorded as discarded alive - 75% of these were recorded as “alive and vigorous”, 24% recorded as “alive and sluggish”, 0.5% recorded as “alive, just”. Less than 1% is recorded as dead. RAG members questioned whether the observer-reported life state may accurately indicate post-capture survival.
86. The RAG agreed that based on the preliminary analysis and data presented, there is an indication that the impacts of the TSPF on the TRL fishery may be significant and recommended that a further analysis of the available data be undertaken by AFMA and CSIRO. The RAG also requested additional information on TSPF observer data collection protocols to support the data analysis.

Action

AFMA to provide all available information and data on the Torres Strait Prawn Fishery (TSPF) observer program for further analysis by CSIRO and the RAG to examine the impacts of the TSPF on the TRL Fishery.

TRL interactions with coral trout

87. The RAG noted that when discussing the proposed removal of the Torres Strait Finfish Fishery’s Western Line Closure (WLC) during community visits in April/May 2019, communities expressed varied views in relation to the possible impacts of the removal of the WLC, particularly in relation to impacts on the TRL stock.
88. Concerns expressed included that increases in coral trout harvests may have adverse impacts on the sustainability of the TRL stock. This concern is based on anecdotal reports of shared habitat and industry observations of interactions between the two species.
89. Other comments from an eastern communities indicated that potential increases in harvests of coral trout would be beneficial to the TRL Fishery as it would alleviate coral trout predation on TRL and increase available habitat for TRL. A traditional inhabitant member added that more recently, Maluiligal communities have expressed a desire to retain the WLC. This is due to diver safety concerns in shallow water where the risk of shark interactions is increased after line fishing has occurred in the same area. The RAG noted that Maluiligal communities are supportive of the desire for Gudumalulgal communities to have the closure removed north of Turnagain Island where the risk of diver safety is reduced as TRL diving is less prevalent.
90. The RAG noted that both the Finfish RAG and Finfish Working Group considered this issue at their recent meetings (27-29 November 2019) and advised that given the complexity of trophic interactions (many and varied, for example, direct and indirect impacts on (i) competition for food, (ii) habitat and (iii) predatory-prey interactions), it is extremely difficult to predict and assess potential impacts that fishing one species may have on another.
91. A scientific member agreed that trophic interactions are difficult to quantify however technical interactions are measurable (e.g. between divers and sharks, between vessels or between fishing gear types).
92. **Given the anecdotal reports above, the RAG advised that specifically, the potential risks of increased diver/shark interactions resulting from berley and baiting for commercial reef line fishing should be considered when assessing the removal of the WLC.**

93. The RAG also noted that technical interactions of line fishing on diving is likely to be less important for Gudumalulgal communities where diving is less prevalent due to turbid, shallow water and where line fishing is more favourable.

9 Five-year research plan

94. The RAG discussed and provided advice on research priorities identified for the rolling Five-Year Research Plan for 2020/21 to 2024/25 for the Fishery. The RAG noted comments provided by both RAG and TRL Working Group members out-of-session in September 2019 on the Plan and Torres Strait Advisory Committee annual research funding cycle. The RAG also considered a draft Terms of Reference for an external review of the TRL survey as drafted by the Chair and independent Science Member.

Research priorities

95. The RAG recommended:

- 1) For the following to remain as essential research priorities (noting also all are currently funded):
 - a. **Fishery surveys, stock assessment, harvest control rules and recommended biological catch (RBC).** This research is used to monitor the performance of the Fishery and inform annual management decisions on the TAC.
 - b. **Ecological risk assessment (ERA).** AFMA has committed to update ERAs for Commonwealth managed fisheries and having an ERA is often considered export approval assessments.
 - c. **Improvement of data collection.** The RAG supported the continuation of the data sub-group as a means to progress options for addressing ongoing fishery dependent data needs for the fishery.
- 2) To increase the research priority of **understanding fishing behaviour** to essential noting the need to carefully understand impacts of quota management on: (i) data collected in the Fishery and therefore how is it used to assess the Fishery; and (ii) broader fisheries management performance against social and economic objectives for the Fishery. The latter would likely inform evaluations on the ongoing role of input controls in the Fishery. The RAG agreed that this research need was the highest priority currently unfunded.
- 3) To revisit the priority ranking for the **Science peer review** research need following RAG agreement of a final draft the Terms of Reference (ToR) for such a review. The RAG provided preliminary advice on the draft ToR prepared by the Chair and Independent Scientist (**Attachment M**). The RAG:
 - a. recommended that the ToR make clear that recommendations are only being sought on the pre-season survey 1+ index of abundance and must have regard to the need to maintain the time series of abundance indices and current resourcing constraints; and
 - b. agreed for the TRL RAG Chair and Independent Scientist to work with CSIRO and other members out-of-session to finalise the draft ToR prior to the next RAG meeting.

10 Other business

96. Dr Robert Campbell, CSIRO Scientific observer presented a preliminary analysis on the effects of habitat on the pre-season survey 1+ index as an extended analysis on the diver-effect presented at TRLRAG 26 on 5 February 2019.
97. Noting that different substrate types can be observed at the same survey sites over time, the analysis examines the percentage of habitat coverage at each survey dive transect (2000m²) to determine whether there is an effect on lobster abundance and probability of seeing a lobster.
98. A preliminary General Linear Model (GLM) analysis and comparison of the habitat-effects index with the survey index shows the general index trends are similar but the absolute values are different in some years.
99. The RAG noted this analysis is preliminary and that it will be useful to explore further in more detail.
100. No other business was nominated for discussion.

11 Date and venue for next meeting

101. The RAG noted that:
 - a) The next TRL RAG meeting is tentatively scheduled for 1-2 April 2020, with exact dates to be confirmed out of session.
 - b) The second data sub-group meeting is proposed for 31 March 2020 noting industry member availability, with a preference to have the meetings back to back to save costs. Followed by the standard December RAG scheduled for 15-16 December 2020.
102. On behalf of RAG members and observers, the Chair thanked Dr Rob Campbell for his significant contributions, scientific expertise and inputs to the RAG over the past nine years.
103. RAG members and observers also thanked the conscientious and dedicated work of Natalie Couchman as the management officer of the TRL fishery and Executive Officer of the RAG over the past few years.
104. The 27th TRL RAG meeting was closed in prayer at 3:37pm on Wednesday 11 December 2019.

Declaration of interests
Dr Ian Knuckey – November 2019

Positions:

Director –	Fishwell Consulting Pty Ltd
Director –	Olrac Australia (Electronic logbooks)
Deputy Chair –	Victorian Marine and Coastal Council
Chair / Director –	Australian Seafood Co-products & ASCo Fertilisers (seafood waste)
Chair –	Northern Prawn Fishery Resource Assessment Group
Chair –	Tropical Rock Lobster Resource Assessment Group
Chair –	Victorian Rock Lobster and Giant Crab Assessment Group
Chair –	Victorian Central Zone Abalone Fisheries Resource Advisory Grou
Chair –	Gulf of St Vincent's Prawn Fishery MAC Research Scientific Committee
Scientific Member –	Northern Prawn Management Advisory Committee
Scientific Member –	SESSF Shark Resource Assessment Group
Scientific Member –	Great Australian Bight Resource Assessment Group
Scientific Member –	Gulf of St Vincent's Prawn Fishery Management Advisory Committee
Scientific Member –	Tropical Tuna Resource Assessment Group
Scientific participant –	SEMAC, SESSF Resource Assessment Group

Current projects:

AFMA 2020/0807	Bass Strait Scallop Fishery Survey – 2020-22
FRDC 2017/069	Indigenous Capacity Building
FRDC 2016/116	5-year RD&E Plan for NT fisheries and aquaculture
Traffic Project	Shark Product Traceability
FRDC 2018/021	Development and evaluation of SESSF multi-species harvest strategies
FRDC 2017/014	Informing structural reform of South Australia's Marine Scalefish Fishery
NT Fisheries	Design and implementation of a tropical snapper trawl survey
Sea Cucumber Ass.	Design and implementation of a sea cucumber dive survey
FRDC 2019-072	A survey to detect change in Danish Seine catch rates of Flathead and School Whiting resulting from CGG seismic exploration.

**27th MEETING OF THE PZJA TORRES STRAIT TROPICAL
ROCK LOBSTER RESOURCE ASSESSMENT
GROUP (TRLRAG 27)**

10-11 December 2019 (9:00 AM – 5:00 PM)

**TSRA Boardroom
Level 1 Torres Strait Haus
46 Victoria Parade, Thursday Island**

ADOPTED AGENDA

1 PRELIMINARIES

1.1 Welcome and apologies

The Chair will welcome members and observers to the 27th meeting of the RAG.

1.2 Adoption of agenda

The RAG will be invited to adopt the draft agenda.

1.3 Declaration of interests

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

1.4 Action items from previous meetings

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

1.5 Out-of-session correspondence

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

2 UPDATES FROM MEMBERS

2.1 Industry members

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

2.2 Scientific members

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

2.3 Government agencies

The RAG will be invited to note updates from AFMA, TSRA and QDAF on matters concerning the Torres Strait TRL Fishery. AFMA will provide updates on the implementation of the Management Plan and draft Harvest Strategy for the TRL Fishery, management arrangements for the 2019-20 fishing season and delivery of the Compliance program.

2.4 PNG National Fisheries Authority

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

2.5 Native Title

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

3 RAG DATA SUB-GROUP MEETING

The RAG will be invited to discuss the outcomes of the first meeting of the TRLRAG Data Sub-Group held on 18 June 2019.

4 CATCH AND EFFORT ANALYSES FOR THE 2018-19 FISHING SEASON

The RAG will be invited to discuss TRL Fishery catch and effort data for the 2018-19 fishing season, including catch-per-unit-effort (CPUE) analyses to be presented by the CSIRO. This is to include consideration of changes to fishing behaviours during the 2018-19 fishing season as a result of the move to a quota management system.

5 RESULTS OF THE NOVEMBER 2019 PRE-SEASON SURVEY

The RAG will be invited to discuss the results of the November 2019 pre-season survey to be presented by the CSIRO.

6 RECOMMENDED BIOLOGICAL CATCH

The use of the eHCR as the basis of advice on a RBC is pending adoption of the revised Harvest Strategy by the PZJA. The RAG will be invited to provide advice on a recommended biological catch (RBC) for the TRL Fishery for the 2019-20 fishing season, based on estimates derived through the application of the empirical harvest control rule (eHCR).

7 PRELIMINARY STOCK ASSESSMENT RESULTS

The RAG will be invited to consider the preliminary results of the integrated stock assessment.

8 INTERACTIONS BETWEEN TRL FISHERY AND OTHER SPECIES

The RAG will be invited to discuss:

- impacts of removing the Western Line Closure in the Torres Strait Finfish Fishery, on the Torres Strait TRL Fishery;
- discarding of TRL in the Torres Strait Prawn Fishery.

9 FIVE-YEAR RESEARCH PLAN

The RAG will be invited to provide further advice on research priorities for the Torres Strait TRL Fishery for the next five funding years (2020/21 to 2024/25). This is to include consideration of matters raised by members out-of-session, including discussion of the priority of identified projects, identification of projects suitable for tactical funding in 2020/21 and new projects (models for managing/administering Traditional Inhabitant quota).

10 OTHER BUSINESS

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

11 DATE AND VENUE FOR NEXT MEETING

The RAG will be invited to discuss a suitable date for the next meeting.

Action items from previous TRLRAG meetings

#	Action Item	Meeting	Responsible Agency/ies	Due Date	Status
1.	<p>AFMA to review the effectiveness of certain TIB licensing arrangements (in its 2016 licencing review) including:</p> <ul style="list-style-type: none"> TIB licenses should share a common expiry date licences to last for longer than the current 12 month period. 	TRLRAG14 (25-26 August 2015)	AFMA	2017	<p>Ongoing and recommend this action be transferred to the Working Group</p> <p>This item will be considered at the next meeting of the TRL Working Group scheduled for December 2019. If required by the RAG, AFMA will provide further updates on this item once it has been considered and prioritised by the TRL Working Group and resourcing has been allocated.</p>
2.	AFMA and CSIRO prepare a timeline of key events that have occurred in the Torres Strait Tropical Rock Lobster Fishery (e.g. licence buy backs, weather events and regulation changes) and provide a paper to TRLRAG.	TRLRAG14 (25-26 August 2015)	AFMA CSIRO	TRLRAG17 (31 March 2016)	<p>Ongoing</p> <p>Draft timeline provided at Meeting Paper 1.4c for comment. Further work to finalise to be undertaken in 2020.</p>
3.	South Fly River studies to be provided for consideration at the next TRL and Finfish RAG meetings.	TRLRAG23 (15 May 2018)	AFMA	TRLRAG24 (18-19 October 2018)	<p>Completed</p> <p>Preliminary results of these studies was presented to TRLRAG25 held on 11-12 December 2018. The final reports were circulated to the RAG out of session on 31 October 2019.</p>
4.	With regards to future TIB catch and effort analyses, CSIRO to explore the use of boat marks to improve location fished data extracted from the TDB02 CDR.	TRLRAG24 (18-19 October 2018)	CSIRO	2019	<p>Completed</p> <p>To be discussed under Agenda Item 4.</p>
5.	CSIRO to provide information on a recent review of the survey	TRLRAG24 (18-19 October 2018)	CSIRO	TRLRAG25	<p>Completed</p>

#	Action Item	Meeting	Responsible Agency/ies	Due Date	Status
	design to the RAG for information.				A report on the review of the Torres Strait TRL Fishery survey design by the U.S. National Park Service was circulated to the RAG out of session on 18 March 2019.
6.	CSIRO to investigate the length frequency conversion factors from the catch weight data provided by MG Kailis.	TRLRAG25 (11-12 December 2018)	CSIRO	2019	Ongoing CSIRO to address when resources become available. This is a lower priority as the outcomes of this work will not affect the RBC calculations for the 2019-20 fishing season.
7.	Considering assessment timelines, PNG NFA to provide CSIRO with a best estimate of PNG catches by mid-November. CSIRO to liaise closely with PNG regarding reporting timeframes and provision of catch data. In parallel, the RAG data sub-group to examine ways to adjust the stock assessment model to account for delayed catch data from PNG.	TRLRAG25 (11-12 December 2018)	PNG NFA CSIRO AFMA RAG Data Sub-Group	2019	Ongoing Throughout the 2018-19 fishing season, AFMA and CSIRO continued to liaise with PNG NFA with regards to the provision of catch and effort data for the PNG TRL Fishery. PNG NFA have provided data which is provided under Agenda Item 4 for discussion. The PNG NFA did not attend to the RAG Data Sub-Group which met on 18 June 2019, and as such this matter was not discussed. To be placed on the agenda for the next meeting.
8.	That the TRL RAG data subcommittee discuss which TVH CPUE series are the best to use within the model.	TRLRAG25 (11-12 December 2018)	AFMA RAG Data Sub-Group	2019	Ongoing The RAG Data Sub-Group met on 18 June 2019, however this item was not considered. A report from the Sub-Group will be considered under Agenda Item 3. This matter was not discussed. To be placed on the agenda for the next meeting.
9.	MG Kailis to submit tissue samples from frozen TRL tails for trace metal analysis to better understand the impacts of dissolved contaminants from the	TRLRAG25 (11-12 December 2018)	MG Kailis	2019	Ongoing MG Kailis to provide an update on this item at the meeting.

#	Action Item	Meeting	Responsible Agency/ies	Due Date	Status
	Fly River run off on important fisheries species in the Torres Strait.				
10.	CSIRO to circulate the final report from the Fly River study to all RAG members once available.	TRLRAG25 (11-12 December 2018)	CSIRO	2019	Completed Preliminary results of these studies was presented to TRLRAG25 held on 11-12 December 2018. The final reports were circulated to the RAG out of session on 31 October 2019.
11.	CSIRO to send information to PNG concerning the current survey design for the Protected Zone TRL Fishery, including details on current and historical survey sites.	TRLRAG26 (5 February 2019)	CSIRO	Prior to TRLRAG27	Completed In mid-2019, CSIRO provided additional information to PNG concerning the current survey design.
12.	CSIRO to provide a copy of report concerning GLM analysis in 2013, to be circulated to the RAG for consideration.	TRLRAG26 (5 February 2019)	CSIRO	Prior to TRLRAG27	Completed Report was circulated to the RAG out of session on 31 October 2019.
13.	CSIRO to undertake further investigations to improve the GLM approach, and present the findings to the next meeting of the RAG.	TRLRAG26 (5 February 2019)	CSIRO	TRLRAG27	Ongoing CSIRO to provide an update on this item at the meeting.
14.	CSIRO to circulate cost-benefit paper to RAG.	TRLRAG26 (5 February 2019)	AFMA	Prior to TRLRAG27	Completed Paper was circulated to the RAG out of session on 18 March 2019.
15.	Draft terms of reference for the RAG Data Sub-Group to be circulated out of session for	TRLRAG26 (5 February 2019)	AFMA	March 2019	Completed Draft terms of reference were circulated to the RAG out of session for comment on 18 March 2019. No

#	Action Item	Meeting	Responsible Agency/ies	Due Date	Status
	member comment, prior to finalisation.				comments were received. The RAG Data Sub-Group met on 18 June 2019. A report from the Sub-Group will be considered under Agenda Item 3.
16.	Information to be provided to the Sub-Group on the use of dive-loggers to collect fishery dependent data in the Tasmanian Abalone Fishery.	TRLRAG26 (5 February 2019)	AFMA	17 April 2019	Completed The RAG Data Sub-Group met on 18 June 2019, where this issue was considered. A report from the Sub-Group will be considered under Agenda Item 3.
17.	Draft terms of reference for the independent peer review of the TRL Fishery survey design to be refined by the Chairperson and Independent Scientific Member out of session, taking into consideration the changes suggested by the RAG and any additional changes received from members.	TRLRAG26 (5 February 2019)	Chairperson Independent Scientific Member AFMA	April 2019	Completed Provided for discussion under Agenda Item 9.
18.	Members to send details of potential reviewers to AFMA for further consideration.	TRLRAG26 (5 February 2019)	RAG members	April 2019	Completed Request was circulated to the RAG out of session on 18 March 2019. No responses were received.

Relevant action items from previous TRLWG meetings*

#	Action Item	Meeting	Responsible Agency/ies	Due Date	Status
1.	Discard reporting and estimation be considered by the RAG (possibly by the RAG data subgroup)	TRLWG8 (8 November 2018)	AFMA RAG Data Sub-Group	2019	Ongoing The RAG Data Sub-Group met on 18 June 2019, where this issue was considered. A report from the Sub-Group will be considered under Agenda Item 3.
2.	RAG to consider the merit and options for improving the index of 0+ lobster abundance, through logbooks or other means. The Working Group noted that this would may be relevant to the RAG data sub-committee.	TRLWG8 (8 November 2018)	AFMA RAG Data Sub-Group	2019	Ongoing The RAG Data Sub-Group met on 18 June 2019, where this issue was considered. A report from the Sub-Group will be considered under Agenda Item 3.

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

PNG Catch Total: Jan - Oct 2019				
Month (2018)	Tail weight (kg)	Tail wt converted to whole wt (C. factor 2.677)	Whole weight (kg)	Total Catch (kg)
JANUARY	4,489.05	12,017.19	502.30	12,519.49
FEBRUARY	4,262.27	11,410.10	2,019.56	13,429.66
MARCH	7,460.08	19,970.64	2,424.17	22,394.81
APRIL	1,463.60	3,918.06	263.90	4,181.96
MAY	7,969.90	21,335.42	729.50	22,064.92
JUNE	5,746.84	15,384.29	3,248.40	18,632.69
JULY	3,369.58	9,020.37	3,260.33	12,280.70
AUGUST	4,077.30	10,914.92	3,063.71	13,978.63
SEPTEMBER	2,907.02	7,782.09	1,395.53	9,177.62
OCTOBER	3,473.01	9,297.25	1,253.39	10,550.64
TOTAL	42,546.91	113,898.07	17,626.63	139,211.11

PNG Jurisdiction of the TSPZ: Jan - Oct 2019				
Month (2018)	Tail weight (kg)	Tail wt converted to whole wt (C. factor 2.677)	Whole weight (kg)	Total Catch (kg)
JANUARY	2,178.23	5,831.12	213.96	6,045.08
FEBRUARY	2,893.69	7,746.41	1,038.64	8,785.05
MARCH	6,015.85	16,104.43	1,790.28	17,894.71
APRIL	1,414.20	3,785.81	263.90	4,049.71
MAY	7,656.90	20,497.52	729.50	21,227.02
JUNE	4,027.13	10,780.63	1,772.75	12,553.38
JULY	1,899.34	5,084.53	2,591.81	7,676.34
AUGUST	2,114.38	5,660.18	2,668.29	8,328.47
SEPTEMBER	1,972.67	5,280.84	1,167.95	6,448.79
OCTOBER	1,735.62	4,646.25	946.81	5,593.06
TOTAL	31,908.01	85,417.73	13,183.89	98,601.62

PNG Waters outside of TSPZ: Jan - Oct 2019				
Month (2018)	Tail weight (kg)	Tail wt converted to whole wt (C. factor 2.677)	Whole weight (kg)	Total Catch (kg)
JANUARY	2,310.82	6,186.07	288.34	6,474.41
FEBRUARY	1,368.58	3,663.69	980.92	4,644.61
MARCH	1,444.23	3,866.21	633.89	4,500.10
APRIL	49.40	132.24	-	132.24
MAY	313.00	837.90	-	837.90
JUNE	1,719.71	4,603.66	1,475.65	6,079.31
JULY	1,470.24	3,935.83	668.52	4,604.35
AUGUST	1,962.92	5,254.74	395.42	5,650.16
SEPTEMBER	934.35	2,501.25	227.58	2,728.83
OCTOBER	1,737.39	4,650.99	306.58	4,957.57
TOTAL	10,638.90	28,480.34	4,442.74	40,609.49

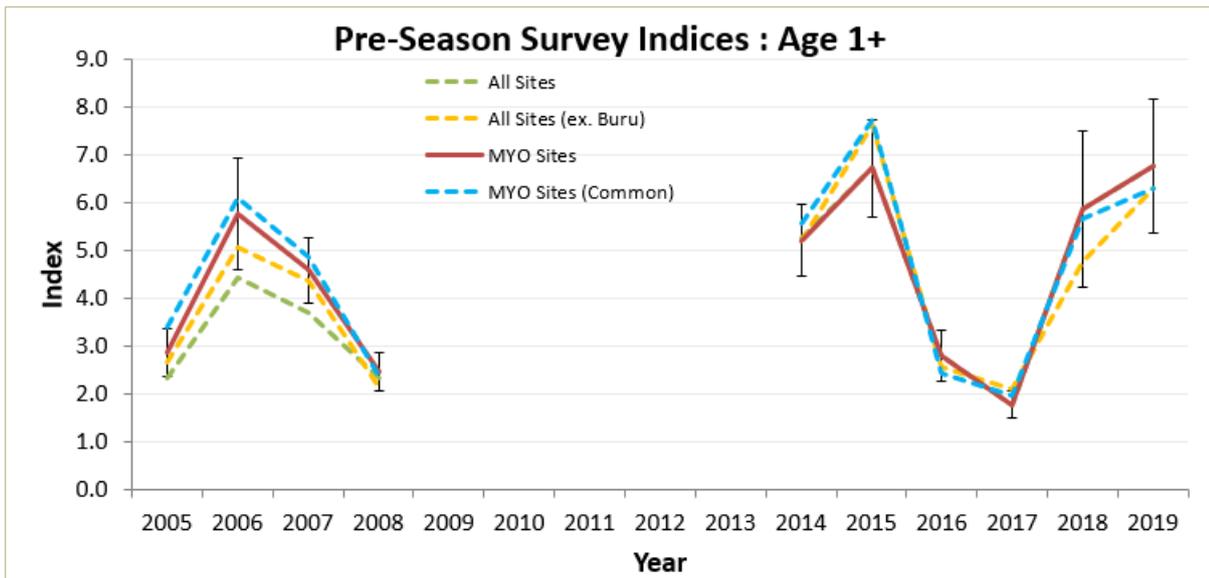


Figure 1. Abundance indices of recruiting (1+) ornate rock lobsters (*Panulirus ornatus*) recorded during pre-season surveys in Torres Strait between 2005 and 2018. The data represents abundance indices for all sites as well as reduced series including Midyear-Only Sites (MYO). Error bars of MYO indices represent standard errors. (Note: pre-season surveys were not conducted during 2009-2013).

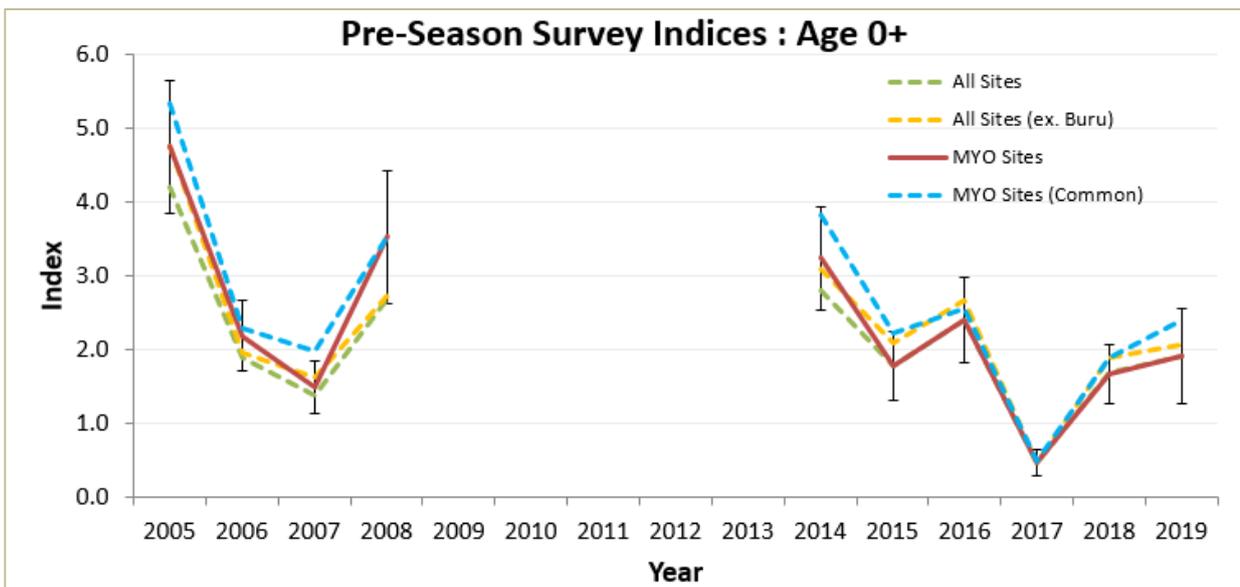


Figure 2. Abundance indices of recently-settled (0+) ornate rock lobsters (*Panulirus ornatus*) recorded during pre-season surveys in Torres Strait between 2005 and 2019. The data represents abundance indices for all sites as well as a subset including Midyear-Only Sites (MYO). Error bars of MYO indices represent standard errors. (Note: pre-season surveys were not conducted during 2009-2013).

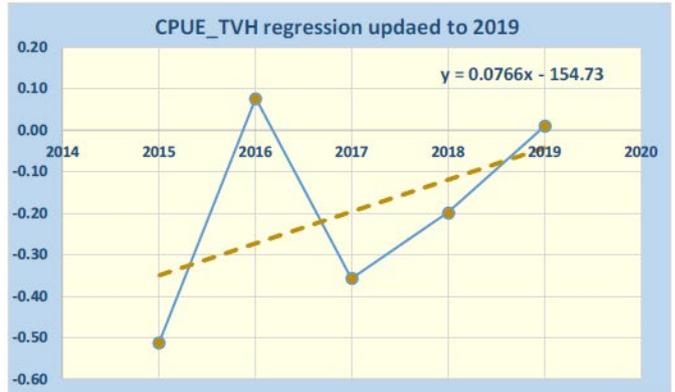
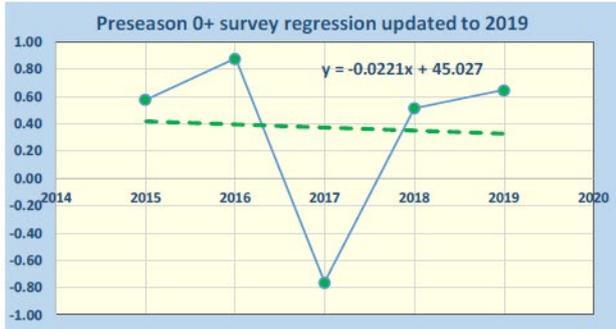
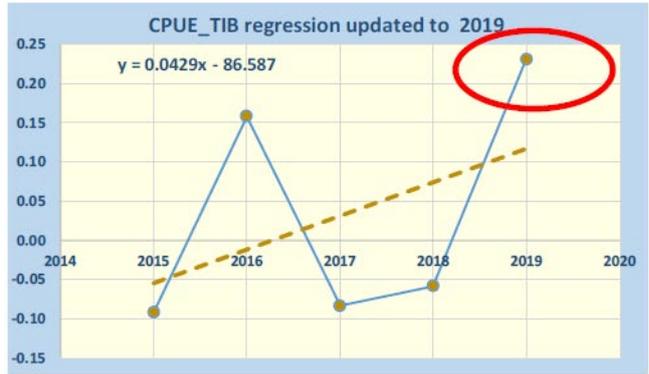


Figure 3. Regression slopes of each eHCR indices; pre-season 1+ survey, pre-season 0+ survey, TIB CPUE and TVH CPUE.

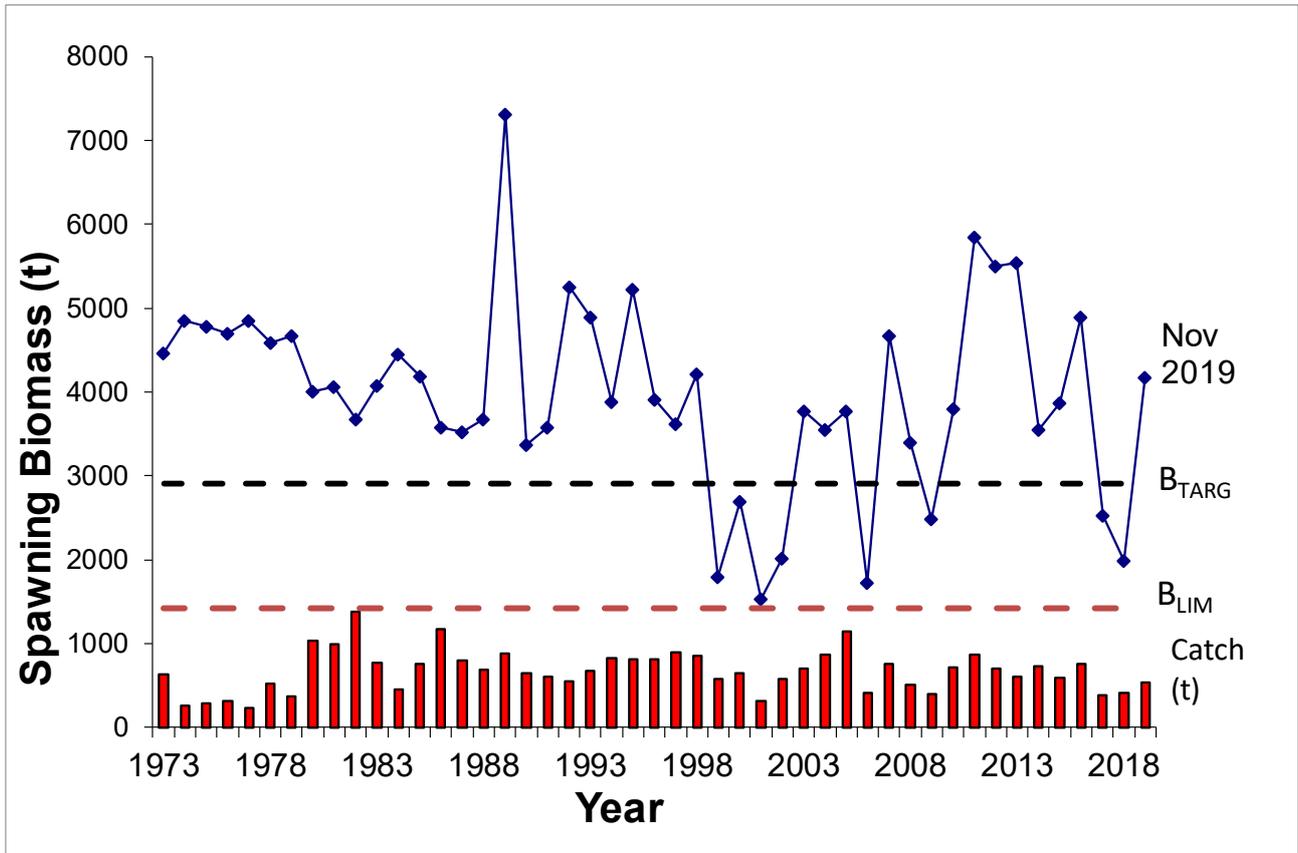


Figure 4. Stock assessment model estimates of spawning biomass relative to agreed reference points under the TRL Harvest Strategy.