Torres Strait Tropical Rock Lobster Resource Assessment Group Meeting 25

Meeting Record

11-12 December 2018

Thursday Island

Note all meeting papers and record available on the PZJA webpage: www.pzja.gov.au

Australian Government

Australian Fisheries Management Authority

Box 7051, Canberra Business Centre, ACT 2610 / Ph (02) 6225 5555 / Fax (02) 6225 5500 / AFMA Direct 1300 723 621 afma.gov.au

Contents

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. Full declaration of interests provided at **Attachment A**.
Georgia Langdon	AFMA Executive Officer	Nil.
Natalie Couchman	AFMA member	Nil.
Mark Anderson[#]	TSRA member	Nil. TSRA holds multiple TVH TRL fishing licences on behalf of Torres Strait Communities but does not benefit from them. They will not be leased in the 2018/19 fishing season.
Danielle Stewart	Queensland Department of Agriculture and Fisheries (QDAF) member	Nil. Harvest Fisheries Manager, QDAF.
Andrew Penney	Scientific member	Research consultant (Pisces Australis), member of other AFMA RAGs (SPFRAG and SESSFRAG). Nil pecuniary or research interests in the Torres Strait.
Éva Plagányi	Scientific member	Lead scientist for PZJA funded TRL research projects conducted by CSIRO.
Aaron Tom	Industry member	Traditional Inhabitant Gudumalulgal and TIB licence holder.
Les Pitt	Industry member	Traditional Inhabitant Kemer Kemer Meriam and TIB licence holder.
Phillip Ketchell*	Industry member	Traditional Inhabitant Kaiwalagal, Traditional Owner and fisher.
Terrence Whap	Industry member	Traditional Inhabitant Maluialgal and Traditional

Name	Position	Declaration of interest
		Owner. Does not hold a TIB licence.
Daniel Takai+	Industry member	Pearl Island Seafoods, Tanala Seafoods, TIB licence holder and lessee of TSRA TVH licence in 2017/18 fishing season.
Brett Arlidge	Industry member	General Manager MG Kailis Pty Ltd. MG Kailis Pty Ltd is a holder of 5 TVH licences.

Observers

Name	Position	Declaration of interest
Joseph Posu	PNG National Fisheries Authority (NFA)	Nil.
Mark Tonks	Scientific observer	Project staff for AFMA funded TRL research projects
Jerry Stephen	TSRA Deputy Chair, TSRA Member for Ugar and TSRA Portfolio Member for Fisheries	TIB licence holder and Native Title holder.
Trent Butcher	Industry observer	TVH licence holder.
Suzannah Salam^	Industry observer	Torres Straits Seafood Pty Ltd, TIB licence holder and lessee of TSRA TVH licence in 2017/18 fishing season.
Nathan Binjuda	Industry observer	Traditional inhabitant crew on TVH operated vessel
Allison Runck	TSRA observer	Nil.
Medina David	TSRA observer	Nil.

Notes:

Departed the meeting at 3.30pm on Tuesday 11 December

* Arrived after morning tea ~ 11am on Tuesday 11 Dec and left again at 3.30pm to attend the Fisheries Stakeholder meeting with Assistant Minister Colbeck. Did not attend on Wednesday 12 December.

^ Attended the full day on Tuesday 11 December. Arrived at 9.40am on Wednesday 12 December.

+ Departed the meeting between 2-3pm on Tuesday 11 December

1 Preliminaries

1.1 Apologies

1. The meeting was opened in prayer at 9 am on Tuesday 11 December 2018.
2. The Chair welcomed attendees to the 25th meeting of the Torres Strait Tropical Rock Lobster Resource Assessment Group (TRLRAG 25). The Chair acknowledged the Traditional Owners of the land on which the meeting was held and paid respect to Elders past and present.
3. Attendees at the RAG are detailed in the meeting participant tables at the start of this meeting record.
4. Apologies were received from Mark David (Industry Member and Traditional Inhabitant Kulkalgal), Dr Ray Moore (Industry Member).

1.2 Adoption of agenda

5. The draft agenda was adopted (**Attachment B**).

1.3 Declaration of interests

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

1.4 Action items from previous meetings

7. The RAG noted the status of actions arising from previous TRLRAG, and where relevant, TRL Working Group (TRLWG) meetings (**Attachment C**).
8. The RAG noted that the final meeting record for TRLRAG 24 held on 18-19 October 2018 was finalised out of session.

1.5 Out-of-session correspondence

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

2 Updates from members

2.1 Industry and scientific

10. The RAG noted updates provided by industry and scientific members, and observers on the performance of the TRL Fishery during 2017/18 and at the very start of the 2018/19 season (only two weeks in) and raised the following:
    a) A Transferable Vessel Holder (TVH) industry member advised that since the start of the 2018/19 season prices have been good due to the low supply of lobsters in the previous season. The start of the 2019 season was so far showing lots of small size lobsters, and not a lot of larger lobsters. Similar results are also being seen with smaller tails from Papua New Guinea (PNG).
    b) Local catch rates (around Thursday Island) are down, however anecdotal reports indicate that Warrior Reef and the central islands are doing well.

c) A Traditional Inhabitant member advised that during the first week of the season, free divers were surprised by the abundance of 0+ and 1+ lobsters in the east which are not normally observed in Kemer Kemer Meriam waters.

d) Other TI members advised that more 1+ lobsters are being observed around home reefs in the western and top western islands, compared to last season where fishers were working further afield. It is usually around 1 January when the larger lobsters come back in to the fishing grounds.

e) A TVH industry observer also reported lots of small lobsters are around. He added that although the lobster stocks is looking strong, warmer water temperatures are having an impact on captured lobsters in cages.

f) An industry buyer advised that the ratio of 1+ lobsters, to larger sizes (2+) is about 60/40 with lots of positive reports from fishers that the lobsters are around. Prices are looking good with no oversupply, and it is expected to remain that way until February when hookah diving commences. Due to an earlier than usual Chinese New Year, the hookah divers will miss out on the higher Chinese New Year prices.

g) Another TVH industry member also advised that frozen whole lobsters will often get a better return for fishers than tails, however the frozen whole market is limited and has been flooded before. Currently there is not a huge demand for whole frozen lobsters unlike 4-5 years ago, however prices are slightly higher. An industry buyer added that the market prefers smaller whole frozen lobsters. It was also noted that there is currently no field on the TRL daily fishing logs to record whole frozen lobsters.

11. The RAG noted that no additional scientific updates were required as all relevant topics were to be covered under other agenda items.

2.2 Government

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

TRL Management Plan and Sectoral Split

a) On 26 November 2018, having considered outcomes of consultation, the Protected Zone Joint Authority (PZJA) decided to determine the *Torres Strait Fisheries (Quotas for Tropical Rock Lobster (Kaiar)) Management Plan 2018* (the Management Plan) and to amend the *Torres Strait Fisheries (Tropical Rock Lobster) Management Instrument 2018* (the Instrument).

b) The Management Plan and amendments to the Instrument came into force for the 2018/19 fishing season starting on 1 December 2018.

c) Unless delayed by legal appeals, a quota management system will be fully operational in the TRL Fishery for the 2019/20 fishing season. A review of existing PZJA licencing policies and management arrangements, including input controls, will be conducted periodically after the quota management system is operational.

d) During 2018/19, separate total allowable catch (TAC) shares will be implemented on an interim basis; 66.17 per cent under an Olympic TAC for the TIB sector and 33.83 per cent share under provisional quota allocations for the TVH sector.

Interim and final TACs

e) In order to give effect to the sectoral split, the PZJA further agreed to open the 2018/19 fishing season with an interim TAC of 200 tonnes. This decision is based on advice received from the TRL Resource Assessment Group and TRL Working Group that an interim TAC derived from the maximum annual catch amount over the years 2005-2018 for the period 1 December and end of February should be implemented.

f) AFMA will be working closely with PNG NFA over the coming months to finalise negotiations on how the Recommended Biological Catch (RBC) is shared between Australia and PNG in line with obligations under the *Torres Strait Treaty*.

Moon-tide Hookah Closures

g) The PZJA also reaffirmed existing management controls currently applied to the TRL Fishery, to be implemented under the Instrument and licence conditions. This includes periodic closures to the use of hookah gear for three days either side of the full or new moon each month based on the largest difference between high and low tide levels.

h) AFMA will be looking to review the current input controls in the TRL fishery to better understand if they are still required as management tools in the fishery once it is fully transitioned to a quota management system.

13. The RAG discussed:

a) Whether tidal flows and currents have been considered when calculating moon-tide closures as current flow rates (as distinct from tidal height differences) have a significant impact on the ability to dive for TRL. Noting the variability in tides across the Torres Strait region, the AFMA member advised that the moon-tide hookah closures are calculated using the Bureau of Meteorology tide charts from Thursday Island. The RAG advised that the Thursday Island charts should be continued to be used.

b) An industry member advised that the TIB sector will continue to advocate for moon-tide hookah closures to remain in place and agreed that strong currents are an important factor influencing TIB fishing effort.

c) In considering the RAGs advice to the TRL Working Group about who will discuss any changes to input controls, a scientific member advised that any changes to input controls will have an impact on Catch per Unit Effort (CPUE) index used in both the assessment and empirical harvest control rule (eHCR). If moon-tide hookah closures, or other input controls, are removed the RAG will need to consider the impacts on CPUE and how these impacts will be adjusted for in future analyses. If the closures are to change, it was suggested that a staggered or transitional approach would be beneficial to try and understand any potential impacts on fishery trends over time.

d) The CSIRO scientific member agreed and advised caution when considering any management arrangements that will impact abundance indices in the fishery noting that fishery data trends will also be impacted by the wholesale change to a quota system. Economic implications should also be considered for the fishery, as well as those for the data and stock assessment.

14. **The RAG agreed that the potential removal of any input controls should be addressed with caution. Given the immediate changes that will apply as the fishery moves to a quota management system, the RAG recommended that all current input controls remain in place for the 2018/19 season before a review (or change) of input controls takes place.**

15. The RAG also discussed:

a) A concern raised regarding the carriage of hookah apparatus on board during a hookah closure. Some industry members queried if at the end of a moon-tide hookah closure, where an operator still has capacity to fish the remainder of their quota using free dive only, if they must still return to port to unload their hookah gear. Some industry members feel this creates an economic disadvantage for their operations. The AFMA member advised that the AFMA compliance team are looking at ways to effectively enforce this rule without being completely unpractical and economically disadvantageous for operators. They stressed that at under present rules, the requirement is for hookah apparatus to be removed during moon-tide hookah closures if an operator is to continue fishing;

b) Concerns with how catches will be tracked against the quota system during 2018/19 if the catch reporting system is not implemented in real time. The AFMA member advised that the primary responsibility lies with TVH operators to keep track of and report what they have caught against the allowable weight provided as a condition on each licence. AFMA will use Catch Disposal Records (CDRs) to verify catches against each TVH operator's allocation. This will be a manual process initially. It is expected that the fishery will move to the Commonwealth system known as GoFish which allows operators to log in online and view their quota balance for the season.

16. The AFMA member also advised that AFMA (through the Australian Institute of Marine Science – AIMS) is monitoring increased water temperatures and the potential impact on TRL stocks. Industry operators were advised to consider their stocking densities of TRL in cages as a precaution during periods of warmer water temperatures. Overstocking may lead to unacceptable quality or mortality rates in conditions during periods of raised water temperatures.
17. The RAG noted an update provided by the QDAF member regarding the East Coast TRL fishery:
    a) QDAF have held a series of TRL Fishery Working Group meetings since the last RAG to progress the development of a TRL Harvest Strategy.
    b) A similar logbook issue was raised in Queensland with regards to whole frozen lobster. QDAF are looking to address this with the rollout of electronic logbooks next year as the data is not being effectively captured on paper logs.
18. The RAG discussed the following key points:
    a) The RAG data subcommittee should learn more about the QDAF e-logs program, to ensure Torres Strait and Queensland TRL datasets remain compatible.
    b) Electronic logbook reporting is being rolled out in the Commonwealth, however changes need to be made to *Torres Strait Fisheries Act 1984* (the Act) before it can be considered in the Torres Strait TRL fishery.
    c) Concerns around data confidentiality in the Fish Receiver System (FRS) when reporting on areas fished. The AFMA member advised that the *Torres Strait Fisheries Act (1984)* currently constrains how spatial data can be collected and so the provision of such data is only voluntary on CDRs. These constraints are also being addressed through legislative amendments to the Act. Any legislative amendments (including mandatory TIB logbook reporting or electronic logs) will take a number of years to achieve as the amendment process is lengthy.
19. The RAG agreed that although legislative changes are a lengthy process, the RAG data subcommittee should start considering the data needs of the fishery moving forward.
20. The RAG noted an update provided by the TSRA member regarding TSRA activities relevant to the management of the TRL Fishery:
    a) New Traditional Inhabitant members were elected at the 2018 Fisheries Summit, with three new members joining the TRL RAG, and three members outgoing.
    b) The TSRA member thanked the outgoing Traditional Inhabitant Members Mr Terrence Whap, Mr Mark David and Mr Phil Ketchell for their contributions to the RAG over the past three years.
    c) The TSRA will be holding an induction program for all incoming and ongoing PZJA forum members in early 2019.

Action

The TRL RAG Chair to provide the TSRA with a copy of expected behaviours of RAG members to assist with the induction program for incoming PZJA forum members.

21. The RAG also noted and discussed the following:

    a) The TSRA is progressing the development of an independent entity that will hold fisheries assets on behalf of traditional inhabitants. The TSRA member advised that a shortlist of model options will be considered.

    b) Based on extensive community consultation advice, the TSRA will not be considering the leasing of any further TVH licences leasing during 2019. The TSRA member advised that the lease arrangements for the 2017/18 season were made before advice was received of a low RBC. Industry expressed the belief that fishing effort had increased through the TSRA's leasing of licences, however the licences were leased by TIB operators already active in the fishery.

2.3 PNG NFA

22. The RAG noted an update from the PNG NFA member regarding management of the PNG TRL Fishery:

    a) The PNG fishery remains closed to hookah diving and is scheduled to re-open in April 2019. The fishery was closed with resistance from the artisanal sector.

    b) Management are looking to implement other appropriate management measures as the early fishery closure was not anticipated.

    c) PNG is hoping for a higher RBC in 2019 to meet market demand.

23. In response to a question from CSIRO about the size of lobsters observed in the fishery, the PNG NFA member advised that this is a key area the NFA is trying to address through the collection of length frequency data. Both CSIRO and the PNG NFA member agreed to continue discussions on data PNG may be able to provide to feed into the current TRL stock assessment.

2.4 Native Title

24. No updated was provided as a Malu Lamar representative was not in attendance.

3 Preliminary Results of the November 2018 Pre-Season Survey

25. The RAG considered a presentation provided by Dr Mark Tonks, CSIRO Scientific observer detailing the preliminary results of the November 2018 pre-season survey:

    a) Dive surveys were conducted between 11-22 November 2018 aboard the *"Wild Blue"* and CSIRO dive tender. The surveys were undertaken by four divers, Mark Tonks, Nicole Murphy, Kinam Salee and Steve Edgar with the experience of 23 TRL surveys combined.

    b) Dive surveys were conducted at 82 sites consisting of 77 repeat pre-season sites and 5 additional sites in the northwest. Photo transects were also completed at 7 sites to monitor coral bleaching.

    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. Most older lobsters (age 2+) have migrated and those that remain are mostly male.

1+ pre-season index

    d) The 2018 1+ pre-season index is above average and approximately 3 times the 2017 survey index. The pre-season 1+ counts per site indicated good recruitment throughout the fishery, but higher counts along the western side. This differs from the 2017 pre-season site counts, which were higher in the south-east and low in most other regions.

e) The survey also indicated good recruitment across all strata particularly in the northwest region (Mabuiag and Buru). Buru had a high standard error due to high count variability between sites. In 2018, Mabuiag and Buru recorded their highest indices over the last 9 surveys.

0+ pre-season index

f) Although less well estimated, the 2018 0+ index was three times the 2017 0+ index however this was not significantly different from the 2006, 2007, 2015 and 2016 indices.

g) 0+ age counts were indicative of typical settlement mostly on the western side of the survey area. 2018 0+ counts were not dissimilar to 2016, but there was fewer 0+ in the south west, and more in the north west. All 2018 0+ counts were significantly better than in 2017.

h) Abundance indices by stratum showed Mabuiag significantly higher than the other stratum. The 2018 0+ indices showed similar regional recruitment trends compared to previous surveys.

2018 pre-season size and sex ratio

i) The modal size of age 1+ has increased compared to recent years.

j) 2018 length frequency trends were similar to 2005 and the sampled sex ratio was almost 1:1, which is as expected.

26. The RAG discussed:

a) The key stratum in the survey are not mapped or selected based specifically on where commercial catches are made. They stem from the original benchmark survey that collected habitat data across the Torres Strait. Survey sites were then randomly selected from areas of habitat known to support lobster populations. The RAG also noted that the strata used in the survey, differ from those collected through the TRL04 logbook and TDB02 CDR. The CSIRO scientific member advised that these strata can be better cross-mapped as improvements are made to the collection of spatial data (lats and longs) through logbooks and CDRs.

b) The Chair noted an issue with the presentation of industry-provided length frequency data analysis which indicated a consistent peak over the years at a certain length. The RAG considered that this was likely due to how a conversion factor is applied to catch weight data to convert it to length.

Action

CSIRO to investigate the reasons for the consistent peak in the length frequency distribution and determine if it is related to conversion factors from the catch weight data provided by MG Kailis.

c) An industry observer expressed concern as to why there are more dive sites around Warrior Reef compared to others where greater lobster production is observed. The CSIRO scientific member reiterated that the original benchmark survey contained hundreds of sites. Following this, the first pre-season survey had 140 sites which were selected from the original benchmark survey. The sites have since been reduced to just 77 but ensuring they remain representative. Other sites were removed due to logistical constraints. For example, some deep sites were removed due to more stringent CSIRO diving requirements. In reducing the number of sites in the survey, some trade-offs around precision were considered by the RAG.

d) The CSIRO Scientific member advised that the survey has been scaled down over recent years in order to reduce costs however this was done with consideration of the potential loss of precision. The original sites were based on habitat, and were reduced in a way to ensure the survey would still give a reliable estimate of recruiting biomass.

27. The RAG was asked to consider whether to include the additional 5 sites from the 2018 surveys in the calculation of the abundance indices:

    a) The RAG noted that the additional 5 sites were added to the 2018 surveys to answer specific questions around the distribution of the stock in that particular year. Such ad-hoc modifications, if they are ongoing, may undermine the representativeness of surveys over time.

    b) The independent scientific member noted that should the re-inclusion of sites (back to 140) be proposed, this must be undertaken the same way they were removed, in a statistical and planned method. With no additional resources available to increase the number of survey sites, continuity in the data into the future must be considered.

Action

CSIRO to calculate the cost of increasing the number of pre-season survey sites from the current 77 sites back to 140 for RAG industry members to consider.

    c) **The RAG agreed that the additional 5 sites from the 2018 surveys should not be included in the calculation of the survey indices.**

28. The RAG noted that analyses pertaining to the catch and effort data from the 2017/18 season, including the standardised CPUE indices, were presented at TRLRAG 24 held on 18-19 October 2018. No further analysis has been undertaken since that time.

4 Stock Assessment Update and RBC

29. The RAG considered a presentation provided by Dr Eva Plaganyi, CSIRO Scientific member detailing the preliminary results of the 2018 stock assessment update:

    a) Summary of life cycle and assessment – The pre-season survey provides a rough indication of how many 0+ lobsters have settled in the region. It also provides a good estimate of how many 1+ recruits will be available to be fished in the coming season (next year). The 2+ lobsters are fished before females migrate out of the Torres Strait to breed between August and September each year. The fishery-dependent CPUE data provides an index of 2+ abundance.

    b) Assessment basics – The number of 0+ settled lobsters is compared with the spawning biomass to inform the stock recruitment relationship. This relationship is highly variable but a low spawning biomass has a higher probability of poor recruitment. The pre-season survey is then used to estimate how many lobsters will be available to be caught in the coming season. The stock assessment model calculates how many of these lobsters can be caught while ensuring the spawning biomass is kept close to the target level (0.65_{SB}). The model applies a fixed target proportion of 0.15 unless the spawning biomass is lower than the reference point.

    c) Summary of model – the stock assessment uses an Age Structured Production Model (ASPM) which corresponds to a Statistical Catch-at-Age Analysis (SCAA) as the data fitted includes catch-at-age information. This is a widely used approach for providing TAC advice. The output of the assessment is a Recommended Biological Catch (RBC) with confidence intervals each year. It is an integrated assessment that takes into account all available sources of information. This includes:

        i. Pre-season survey data (9 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);

v. CPUE data from TVH sector;

vi. CPUE data from TIB sector; and,

vii. Historical information.

30. The PNG NFA member noted that some PNG catches from recent months are still outstanding and that there had not been any trawling effort in the Gulf of Papua in the past season. Noting that the PNG season does not normally close until 1 December, the RAG agreed that the timelines for assessment need to be considered if data concerning catches from the PNG sector are delayed.

Action

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.

d) TVH CPUE – the model incorporates six different standardised CPUE series. There is little difference between these series. The RAG requested the data sub-group have further discussions as to the best series to use. The reference case CPUE series currently used in the assessment is 'Int-1'.

Action

That the TRL RAG data subcommittee discuss which TVH CPUE series are the best to use within the model.

e) TIB CPUE – 4 different standardised CPUE series are used for the TIB sector. The RAG agreed to use the 'Seller' series as the reference case as the remaining three standardisations are impacted by the issue of area caught vs area landed. This issue is to be discussed further by the RAG data sub-group.

f) Model 'Reference Case' Specifications

i. Fixed steepness h=0.7

ii. Fixed hyperstability parameters for each CPUE series (TVH 0.75; TIB 0.5)

iii. Mid-year survey index – after applying mixture model to separate age classes

iv. Pre-season survey index – use as Reference MYO (mid-year only) series and same series as in November 2017 without the additional 5 sites added

v. CPUE TVH – Int-1 standardised series (and Int-3)

vi. CPUE TIB – Seller standardised series

g) Key sensitivities –

i. fix steepness h=0.6 and try to estimate h

ii. fix CPUE hyperstability parameters (TVH 1; CPUE TIB 1); try to estimate hyperstability parameters

iii. pre-season survey index – use the additional 5 sites added; test other series particularly excluding Buru which provides a lower standard error for 1+ index; downweight pre-season 0+ (2017)

iv. CPUE TVH – Int-3 standardised series; nominal

v. CPUE TIB – Seller&A standardised series; nominal

31. The RAG noted that each CPUE series has an associated variance to which the model weights each accordingly. The 1+ index is the most reliable indicator of biomass and the key input to the model with the greatest weight, however the model considers all corroborating information.

32. In the current assessment update, a significant data conflict exists between the November 2017 0+ index (which was very low relative to historical) and the 2018 1+ index (which was closer to average). Given the good confidence in the survey observations of 1+ lobsters, CSIRO explored the impacts of the anomalous 2017 0+ index on the model. The stock assessment model is sensitive to the inclusion or exclusion (or down-weighting) of the 2017 0+ index. To inform the discussion on how the anomalous 0+ index should be treated, CSIRO presented some alternative hypotheses to explain the data conflict (**Attachment D**, Table 1).

33. The RAG agreed that Hypotheses 4 was the most plausible explanation. It is known that lobster settlement changes from year to year however if it were to change radically, this is unlikely to be detected in the survey. The 0+ counts will always be more uncertain than the 1+ counts, given the cryptic nature of 0+ lobsters; even if there is a variable distribution of 1+ lobsters, the survey can still capture this, however if for example, all 0+ settled up in the north west or somewhere outside the survey sites this may not be captured in the fishery-wide survey counts.

34. Previously, the RAG has agreed that the 0+ index contains valuable information and is a key input in to stock assessment. With the exception of 2017, the 0+ index has generally been consistent with the following year's 1+ index. The independent scientific member agreed that anecdotal industry reports reaffirm that perhaps the survey did not accurately capture the 0+ lobster counts due a change in distribution or some other factors. Industry observers provided anecdotal reports of significant numbers 0+ lobsters observed in the fishery last season. The CSIRO scientific member agreed that, given the sound evidence of a reasonable 2018 1+ index, there must have been 2017 0+ lobsters in the fishery that were not evident in the survey index.

35. When examining the model versus observed pre-season index, there is a conflict between the 2017 0+ and 2018 1+ indices. To demonstrate the impact this conflict can have on the assessment, CSIRO undertook a comparison of the stock assessment model fit to the pre-season survey index when; (A) fitting to the 2017 0+ index, versus (B) excluding the 2017 0+ index. Under scenario (A), the model fits to the lower end of the confidence intervals and greatly overestimates the 0+ index relative to the observed. Under scenario (B), the model allows the 0+ index in 2017 to be freely estimated which produces a much higher predication as needed to improve the fit to the higher 1+ numbers observed in 2018 (**Attachment E**, Figure 1).

36. Similarly, when comparing the mid-year survey index of abundance (**Attachment E**, Figure 2) and the model versus observed survey catch-at-age proportions (**Attachment E**, Figure 3) the assessment achieves a much better fit when the 2017 0+ is excluded.

37. <u>Results of the Reference Case</u>

    a) The reference case model fits well to both previous benchmark surveys, and the 1+ and 2+ relative abundances from mid-year surveys.

    b) Stock recruitment residuals are average, however the results are higher when the 2017 0+ is down-weighted.

    c) Spawning biomass has declined in recent years but the RBC for the 2018/19 season will enable the spawning stock biomass to increase back towards the target.

    d) Fishing mortality estimates also indicate that the spawning stock biomass was low and supports the 2018 decision to limit catches.

    e) Hyperstability parameters are fixed within the reference case model. The TIB CPUE series has a far more hyperstable index than the TVH CPUE series. This is largely due to the TVH fleet being more mobile and therefore more efficient at maintaining higher catch rates. When estimating the hyperstability parameters the model CPUE index is lower than the model observed.

38. In considering how to treat the anomalous 2017 0+ index in the assessment, the RAG considered and discussed the following key points:

a) Given that the model fits the 0+ index reasonably well throughout the time series, except for 2017, it provides support to down-weight but not exclude the single 2017 0+ data point;

b) The mid-year survey validates down-weighting or excluding the 0+ index and supports the results of the 2018 pre-season survey;

c) The 2017 0+ index falls outside of the normal distribution which is statistically possible, although rare;

d) Caution should be exercised around selecting a down-weighting value on the 0+ index simply because it provides a more favourable 1+ index;

e) The 2017 0+ index is a result of the 2016 spawning stock biomass which experienced an anomalous year in terms of poor environmental conditions including high water temperatures. Oceanographic modelling will improve our understanding of such conditions on the abundance of the stock;

f) Excluding the 0+ index entirely would impact the eHCR as the harvest control rule incorporates the 0+ index. However, with a stock assessment scheduled every three years under the draft Harvest Strategy, continuing with one anomalous data point should not impact the overall function of the eHCR.

39. **There is evidence to suggest the 2017 0+ index may be anomalous. The RAG agreed that the 0+ series should be down-weighted appropriately rather than be excluded entirely. The down-weighting should be undertaken using an appropriate statistical methodology and not be applied arbitrarily. CSIRO undertook to complete this work prior to the next meeting.**

40. Recommended Biological Catch – although the RAG agreed on how to treat the 2017 0+ index, the CSRIO scientific member presented a range of RBC values depending on how the 2017 0+ index may be treated (e.g. excluded or down-weighted by doubling the variance).

    a) When the 2017 0+ index is included, the reference case model provides an RBC value of 533 tonnes.

    b) When the 2017 0+ variance is doubled as a means of down-weighting this point, the reference case model provides an RBC value of 637 tonnes.

41. **Given the RAG advice to apply a statistically calculated down-weighting to the 2017 0+ index, the RAG noted that the final RBC would likely lie somewhere between 533 and 637 tonnes. A final RBC value will not be available until the February 2019 TRL RAG meeting.**

42. The RAG also noted advice from the AFMA member that once a final RBC value is available, Australia and PNG will need to have discussions as to how the RBC is shared between the two countries under the *Torres Strait Treaty*. The initial split is 85 per cent to Australia, and 15 per cent to PNG, based on the agreed distribution of the stock. Each country then has a right to access 25% of the other country's share in that country's waters through cross-endorsement. Discussions on this arrangement are scheduled to commence in January 2019.

43. Environmental Correlates – Although not formally included in the current reference case model, the RAG considered some preliminary results on how environmental correlates may impact the stock assessment:

    a) The predictions are for temperature increases under the current emission scenario for Australia. Although not expected for several decades, once temperatures in Torres Strait consistently exceed 30 degrees Celsius, the impacts on the TRL fishy may be significant. Most marine animals including TRL have thermal tolerances with optimal conditions,

however once conditions are above the thermal tolerance, negative impacts on the population increase markedly.

b) The climate-linked model indicates that spawning biomass is trending downwards more significantly than the non-climate linked model which also changes the historic depletion statistics.

c) Under the climate-linked model, some additional growth variability can be explained. When understanding historical trends, some can be explained by sea surface temperatures (SST).

44. The RAG acknowledged that under a climate-linked model, if a significant impact is detected, this can have implications for reference points and how that impacts the stock assessments that underpin the Harvest Strategy and eHCR. Other reference points such as fished versus unfished biomass may need to be considered in future.

45. **Noting that understanding climate effects is a high research priority for the TRL fishery, the RAG agreed that further consideration of the impacts of SST on the fishery is important and that CSIRO should continue to explore this.**

5 Revision of Draft Harvest Strategy and Control Rules

Empirical Harvest Control Rule (eHCR)

46. The RAG considered a presentation provided by Dr Eva Plaganyi, CSIRO Scientific member detailing the results of testing of alternative empirical harvest control rules for the Torres Strait TRL fishery.

47. At the last RAG meeting held on 18-19 October 2018, members recommended that in light of the 2017/18 season, the number of years to be averaged in the eHCR index and decision rule triggers be revisited at the next meeting of the RAG prior to finalising the Harvest Strategy. The eHCR is designed to adjust the RBC relative to a recent average, based predominantly on the logarithm of the slopes of recent trends of four key indicators; the pre-season recruiting lobster (1+) weighted at 70%, with lower weighting accorded to trends in recently-settled lobster (0+) and CPUEs from the TIB and TVH fishing sectors (each 10%).

48. Key performance statistics also previously considered by the RAG included spawning biomass level, and levels relative to target reference levels, average annual catch (over 20 years), and average annual variability in catch as well as risk to the fishery and risk of closure of the fishery. Other eHCR candidates have previously been considered in terms of how well each rule performed with regard to the fishery objectives, however the RAG agreed the eHCR that performed the best also dampened inter-annual variability when applied based on trends from the past 5 years.

49. For comparative purposes, the CSIRO scientific member provided the results from re-testing the rule using the alternative 3-year slope average, as well as a 3-year slope average in combination with catch averaged over 3 years, rather than 5.

50. The RAG noted the following results of key statistics performance under each alternative eHCR (compared to the status quo) (**Attachment F**, Figure 4):

a) Under each eHCR, there is no risk to the spawning biomass falling below the limit reference point (Bsp<0.32K);

b) the risk of the spawning biomass falling below the precautionary limit reference point of 0.48K across each eHCR however the range of variance for both the 3-year alternative eHCR is considerably higher;

c) when considering average annual variability (AAV), the status quo 5-year eHCR performs best, with the lowest median AAV; and

d) when considering average catch, the median catch under the status quo 5-year eHCR is higher compared to the alternative 3-year candidates.

e) The use of a 3-year slope in combination with a 3-year catch average did not perform satisfactorily as biomass declines over time, however the alternative 3-year rule with 5-year average catch performed reasonably.

f) When comparing RBC outputs using available data in 2018, the 5-year slope eHCR yields an RBC of 500 tonnes, and the 3-year slope eHCR yields an RBC of 693 tonnes.

51. The RAG acknowledged that the key trade-off using an alternative 3-year eHCR results in much greater catch variability between years, i.e. the RBC may be much higher, or lower in any year. However, under the status quo 5-year eHCR, this variability is dampened to a greater extent.

52. **In consideration of the comparative results presented, the RAG agreed to not change the current eHCR and continue the use of the 5-year slope rule. Given this advice, the RAG also agreed that additional sensitivity analyses on the alternative eHCRs were no longer required.**

Harvest Strategy Decision Rules

53. The RAG considered the decision rule triggers under the draft Harvest Strategy. At the last RAG meeting, members discussed that given the experience during the 2017/18 season, the mid-year survey trigger may not align with the current expectations or management of the fishery.

54. The RAG noted the following key points:

a) If in any year the pre-season survey 1+ index is less than or equal to 1.25, a stock assessment is triggered;

b) If the eHCR limit reference point is triggered in the first year, a stock assessment update must be conducted in March;

c) If after the first year the stock is assessed below the biomass limit reference point, it is optional to conduct a mid-year survey noting that the pre-season survey must continue annually.

d) If the stock assessment determines the stock to be below the biomass limit reference point in two successive years, the TRL fishery will be closed to commercial fishing. Although unlikely, this circumstance could also result from other variables such as increased water temperatures, not just fishing mortality.

e) The current 1.25 trigger limit is based on historical lows in the 1+ index and although never breached, the 2017/18 1+ index was the lowest it had been within the series.

55. The CPUE index is a proxy measure for spawning biomass and so understanding trends in this index, particularly downward trends is important in planning management actions.

56. The CSIRO scientific member noted the importance of having pre-agreed actions in place if the trigger limit is breached which must also be considered with regard to resourcing availability for subsequent action. A more conservative trigger limit would provide an earlier indication that abundance may be in decline and to better understand what might be happening to the stock.

57. The RAG discussed that industry's reaction to the low RBC in the 2017/18 season and management changes to control catch that season, may suggest a more precautionary trigger is required. In light of this, the RAG considered two options for setting a higher trigger limit: 1) a biological trigger limit related to a biomass index; or 2) a TAC-based trigger limit. The RAG noted that using a TAC-based trigger limit may trigger a stock assessment more frequently which can have cost implications. It would also be affected by mechanisms (averaging) that dampened TAC changes, thereby masking underlying changes in biomass. The RAG also discussed concerns about modifying the trigger simply to satisfy economic objectives.

58. It was noted however, that with the determination of the TRL Management Plan the concerns expressed by industry the previous season under a low RBC would be less of an issue now that sectoral catch shares are in place. These concerns may also be addressed once variability in TACs is dampened under the 5-year eHCR.

59. It was also noted that the trigger and the Harvest Strategy can always be reviewed if considered to not be working effectively.

60. **Noting the sectoral catch shares in the fishery which may now alleviate previous concerns relating to the availability of TRL in a low TAC scenario; and the need to monitor the stock spawning biomass to inform RBCs, the RAG agreed to maintain the 1.25 trigger limit as a biological indicator to trigger an extraordinary stock assessment rather than an economics based trigger (e.g. TAC-based limit).**

6 Other Business

61. In response to an action item arising from the RAG, the CSIRO scientific member presented the preliminary key findings of the National Environmental Science Program (NESP) project assessing the influence of the Fly River runoff in the Torres Strait region. The RAG noted the following key points:

    a) The area of the Fly River influence is largely limited to the northern Torres Strait

    b) Habitats located north of Masig Island, as far east as Bramble Cay and at least as far west as Boigu Island are located in higher potential risk areas of exposure to brackish and turbid waters and associated contaminants from or derived from the Fly River.

    c) The assessment of trace metals in sediment and water across the region identified relatively low concentrations overall, with comparatively higher concentrations in the norther Torres Strait, and around Saibai and Boigu Islands in particular.

    d) The environmental and public health implications of this influence are still not well understood. While the impacts on TRL in particular are assumed to be low, the bioaccumulation risk for species such as turtles and dugong is much higher.

    e) While this movement of water from the Fly River is a historic pattern, the estimated 40 per cent increase in sediment discharge associated with the operation of Ok Tedi mine is likely to have changed the characteristics of sediment and contaminant concentrations in this region.

    f) Under certain flow conditions, water can travel as far as the Torres Strait. Flow patters can be variable depending on currents and trade winds. Further, increased turbidity will still be seen in the Torres Strait during monsoon seasons due to the resuspension of sediments in the water column.

    g) It is unclear how the high concentrations of dissolved copper in benthic sediments around Saibai Island are impacting the area relative to deemed safe levels.

62. The RAG expressed a strong interest in further understanding the impacts on Torres Strait fisheries, particularly on larval production and survivability through testing tissue samples from TRL, mud crabs and sea cucumbers. A TVH industry member from MG Kailis offered to provide testing of frozen TRL tails for trace metal analysis.

Action

MG Kailis to submit tissue samples from frozen TRL tails for trace metal analysis to better understand the impacts of dissolved contaminants from the Fly River run off on important fisheries species in the Torres Strait.

63. While the results of the study are preliminary, the CSIRO scientific member agreed to circulate the full report to members when it becomes available.

Action
CSIRO to circulate the final report from the Fly River study to all RAG members once available.

7 Date and venue for next meeting

64. The next TRL RAG meeting is tentatively scheduled for the week beginning 4 February 2019, with exact dates to be confirmed out of session.

65. The Chair thanked Mr Terence Whap, Mr Mark David and Mr Phil Ketchell as all outgoing RAG members for their time and contributions to the RAG over the past three years. Their input to the fisheries management process was constructive and highly valued.

66. The meeting was closed in prayer at 10:50am on Wednesday 12 December 2018.

Declaration of interests
Dr Ian Knuckey – October 2018

Positions:

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

Current projects:

AFMA 2018/08	Bass Strait Scallop Fishery Survey – 2018 and 2019
FRDC 2017/069	Indigenous Capacity Building
FRDC 2017/122	Review of fishery resource access and allocation arrangements
FRDC 2016/146	Understanding declining indicators in the SESSF
FRDC 2016/116	5-year RD&E Plan for NT fisheries and aquaculture
AFMA 2017/0807	Great Australian Bight Trawl Survey – 2018
Traffic Project	Shark Product Traceability
FRDC 2018/077	Implementation Workshop re declining indicators in the SESSF
FRDC 2018/021	Development and evaluation of SESSF multi-species harvest strategies
AFMA 2017/0803	Analysis of Shark Fishery E-Monitoring data
AFMA 2016/0809	Improved targeting of arrow squid

25th MEETING OF THE PZJA TORRES STRAIT TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRLRAG 25)

Tuesday 11 December 2018 (9:00 AM – 5:00 PM)

Wednesday 12 December 2018 (8:30 AM – 11:00 AM)

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 25th 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 a summary of management arrangements for the 2018/19 fishing season.

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 PRELIMINARY RESULTS OF THE NOVEMBER 2018 PRE-SEASON SURVEY

The RAG will be invited to consider the preliminary results of the November 2018 pre-season survey.

4 STOCK ASSESSMENT UPDATE AND RBC

The RAG will be invited to consider the preliminary results of the integrated stock assessment. Preliminary estimates of the 2019/20 RBC will be provided based on the integrated stock assessment. Preliminary estimates of the 2019/20 RBC will also be provided based on the current empirical harvest control rule (eHCR), but will for noting as the Harvest Strategy has not been agreed by the PZJA.

5 REVISION OF DRAFT HARVEST STRATEGY AND CONTROL RULES

At their last meeting, the RAG recommended that some of the conditions and decision rule triggers in the harvest strategy be revisited prior to finalising the Harvest Strategy. This included consideration of the number of years to be averaged across in the eHCR index.

6 OTHER BUSINESS

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

7 DATE AND VENUE FOR NEXT MEETING

The next RAG meeting is proposed for February 2019.

Action items from previous TRLRAG meetings

#	Action Item	Meeting	Responsible Agency/ies	Due Date	Status
1.	AFMA to review the effectiveness of certain TIB licensing arrangements (in its 2016 licencing review) including: • TIB licenses should share a common expiry date • licences to last for longer than the current 12 month period.	TRLRAG14 (25-26 August 2015)	AFMA	2017	**Ongoing** AFMA has begun undertaking a review of licensing of Torres Strait Fisheries, this issue will be considered as part of this review. At present however, AFMA resources are focused on progressing the proposed legislative amendments as a matter of priority. Further work on this item will be progressed in the 2019/20 financial year. • Administrative arrangements can be made to provide for licences held by the same person to expire on the same day. This change can be progressed when resources allow. • The *Torres Strait Fisheries Regulations 1985* currently provide for TIB and TVH licences to be issued for up to 5 years. Administrative arrangements can be progressed when resources allow.
2.	AFMA and CSIRO prepare a timeline of key events that have occurred in the Torres Strait Tropical Rock Lobster Fishery (e.g. licence buy backs, weather events and regulation changes) and provide a paper to TRLRAG.	TRLRAG14 (25-26 August 2015)	AFMA CSIRO	TRLRAG17 (31 March 2016)	**Ongoing** AFMA to complete further work. This has been difficult to action ahead of other priorities for the TRL Fishery.
3.	AFMA to liaise with Mr Pitt and Malu Lamar to provide agreed traditional names for the area around Erub.	TRLRAG23 (15 May 2018)	AFMA		**Ongoing** Further discussions needed to finalise this action. A map developed by the TSRA's Land and Sea Management Unit in consultation with PBCs, has recently been developed. A copy of this map has been provided to CSIRO and is provided at **Attachment 1.4c** for information.
4.	South Fly River studies to be provided for consideration at the next TRL and Finfish RAG meetings.	TRLRAG23 (15 May 2018)	AFMA	TRLRAG24 (18-19 October 2018)	**Ongoing**

#	Action Item	Meeting	Responsible Agency/ies	Due Date	Status
					A report detailing the findings of these studies is currently being finalised and will be provided once available, expected just prior to TRLRAG25.
5.	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	**Ongoing** To be examined when the next analyses are undertaken.
6.	Circulate copies of the Dao et al 2015 and Rothlisberg et al 1994 papers to the RAG for information.	TRLRAG24 (18-19 October 2018)	AFMA	TRLRAG25	**Completed** Papers provided at **Attachments 1.4d-e** for information.
7.	CSIRO to provide information on a recent review of the survey design to the RAG for information.	TRLRAG24 (18-19 October 2018)	CSIRO	TRLRAG25	**Ongoing** A review of the Torres Strait TRL Fishery survey design by the U.S. National Park Service is not yet finalised for distribution. A copy will be provided to the RAG once finalised. Provided at **Attachments 1.4f-i** for information are published peer-reviewed papers relating to the Torres Strait TRL Fishery survey design.
8.	RAG members to provide comments on the CSIRO TRL age class poster. CSIRO to include a better image of the 2+ lobster on the poster	TRLRAG24 (18-19 October 2018)	RAG CSIRO	2019	**Ongoing** Comments to be provided out-of-session and poster to be finalised in 2019.
9.	AFMA to prepare some explanatory material and a diagram explaining the start of season catch limit.	TRLRAG24 (18-19 October 2018)	AFMA	TRLRAG25	**Completed** Diagram provided at **Attachment 1.4j** developed and distributed to interested stakeholders. Further explanation was provided to all TRL Fishery licence holders prior to the start of the 2018/19 fishing season.

Table 1. Consideration of alternative hypotheses to explain the low 2017 0+ survey index compared with the 2018 1+ survey index. ***Source: TRLRAG25 Agenda paper 4a – Plagányi E et al. (2018) Preliminary summary regarding 2018 assessment of Torres Strait tropical lobster TRL stock. Summary Report for TRLRAG Dec 2018.***

	Alternative Hypotheses	Does it explain low 0+ in Nov 2017?	Does it explain 1+ size distrib^{n} in June 2018?	Notes and evidence	Plausibility
1	The 2017 0+ index was negatively biased due to observational error	No	no	There was some concern that as 2017 was the first year without a "gold standard" (GS) diver participating in the survey with considerable experience detecting the small 0+ age class, this may have biased the index negatively. However a statistical comparison of historical performance between GS and Other teams showed that whereas the GS teams generally found slightly more 0+, there was no significant difference between the results, and evidence of rapid learning. Even if the maximum likely bias is applied to the 0+ index, it does not increase it sufficiently to explain the 2018 1+ abundance.	low
2	The 2017 0+ index was low because of the timing of settlement	maybe	maybe	As lobsters spawn over a period of a few months, there is also approximately 3 months variability in terms of when they settle. In addition, the anomalous environmental conditions in 2016 (influencing the spawners producing the 2017 0+ cohort) could easily have influenced the timing of spawning and successful transport and settlement of pueruli. If settlement occurred earlier than usual, then this could explain relatively larger 1+ observed during 2018, but it means the 0+ would have been easier to observe during the 2017 survey. On the other hand, if settlement occurred later, then this explains the reduced numbers during the survey, but not the larger sizes of 1+ during 2018 (but it's possible that this was a result of a combination of timing of settlement and change in growth rate as below).	medium
3	Faster growth due to higher temperatures in 2017-2018 and/or reduced density dependence	no	yes	TRL growth is known to increase with increasing SST (Skewes et al. 1997) and there is evidence to suggest that the 2016 high temperatures had an influence on the stock, but there is less	high
4	The 2017 0+ index was low because the distribution of settling recruits changed substantially	yes	yes	The recent anomalous environmental conditions would have had an influence on local Torres Strait currents, as well as sand and habitat distribution and quality which could have influenced the spatial pattern of puerulus settlement. There is some evidence from the 2017 preseason survey 0+ spatial distribution data that the pattern differed to that observed in previous years e.g. lower than usual density in TI_Bridge stratum. The highest densities of 0+ were in the South-East and Mabuiag strata, so it's possible that relatively more settlement may have occurred to the north-west to the extent that the index wasn't as comparable as in previous years. Previous research (Skewes et al. 1997) showed that there are differences in growth rate	very high

Alternative Hypotheses	Does it explain low 0+ in Nov 2017?	Does it explain 1+ size distrib^{n} in June 2018?	Notes and evidence	Plausibility
			between the four zones (NW, SW, Central, SE), with lobsters being larger in the NW, and this may have contributed to the larger average size of this 1+ cohort (see Tonks et al. 2018).	

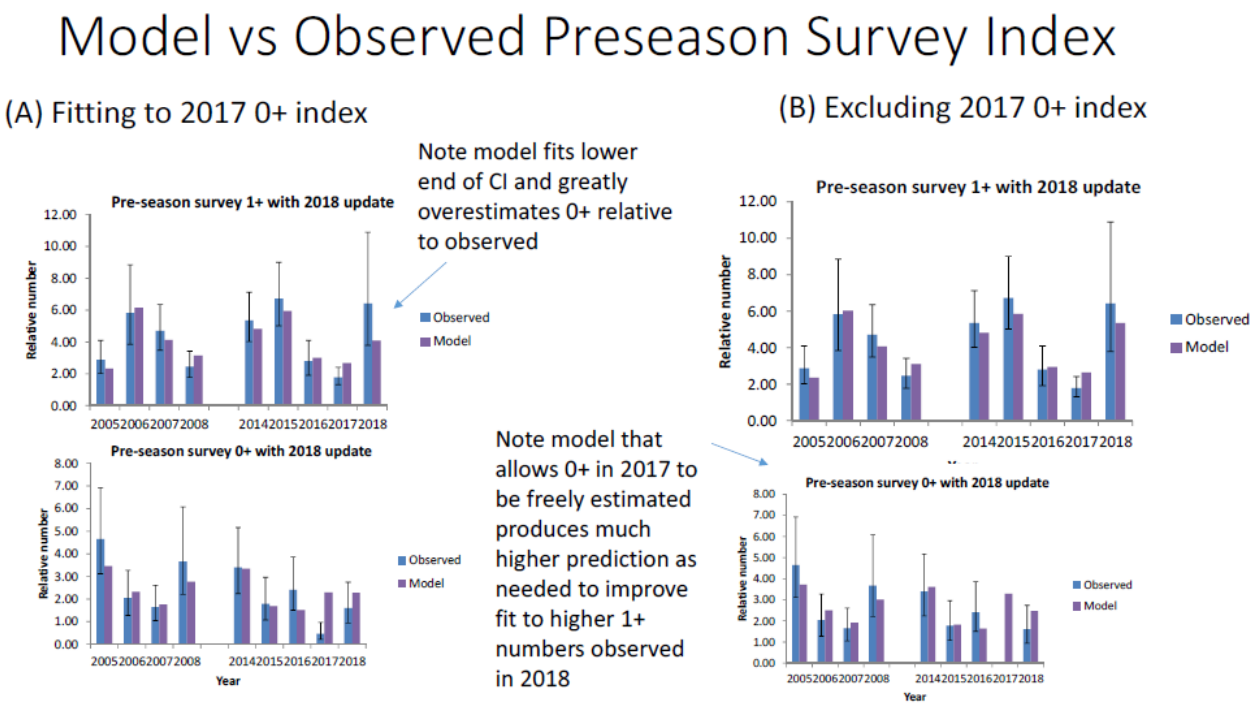

Figure 1. Comparison of stock assessment model fit to pre-season survey index when (A) including versus (B) excluding (for illustrative purposes) the 2017 0+ index.

Source: TRLRAG25 Agenda paper 4a – Plagányi E et al. (2018) Preliminary summary regarding 2018 assessment of Torres Strait tropical lobster TRL stock. Summary Report for TRLRAG Dec 2018.

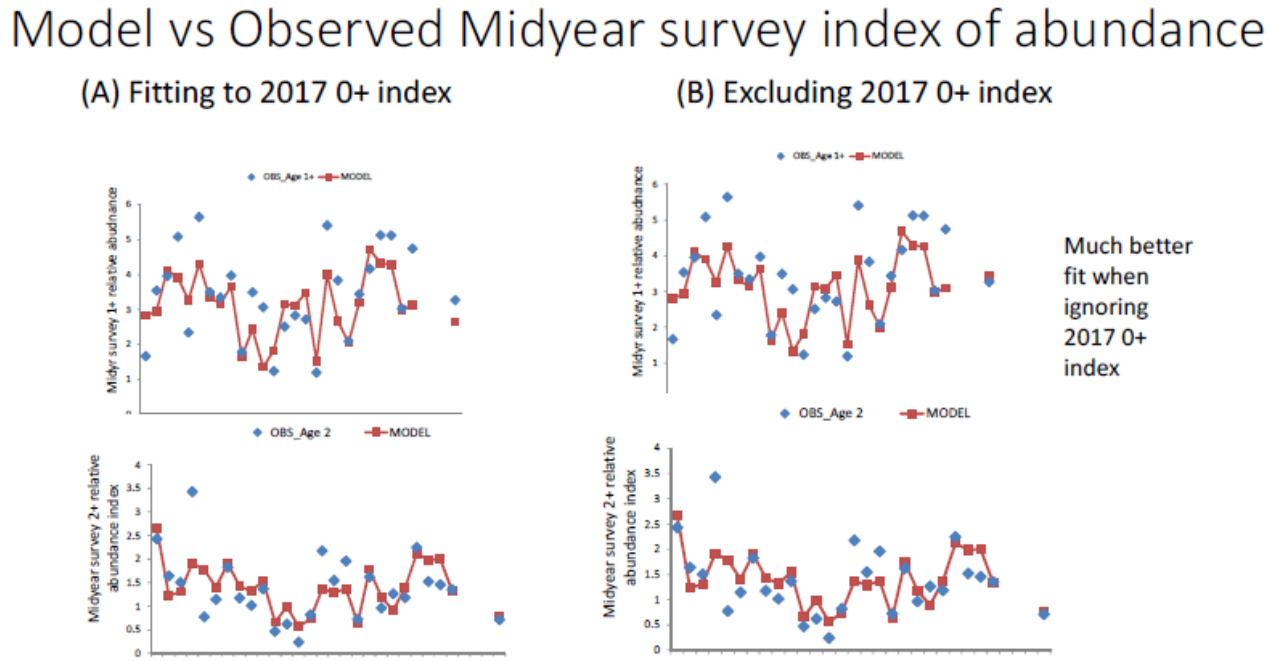

Figure 2. Comparison of stock assessment model fit to Midyear survey index when (A) included versus (B) excluding (for illustrative purposes) the 2017 0+ index.

Source: TRLRAG25 Agenda paper 4a – Plagányi E et al. (2018) Preliminary summary regarding 2018 assessment of Torres Strait tropical lobster TRL stock. Summary Report for TRLRAG Dec 2018.

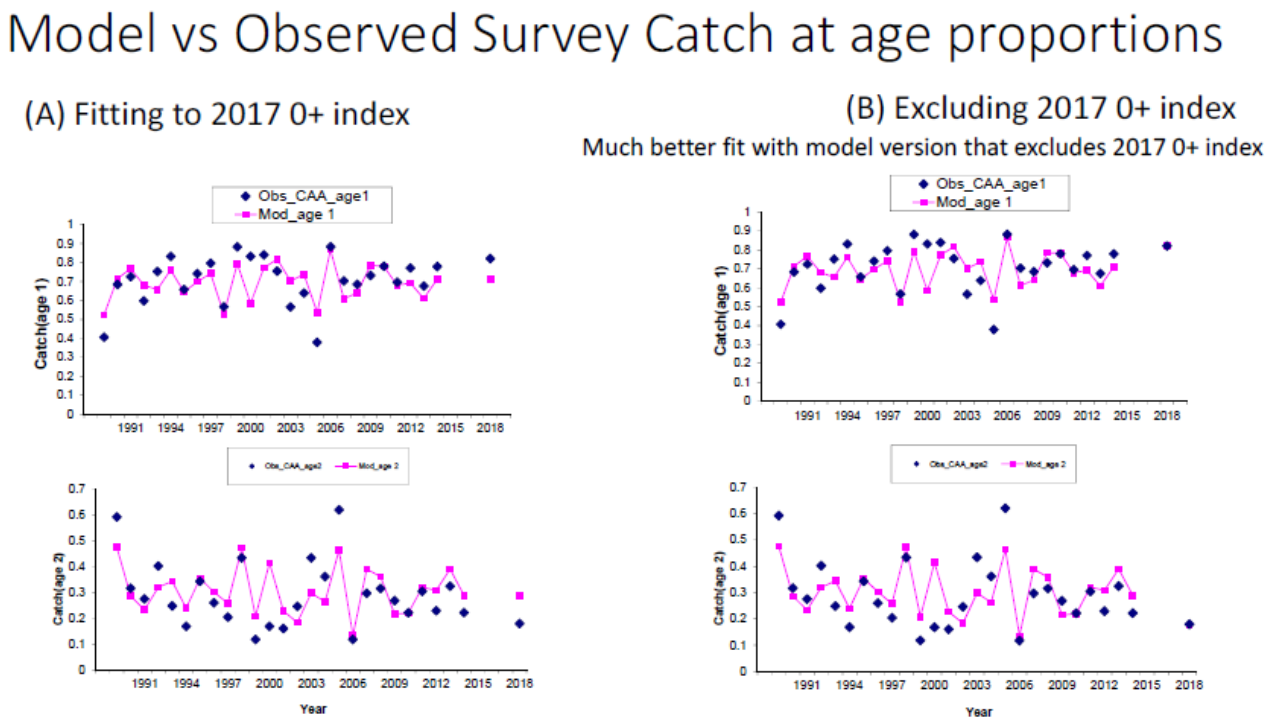

Figure 3. Comparison of stock assessment model fit to Survey Catch-at-Age information when (A) including versus (B) excluding (for illustrative purposes) the 2017 0+ index.

Source: TRLRAG25 Agenda paper 4a – Plagányi E et al. (2018) Preliminary summary regarding 2018 assessment of Torres Strait tropical lobster TRL stock. Summary Report for TRLRAG Dec 2018.

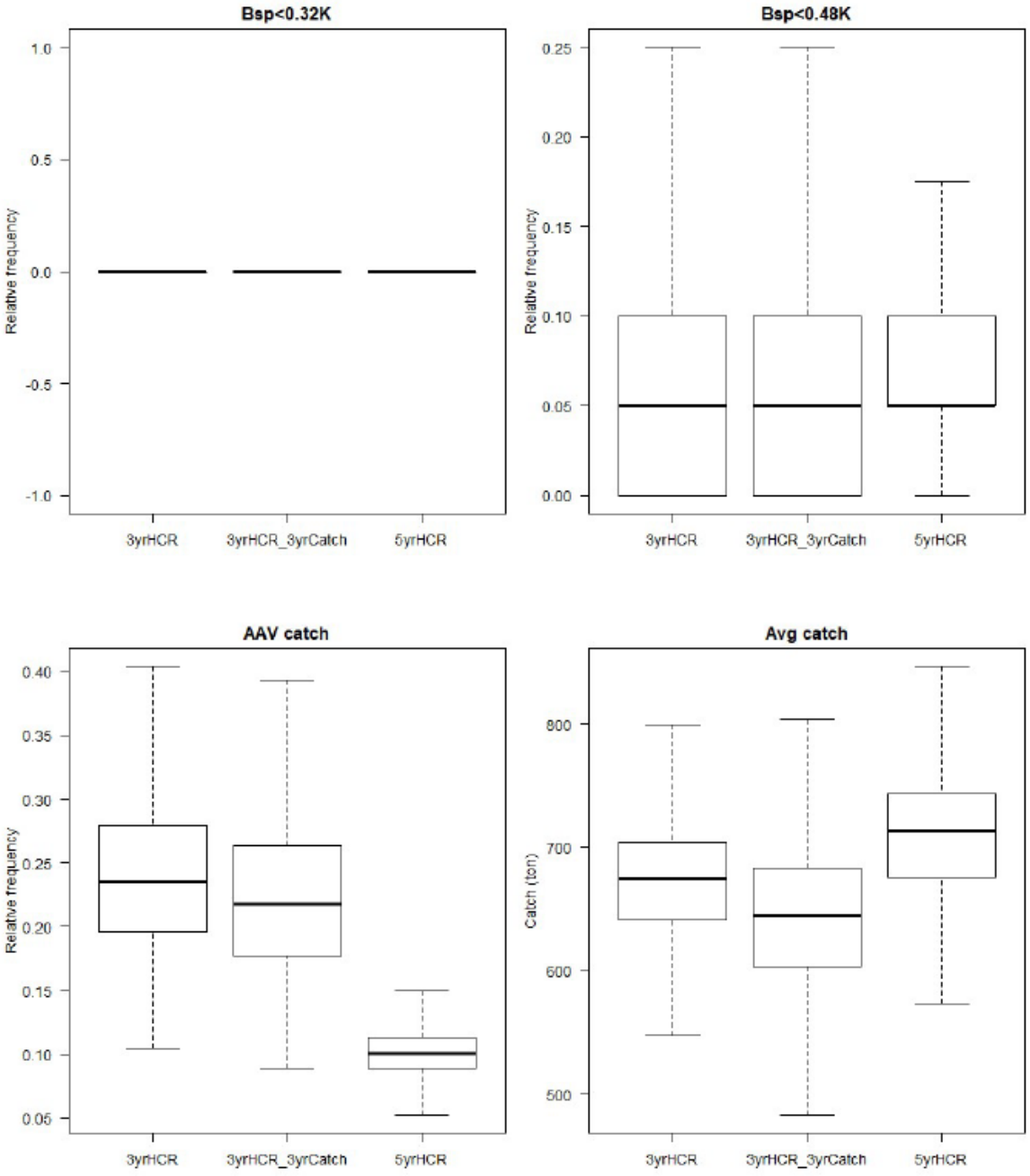

Figure 4. Comparison of some key performance statistics for final set of eHCRs. Plots show probability of depletion below each of two reference levels, B_{LIM} = 0.32K and precautionary level 0.48K limit reference point, together the Average Annual Variability (AAC) of catch, and ottal annual catch (t). The central lines shows the median, the box the 75th and 25th percentiles and the whiskers represent the full range of porojected values exlcluding outliers.

Source: TRLRAG25 Agenda paper 5c – Plagányi E et al. (2018) Testing an alternative empirical harvest control rule for the Torres Strait Panulirus ornatus tropical rock lobster fishery.