PZJA Torres Strait Finfish Fishery Resource Assessment Group

FFRAG Meeting 9

14-15 October 2021 Novotel Oasis, Cairns

DRAFT Meeting Record

Note all meeting papers and records are available on the PZJA webpage:

https://www.pzja.gov.au/torres-strait-finfish-groups



Australian Government

Australian Fisheries Management Authority

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1 Preliminaries

- The ninth meeting of the PZJA Torres Strait Finfish Fishery Resource Assessment Group (FFRAG) commenced at 0900 hrs. FFRAG Chairperson, Mr David Brewer, welcomed participants and acknowledged the Traditional Owners of the various lands on which members were participating from and paid respects the elders of the community past, present and those emerging.
- 2. No apologies were received. All members were present at the commencement of the meeting. Members from SE QLD and interstate attended the meeting via video conference.
- 3. Kenny Bedford and Yen Loban provided a verbal apology that they were not able to attend day 2 of the meeting. Tim Skewes entered the meeting for the purpose of giving a presentation under agenda item 5.4. Andrew Trappett entered the meeting for the purpose of observing Rik Buckworth's presentation under agenda item 5.1, and to present an update to the 'Biological sampling' project under agenda item 5.2.
- 4. The Chair sought consent from the RAG to record the meeting for the purpose of ensuring an accurate record. The Chair advised that the recording is kept secure and is deleted once the final meeting record is published. There were no objections to the meeting being recorded.

1.1 Adoption of agenda

- 5. The agenda (**Attachment A**) was adopted as circulated by AFMA prior to the meeting. The RAG noted that a discussion on the review of the Western Line Closure had been added to the agenda as agenda item 4.3 as requested by an industry member.
- 6. A change to the order of stock assessment related agenda items to better suit flow of discussion was agreed to in-session. The order was revised to 3.1 3.3 5.1 3.2.

1.2 Declarations of interests

- 7. Consistent with the Protected Zone Joint Authority Fisheries Management Paper No. 1 (FMP 1), which guides the operation and administration of PZJA consultative forums, the RAG noted the requirement to declare all interests, perceived or real. Each member declared their interest in the fishery as documented in **Table 1** (below). In line with the AFMA standard for declaring potential conflicts of interest in Commonwealth MACs and RAGs to best protect the integrity of advice, members with grouped interests (industry, research, TSRA, AFMA) were sequentially asked to leave the room to allow the remaining RAG members to:
 - freely comment on the declared interests
 - agree if the interests precluded the members from participating in any discussions and
 - agree to any methods to treat the declared interest (e.g. the member provides preliminary input but leaves the room when any advice is formed).
- 8. The RAG noted that, in addition to the process under this item, it remained the obligation of all members to update their declarations throughout the meeting as required.

Research interests

9. Members with declared research interests left the room to enable free discussion of these interests (David Brewer, Rik Buckworth, Michael O'Neill, Ash Williams). The RAG noted that these members could be perceived to have a personal interest in the outcomes of RAG advice relevant to research priorities or funding. However, the RAG noted that there is value in having

these members involved in discussion involving research priorities. It was noted that scientific members were appointed to the RAG in recognition of their scientific expertise relevant to the fishery. It was noted that any perceived conflict of interest would need to be managed on an ongoing basis throughout relevant deliberations. It was suggested that scientific members take part in discussions about research priorities, however, that the members then be asked to leave the meeting whilst the research priorities are formally recommended by the RAG.

- 10. The remaining members agreed that the scientific members should participate in all other agenda items and advice being formed.
- 11. Members with research interests re-joined the RAG and were advised of the RAG consideration of their declared interests.

Industry members' interests

- 12. Members with declared fishing interests in the fishery left the room to enable free discussion of these interests (Tenny Elisala, Rocky Stephen, John Tabo Jr, Paul Lowatta, Kenny Bedford, Maluwap Nona, Tony Vass, Yen Loban and Mark Anderson). As per previous RAG meetings the remaining members agreed that industry members could be perceived to have individual interests in the outcomes of advice put forward by the RAG. It was noted though that the members were engaged in the meeting to provide industry expertise and knowledge within their cluster nations. This expertise and knowledge were critical to the meeting provided industry members acted in the interest of the fishery as a whole. It was also noted that there is no discussion on the recommendation of TACs tabled for this meeting.
- 13. The remaining members advised that the industry members should participate in all agenda items and advice being formed. The industry members re-joined the meeting and were advised of the RAG consideration of their interests.

Government agencies interests

- 14. Members with interests related to the business of the Torres Strait Regional Authority, AFMA, and QDAF left the meeting (Mark Anderson, Tenny Elisala, Rocky Stephen, Kenny Bedford, John Tabo, Chris Boon, Selina Stoute, Ash Lawson). The remaining RAG members discussed the declared interests of the members and participants that had left the room. It was noted that the TSRA had declared their holdings of Sunset licences and revenue generated from leasing these entitlements for the benefit of Traditional Inhabitants. It was further noted that TSRA is investing in fisheries infrastructure, training and employment schemes in line with their functions. Members noted that having responsibility for the leasing program, which is designed, in part, to generate revenue and for making fishery development investments, could mean a perceived interest in maximising the available TAC. Consistent with advice from earlier RAGs, it was noted that it is important to maintain an awareness of this potential perceived conflict and ensure members acted in the interest of the fishery. The members agreed that TSRA views were important in forming advice to the PZJA.
- 15. The members noted AFMAs interest in the fishery was managing for sustainable fishing. AFMA and TSRA members re-joined the meeting and were advised of the members' consideration of their declared interests. The RAG agreed that TSRA and AFMA members should participate in all agenda items and advice being formed.

Table 1. Attendance and declarations of interest – Finfish RAG 9 meeting members.

Name	Position	Declaration of interest
Members		
David Brewer	Chair	 Director – Upwelling P/L (David Brewer Consulting). Honorary Fellow - CSIRO Chair - Torres Strait Finfish RAG Scientific member – Torres Strait Finfish Working Group Scientific member – Northern Prawn Fishery RAG Current consultancies with Quandamooka Yoolooburrabee Aboriginal Corporation. Co-investigator on the completed Torres Strait 'Non-commercial catch' project funded by TSSAC with RAG member Kenny Bedford. As a fisheries consultant, may apply for funds for Torres Strait fishery research projects in the future where consistent with his role as Chair.
Rocky Stephen	Industry member	 Councillor for Ugar. Chairperson of Kos and Abob Fisheries Ugar. Works with brother in a commercial fishing business on Ugar (Brother Bear Fisheries). Eastern cluster representative on the PZJA Finfish RAG & Working Group. Traditional inhabitant member - Torres Strait Scientific Advisory Committee. TSRA Board member for Ugar TSRA Finfish Quota Management Committee. TSRA Board Fisheries Advisory Committee member. Member of Zenadth Kes Fisheries company.
John Tabo Jr	Industry member	 Commercial coral trout fisher (TIB). Holds a Torres Strait Traditional Inhabitant Boat Licence. Member of the Torres Strait Regional Authority Finfish Quota Management Committee. Member of the Zenadth Kes Fisheries company.
Tenny Elisala.	Industry member	• TSRA Ranger Dauan, TIB licence holder, PBC director.
Paul Lowatta	Industry Member	TIB industry member, Finfish RAG, PBC director
Kenny Bedford	Industry Member	 Runs a consultancy business which has delivered projects relevant to Torres Strait fisheries. Principal investigator for 'Non-commercial catch' project (agenda item 5.4) Board director of Zenadth Kes Fisheries company.
Tony Vass	Industry Member	 No financial interests in the Torres Strait. Former mackerel fisher in Torres Strait 1990 to 2008, does not own or operate a licence in Torres Strait.
Michael O'Neill	Scientific Member	 Principal fisheries scientist working with the Queensland Government (Department of Agriculture and Fisheries, Fisheries Queensland) in the stock assessment program. Principal scientist for TSSAC three-year project for Spanish mackerel stock assessment work.

Name	Position	Declaration of interest			
		Member of PZJA Finfish RAG and Working Group.			
Selina Stoute	AFMA Member	Employed by AFMA, no pecuniary interests or otherwise			
Chris Boon	RAG Executive Officer - AFMA	Employed by AFMA, no pecuniary interests or otherwise			
Mark Anderson	Torres Strait Regional Authority (TSRA) Member	 Employed by TSRA. Program manager for economic development fisheries and infrastructure. No pecuniary interests as an individual - TSRA holds fishing licences on behalf of traditional inhabitants. 			
Ashley Williams	Scientific Member	 CSIRO Scientist. Involved in previous Torres Strait research. Project leader for 'Close-kin mark-recapture design' (CKMR) project 			
Rik Buckworth	Scientific Member	 Independent Fisheries Scientist with Sea Sense Consultancy. Adjunct professor at Charles Darwin University Ex-NT Fisheries Ex-CSIRO Scientist. Current CSIRO honorary fellow. AFMA Northern Prawn RAG. Project member for TS 'Spanish mackerel stock assessment' project. Team member of 'Close-kin mark-recapture design' project. Chair of Northern Territory Aquaculture Management Advisory Committee. 			
Ash Lawson	QDAF member	 Manager of the east coast Spanish mackerel, charter, and deep- water line fisheries. Currently transitioning into managing the east coast inshore finfish fishery. 			
Permanent O	bservers				
Maluwap Nona	Malu Lamar	 TIB licence Holder. Malu Lamar representative for the meeting. Chair of 2 PBCs (Badu Ar Mua Migi Lagal & Maluilgal). 			
Casual Obser	vers				
Quinten Hirakawa	TSRA officer	 TSRA project officer. TIB licence holder with mackerel, line, cray, and BDM endorsements. Commercial TRL fisher background. 25 years working with Queensland Boating and Fisheries Patrol (QDAF). Recent employment with TSRA Ranger Program and now with the TSRA Fisheries Team. Co-investigator on behalf of TSRA for the current 'Spanish mackerel and coral trout biological sampling' project. 			
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Name	Position	Declaration of interest
Yen Loban	TSRA fisheries portfolio member	 TIB licence holder. Board director of the Zenadth Kes Fisheries Company. Chair of the TSRA Board Fisheries Advisory Committee.
Trevor Hutton	CSIRO	 Member of the PZJA Finfish Working Group. Project team member for past 'FF harvest strategy' project.

1.3 Review of action items from previous RAGs

- 16. The RAG noted an update from the RAG EO on status of actions as detailed in the agenda paper. It was agreed to remove several items marked 'ongoing' that had become part of business-as-usual work for the Fishery.
- 17. Below is a summary of previous actions with updated status as discussed at FFRAG 9.

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Number	Action	Status update
FFRAG 8, Action 1	AFMA to complete project work with industry members in 2021 with a view to implementing a new logbook for the 2021-22 season.	Ongoing – The RAG noted advice from AFMA that due to the timing of 2021 black teatfish opening in the Torres Strait Beche-de-mer Fishery, commencing on 30 April 2021, and the level of AFMA resources required to support a new logbook. This work will now be actioned by AFMA in 2022.
FFRAG 7, Action 1	QDAF to investigate whether older licensing data might be available to understand vessels and years active during the pre-1989 phase of the TSFF.	Actioned – Actioned by QDAF. Verbal update provided within agenda item 3.1 at FFRAG 9.
FFRAG 7, Action 2	AFMA to request access to the logbooks of Mr Snowy Whitaker, <i>AFV Trader Horn</i> from the Townsville Maritime Museum where they are reportedly catalogued.	Ongoing – enquiry sent by AFMA on 27 October 2020. AFMA to follow up this request and report back at FFRAG 10.
FFRAG 6, Action 1	AFMA to develop a work plan for the FFRAG to advise on best estimates of coral trout catches taken outside the commercial Torres Strait Finfish Fishery (Traditional take - kai-kai, recreational, charter sector).	Ongoing – The RAG agreed to retain this action item, noting however, that progressing this action needs to be assessed against other RAG priorities and in light of any future research investment to develop an approach for measuring non-commercial fishing for the region.
FFRAG 5, Action 1	AFMA are to advise on appropriate information streams and resources to help the FFRAG to consider the impacts of climate change on the Torres Strait Finfish Fishery.	Actioned – AMFA has provided information relevant to climate change impacts to the RAG. The RAG agreed to remove this action item and for

		AFMA to continue to do so as 'business as usual'. AFMA to continue to bring any new climate change information relating to the Finfish Fishery to the RAG's attention.
FFRAG 5, Action 2	AFMA are to confirm that TIB licence holders are receiving text message, catch- watch updates from AFMA linking fishers to the reports on the PZJA website.	Actioned – To be removed as an action item. The RAG noted advice from AFMA that it is 'business as usual' for AFMA to raise awareness of the SMS system with stakeholders through various means - during community meetings, individual correspondence etc. Noting this, the RAG agreed that the action was being addressed and there was no need to retain.
FFRAG 5, Action 3	AFMA to update the FFRAG on the outcomes of Torres Strait case study, 'Fisheries adaptation to climate change' to be presented once complete (it was noted that it may be appropriate for AFMA to arrange an expert to present to the FFRAG on this report at an upcoming meeting).	Ongoing – The recently released final case study report was circulated to the RAG on 13/10/21. The RAG requested that AFMA provide a presentation on report findings at a future RAG meeting.
FFRAG 5, Action 5	FFRAG are to work on forming a matrix of scenarios (different target reference points and building rates) to support RBC setting and deciding control rules for the harvest strategy. Matrix is to compare RBC, time to reach B Target and risk to stock (being number of model runs dropping below the limit reference point.	Ongoing – The RAG noted that a matrix of scenarios has been developed and is currently being used to support setting the RBC. It was noted that the matrix will likely be reviewed alongside further work to develop a harvest strategy for the fishery. To be retained as an action item for further development.
FFRAG 5, Action 6	Obtaining accurate catch and effort data from the TIB sector is a key data need. AFMA and TSRA are to continue supporting industry in collecting voluntary effort data in catch disposal records and work on progressing compulsory logbook reporting as a priority.	Ongoing – The RAG noted AFMA advice that it remains an ongoing focus for AFMA to support the TIB sector to report accurate catch and effort data. AFMA further advised that it is continuing to work with the Commonwealth Department of Agriculture, Water and the Environment to progress legislative amendments. AFMA welcomed advice from members on any specific actions or initiatives to explore noting such requests would replace the current broad action.

		The RAG agreed to retain the action in its current form for the time being.
FFRAG 5, Action 7	FFRAG are to consider retrospective analyses for Spanish mackerel and how these can be built into the assessment	Ongoing – The RAG noted advice from Dr O'Neill that this analysis is to be built into the next stock assessment.

1.4 Out of session correspondence

18. The RAG noted the out-of-session correspondence as provided in the FFRAG 9 papers.

2 RAG Updates

2.1 Industry and scientific updates

- 19. Industry members provided the following updates to the FFRAG on recent developments within the Torres Strait Finfish Fishery:
 - a) Spanish mackerel catch rates in the sunset sector are going well.
 - b) Most fishers are doing it tough due to rough weather. Reported to be one of the roughest sessions in years so far. However, the fish are still there, it's just difficult to physically operate in these conditions. This means there has been low fishing effort at a community level.
 - c) Since the weather has improved in recent weeks, effort has increased and good catches of Spanish mackerel have been taken by fishers operating out of Ugar.
 - d) A concern raised by an industry member was that boats from neighbouring islands are fishing in waters around Ugar, and that this catch may be going unreported. It was unknown whether these boats are taking fish for kai kai, or to be sold to the fish freezer on Erub.
 - e) There are only two boats currently commercially fishing out of Mer Island. One boat is fishing for trout, and the other is fishing for mackerel. However, there are plenty of boats going out fishing for kai kai. It was also reported that several trout boats are going back and forth between targeting trout and beche-de-mer.
 - f) There is interest within the Mer community to participate in the 'Whaphill' project. People are interested in taking part in the trout fishery, but do not know 'where to start' to get into the fishery.
- 20. The TSRA fisheries portfolio member sought general advice on what would happen to the stock assessment if there was an influx on young (new) TIB fishers into the fishery. The RAG noted that a potential increase in TIB effort highlights the importance of increasing the quality of data received from the TIB sector to support a transition to TIB fishers utilising the whole TAC i.e. having CDR effort data section filled, which is currently voluntary. AFMA advised that if it is known that new fishers intend to enter the fishery, AFMA will endeavour to meet with those individuals to provide information on the reporting requirements for the fishery.
- 21. There were no updates tabled by scientific members.

2.2 Government agencies update

- 22. The FFRAG noted AFMA updates as detailed in the agenda paper. AFMA further advised that it would provide a more detailed summary of CDR data (covering TIB 'data completeness') at the next FFRAG meeting (FFRAG10). The RAG noted that AFMA was unable to prepare the data summary in time for the current meeting.
- 23. It was raised by a scientific member that relating to paragraph 9 'ABARES Fishery Status Reports' within agenda 2.2, that, although currently both Spanish mackerel and coral trout are classified as not being overfished, and not subject to overfishing, due to the increasing length of time since the last evaluation of the coral trout stock there is an increasing risk of it becoming unknown what the productivity of the stock is. This was flagged to the RAG that unless a stock assessment can be endorsed, then there is a risk that the fishery may be classed as status 'uncertain' for being over-fished/subject to overfishing.
- 24. The FFRAG noted the following updates from the QDAF:
 - a) 13 different harvest strategies have been implemented for Queensland fisheries over the past two years.
 - b) A significant quota-allocation process has recently been completed for the east coast inshore net, line and crab fisheries.
 - c) A stock assessment for the East Coast (EC) Spanish Mackerel Fishery is currently being completed. It is being independently peer-reviewed and formally released.
 - d) A range of Queensland fisheries data (quota, recreational survey, economic) is now available online. See below links:
 - <u>https://fishnet.fisheries.qld.gov.au/Content/Public/Report.aspx</u> for EC quota.
 - <u>https://www.daf.qld.gov.au/business-priorities/fisheries/monitoring-</u> <u>research/monitoring-reporting/statewide-recreational-fishing-surveys/dashboard</u> for EC recreational data.
 - Fisheries economic and social data | Department of Agriculture and Fisheries, Queensland (daf.qld.gov.au) and Economic contribution of recreational fishing | Department of Agriculture and Fisheries, Queensland (daf.qld.gov.au) for EC economic data.
 - e) A new state-wide recreational fishing survey is currently being planned and designed for 2022. Dr O'Neill advised that there is a section in this plan that outlines a 'data needs' analyses, and he could help facilitate building in a Torres Strait need for recreational survey estimates. This raises an opportunity for the RAG to consider providing advice on the survey design.
- 25. The FFRAG noted the following updates from the TSRA:
 - a) The 'Whaphill' project has identified three communities for project development on the islands of Dauan, Saibai and Boigu. The project will progress the development on these islands throughout the remaining months of 2021. Four other sites throughout Torres Strait will be coming back online (after a hiatus due to COVID impacts) in the first half of 2022.
 - b) TSRA are investigating aquaculture opportunities for the top western islands.
 - c) Good catches of Spanish mackerel are reported out of Erub with the weather coming good.

- d) Erub Fisherman's Association were successful in obtaining funding for 10 job seekers out of the Federal Governments '1000 jobs package'. This will support wages for project trainees for a further 12 18 months, which in turn will support increased fishing effort.
- e) There is an issue in that, of 460 licenced fishing vessels in the Torres Strait, only 67 of them currently meet the requirement of the Australian Maritime Safety Authority (AMSA) compliance regime. Vessel's built pre 2013 have an exemption. However, any boat built after 2013 needs level floatation. TSRA are working on this issue.
- f) TSRA working with AMSA to arrange a Cert 2 style certification for the region's fishers to make sure they are compliant to operated vessel.

FFRAG 9 ACTION 1: AFMA to present a summary of CDR catch and effort reporting for the TIB sector at FFRAG 10.

2.3 Papua New Guinea National Fisheries Authority Update

26. The RAG noted that PNG NFA were unable to attend the meeting. Relevant to arrangements with PNG, the AFMA member advised that the Torres Strait Treaty Traditional Inhabitants Meeting and Joint Advisory Committee Meeting were recently held. Both meetings discussed matters around the Daru MOU and New City proposal. Both meetings emphasised the need to be included in any consultations on these and other such proposals. AFMA further advised that it is the Australian Government's understanding that no further activities or commitments have arisen under the Daru Mou.

2.4 Native Title Update

27. The FFRAG noted the following updates from the Malu Lamar representative.

- a) It was noted that Malu Lamar, as a trustee under Section 203b of the Native Title Act 1993, has a mandated duty of care to protect the rights and interests of Torres Strait Islanders.
- b) In 2019, Malu Lamar undertook consultations in the Gudamalulgal nation communities, in which resolutions were passed to support the removal of the western line closure. It is Malu Lamar's view that they support this resolution to remove the closure in 2022 north of Buru (Turnagain) Island.

3 Spanish Mackerel Stock assessment

3.1 Review of data inputs to support the 2021 Spanish mackerel stock assessment

- 28. The FFRAG reviewed a presentation by Dr O'Neill on the Spanish mackerel stock assessment and model analyses (**Attachment B**). The presentation reported results up to the 2020-2021 fishing year, including new data inputs to discuss for the 2021 assessment. The presentation supported discussion and advice across 4 separate data assessment categories:
 - 1. Total Annual Harvest
 - 2. Standardised Catch Rates
 - 3. Biology

4. Stock Assessment Model

Historical licencing information

- 29. Slides 39-40 of the presentation summarises the outcomes of discussions with Cameron Miller on 11/10/2021 regarding available licencing information to understand historical vessel information pre-1989 (FFRAG 7 Action item 1). These outcomes were:
 - a) The available pre-1989 data is in printed-list form. No electronic data is available.
 - b) This printed information is for all QLD commercial line fishing licences for the years 1983-1989. No specific fisheries are listed.
 - c) The data contains information, such as vessel lengths, and could contain information about how many vessel were fishing in the Torres Strait region. However, vessel-name information appears to be limited.
 - d) Known Torres Strait vessels would need to be collated and pulled from the lists
 - e) There is one folder of printed information per year, with 100 pages per folder. This would take a lot of manual labour to enter/handle this data.
 - f) This data should be treated as confidential.
 - g) It isn't certain how this data could be used to assist harvest estimates.
- 30. The questions raised by Dr. O'Neill were:
 - a) How can this data be used to improve the pre-1989 harvest estimates?
 - b) Is it worth collating and assessing this data?
- 31. Advice from a scientific member raised issues surrounding the high degree of assumptions that would need to be made in assigning catch figures to this licence data. However, further discussion raised that it could be used to gain better estimates of the quantum of fishing effort during that period, much like using the limited available data to best estimate IUU (Illegal, Unreported and Unregulated) fishing.
- 32. It was noted that a 'sampling frame' could be utilised to best estimate the total historical catch. This could be done by using known effort data from logbooks to assign mean catch rates to each historical boat fishing in the region. However, it was reiterated that this exercise will require assumptions to be made. It was estimated that it would cost several thousand dollars to digitise and analyse the data.

Dory data – future considerations

- 33. Dr. O'Neill raised re-opening the data topics of 're-examining the number of dories reported', along with 'categorising fishing skippers and dory drivers', at least for the next stock assessment (2022). Considering the reduced number of fishing vessels in recent seasons, the number of dories that are operating within the fishing operation becomes important when entering data into the analysis. Dory-specific data will be vital to best estimate catch rates moving forward.
- 34. It was noted that it is still desirable to use the data from 'categorising fishing skippers and dory drivers'. However, there is a lot of work involved in cleaning up the data set before it can be used.
- 35. It was also noted that it's important to discuss the impacts of only having one boat in the analysis, and the ramifications this has on standardised catch rates.

Data Item 1 – Total Harvests

- 36. The RAG noted the stock assessment data inputs that were recommended at FFRAG 7 meeting (08/10/2020). The FFRAG 7 meeting was a dedicated 'data meeting' in which discussions resulted in a significant number of data input recommendations. Dr O'Neill asked the RAG if there is any new information to suggest that these stock assessment data inputs should be changed for the 2021 assessments.
- 37. The RAG recommended the following:
 - a) Retain pre-1989 harvest estimates.
 - b) Retain current IUU estimates.
 - c) Retain the models to estimate catch within the missing years, 1979-1989.
 - d) Retain the current data scenarios for harvest uncertainties.
 - e) Retain 2020-21 TIB data as reported.
 - f) Increase the subsistence (traditional) catch estimate to 15 tonnes, and recreational catch estimate to 5 tonnes for 2020/21 season as recommended at FFRAG 8. At this point in time, the 1989-2019 estimates of subsistence catch are to be left at 10 tonnes per year. The RAG agreed to further consider how to retrospectively apply this information to the previous years of subsistence catch estimates.

Data Item 2 – Standardised Catch Rates

- 38. The RAG noted that newly available data (from 2020-21 season) will be included into standardised catch rate analysis. RAG advice was sought on the terms of the generalized linear model (GLM).
- 39. The GLM is the model which standardises the catch rates for each fishing year, based on influences such as seasonal changes, wind strength and direction, spatial variation, variations between operators, lunar cycle and fishing power.
- 40. It was noted that only one sunset vessel undertook 92% of the fishing effort during the 2020-21 season. This has resulted in a wide range of daily catch rates for the 2020-21 season. Despite this, according to the standardised catch rate model (GLM) (as applied to the 2020 stock assessment), the standardised catch rate for the 2020-21 season were about the same as assessed for the previous season (2019-20).
- 41. After discussion and advice received from the scientific members, the RAG recommended the following:
 - a) **Retain** the GLM influences/model terms applied to the updated catch rate standardisation.
 - b) The available TIB catch per unit effort (CPUE) data for 2018/19-2020/21 seasons (three data points) be incorporated into a 'sensitivity analysis' for 2021, with the view to include it in the assessment in 2022. This means it will not be used in the range of models to calculate the RBC in 2021. However, the RAG will begin to understand how this data will affect the model. This is beneficial as TIB data will need to be included in future models as more data becomes available

Data Item 3 – Biology

42. The RAG noted that newly available data from the 'Biological Sampling Program' suggests that there is a strong year-class of two year old fish in 2021, plus evidence of a strong class of older

fish. Unlike previous years the data also shows higher numbers of 3-4 and 5-6-year-old fish. This data suggests that the age structure of the population is recovering.

Steepness parameter

- 43. In response to advice received through a peer review process of the east coast Spanish mackerel stock assessment, the stock assessment team sought advice from the RAG on the steepness parameter used in the model.
- 44. This parameter defines the capacity of Spanish mackerel to replenish itself. It represents the number of new spawners produced by each spawner over its lifetime at low spawner abundance. The value scales the proportion of virgin recruitment produced by a low 20% spawning biomass size.
- 45. Dr O'Neill advised that to date steepness is estimated by model to best fit to the data inputs. The estimate has been around 0.4. Dr O'Neill advised that as part of the east coast stock assessment peer review, an independent stock assessment scientist (Dr Neil Klaer, a former CSIRO scientist with extensive stock assessment experience in Australia's southern fisheries) advised that it is typical in assessments for pelagic and demersal species to have high steepness, up to 0.7.
- 46. The RAG noted that the approach and estimated steepness value currently used for the Torres Strait Spanish mackerel fishery was similar to comparable assessments:
 - a) Review undertaken by Thurston (NOAA) using r-package of a wide range of *Scomberomorous* species found a steepness of 0.45 was the mid-point of all estimates;
 - b) Begg 2016: Tested fixed steepness values of 0.38, 0.53, and 0.57. At the time of Begg's assessment, there was less data for the fishery, so it was not possible for the model to estimate steepness;
 - c) Gulf of Carpentaria Spanish Mackerel assessment: model used 0.6; and
 - d) East Coast Spanish Mackerel stock assessment: model used 0.45.
- 47. The RAG noted advice from the scientific members that it is near impossible to calculate steepness from empirical data (i.e. not estimating it from model calculations). This is because the fishery would need to be fished down to an overfished state, then recover, to provide any empirical information on steepness. The RAG further noted advice from Dr O'Neill that if you force the model to fit very high or low steepness parameters the goodness of fit becomes unacceptable.
- 48. The RAG agreed that the estimated steepness parameter of 0.4 is low but plausible for the stock.
- 49. The RAG recommended:
 - a) that the estimated steepness parameter of 0.4 be used in the model; and
 - b) two sensitivities to be run using 0.6 and 0.7. The sensitivity runs will assist the RAG to learn how the model performs using higher steepness parameters and therefore to undertake a more detailed review in the future.

Natural mortality

50. The RAG discussed the natural mortality values of **0.3**, **0.35 and 0.4** per year are currently applied to the stock assessment model, and agreed that there is no newly available data to suggest changing these values.

Data Item 4 – Stock Assessment Model

51. The RAG reviewed and agreed to the recommended data treatments for the 2021 stock assessment model. The key treatments are summarised below:

1. Total harvests:

- Apply two models of historical estimates 1940-1988
- Apply the agreed tapered estimate of Taiwanese IUU harvests to these models.

2. Standardised catch rates:

- Do not apply tender/dory data
- Apply the Qld north east coast 'fishing power' offset to the GLM
- Incorporate available TIB CPUE data into a 'sensitivity analysis' for 2021.

3. Fish age frequencies:

• Utilise all years with fish age or length data

4. Natural mortality rate

• Apply a natural mortality rate of 0.3, 0.35 and 0.4

5. Steepness parameter

• Estimate steepness, and sensitivity test higher fixed steepness values of 0.6 and 0.7.

52. Based on the RAG's advice on each data issue, the RAG noted and agreed that six core analyses would be used to assess the stock (see **Table 3**). In addition, it was agreed that extra model runs would be undertaken as sensitivity trials. These model runs will further test assumptions and a range of values to best estimate the stock biomass. The factors for testing three key extra model runs are described in **Table 4**.

Table 2 Analysee	/ model rune agree	d to be expliced to th	a 2021 Tarras Stu	rait Spanich mook	oral fichary
Table J. Analyses	/ model runs agree	u to be applied to th		rait opamon macr	cier institery.

Label	Fish weights	Catch rate series	Natural mortality rate (M)	Steepness parameter	Harvest pre- 1989	Ageing data	Start year for data
1	Weighted average	No tender data. Fishing power included.	0.3	Estimated	Historic catches actual + polynomial model + IUU tapered	All years	1940
2	Weighted average	No tender data. Fishing power included.	0.35	Estimated	Historic catches actual + polynomial model + IUU tapered	All years	1940
3	Weighted average	No tender data. Fishing power included.	0.4	Estimated	Historic catches actual + polynomial model + IUU tapered	All years	1940

Label	Fish weights	Catch rate series	Natural mortality rate (M)	Steepness parameter	Harvest pre- 1989	Ageing data	Start year for data
4	Weighted average	No tender data. Fishing power included.	0.3	Estimated	Historic catches actual + logistic model + IUU tapered	All years	1940
5	Weighted average	No tender data. Fishing power included.	0.35	Estimated	Historic catches actual + logistic model + IUU tapered	All years	1940
6	Weighted average	No tender data. Fishing power included.	0.4	Estimated	Historic catches actual + logistic model + IUU tapered	All years	1940

Table 4. Extra model runs (sensitivity analyses) to be applied to the 2021 Torres Strait Spanish mackerel fishery.

Label	Fish weights	Catch rate series	Natural mortality rate (M)	Steepness parameter	Harvest pre- 1989	Ageing data	Start year for data
1	Weighted average	No tender data. Fishing power included. + TIB CPUE data included (sensitivity analysis)	0.35	Estimated	Historic catches actual + polynomial model + IUU tapered	All years	1940
2	Weighted average	No tender data. Fishing power included.	0.35	0.6	Historic catches actual + polynomial model + IUU tapered	All years	1940
3	Weighted average	No tender data. Fishing power included.	0.35	0.7	Historic catches actual + polynomial model + IUU tapered	All years	1940

RBC calculation

- 53. The RAG revisited the process that was used to calculate the RBC for the 2021/22 season. Of note, the three key components of the RBC calculation were:
 - a) Forecasting the RBC to account for the time lag between the stock assessment and the beginning of the 2021/22 fishing season. This is where stock recruitment and mortality for the 2020/21 season was accounted for. Average recruitment was assumed, removing natural mortality, and removing predicted fishing mortality of 55 t (39 t sunset harvest, 4 t TIB harvest (based on the mean of the past three TIB seasons), 10 t subsistence, 2 t of

recreational and 0 t of charter catches). The estimates of non-commercial catches for the 2021/22 season is addressed in agenda item 3.3

- b) Producing a range of RBC values which corresponded with biomass target reference points (also referred to as target fishing mortality rates: 'F-values). These F-values ranged from 'maximum sustainable yield' (MSY) to 'F₆₀' (to maintain a stock that is at 60% of virgin biomass)
- c) Running simulations to assess risk to the stock over 12 years against each RBC value.
- 54. The RAG discussed whether the same approach should be applied to calculate the RBC for the 2022/23 season. It was also discussed whether the stock assessment team should assume average recruitment in the fishery as an input into the RBC calculation.
- 55. The RAG recommended that the same RBC approach be applied, and that unless there is evidence to suggest otherwise, then average recruitment should be assumed. It was also agreed to apply the same method to predict total fishing mortality for the 2021/22 season.¹

FFRAG 9 ACTION 2: AFMA to assess the feasibility of getting pre-1989 data digitised.

3.2 Update on Additional Objectives of the Torres Strait Finfish Fishery Spanish Mackerel Stock Assessment Project

- 56. The RAG noted a presentation by Dr O'Neill on the additional objectives of the project Torres Strait Finfish Fishery Spanish mackerel stock assessment (project number 200815) to:
 - a) Compare and evaluate spawning biomass ratio and RBC results from the custom and Stock Synthesis (SS) software; and
 - b) Streamline the Spanish mackerel stock assessment system (completed by year 3 of the project).
- 57. The presentation slides can be reviewed in Attachment C.
- 58. The RAG noted that the stock synthesis model will be trialled for one analysis during the stock assessment in 2021, and the results will be presented to the RAG at FFRAG 10 meeting. For the SS model to be deemed acceptable, it will need to produce similar results to the established custom stock assessment model when given the same parameters.

3.3 Estimates of Spanish Mackerel and Coral Trout Catch Taken Outside the Fishery

59. The FFRAG were asked to discuss and provide advice on best estimates of Spanish mackerel and coral trout catches taken outside the commercial fishery to support advice on TACs for the 2022-23 fishing season. Catches outside the fishery include catches taken for Traditional use (kai kai), recreation, charter fishing and PNG catch sharing. Estimates of current/projected catch are used to assist in recommending the next season's notional TAC.

¹ This figure was clarified by the stock assessment team out of session. The total predicted fishing mortality for the 2021/22 fishing season is **74 t** (50 t sunset harvest, 4 t TIB harvest (based on the mean of the past three TIB seasons), 15 t subsistence, 5 t recreational and 0 t of charter catches).

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- 60. Noting that there was no new information available, the RAG recommended applying the same Spanish mackerel catch estimates recommended by the FFRAG at its meeting on 4-5 November 2020 (**Table 5** below).
- 61. Consistent with previous years, the RAG noted the current under-utilised nature of the coral trout fishery and agreed it was not priority at this time to estimate catches taken outside of the commercial fishery. It remains an action for AFMA to develop a work plan for the FFRAG to advise on best estimates of coral trout catches taken outside the commercial fishery, noting however, that progressing this action needs to be assessed against other RAG priorities, and in light of any future research investment to develop an approach for measuring non-commercial fishing for the region.

Table 5. FFRAG 8 (4-5 November 2020) summary advice of available information on catches outside of the commercial Spanish mackerel fishery.

Source of catches	Expected catch (t)	Comments
Subsistence catch (kai kai) by Traditional Inhabitants	15	Based on data from <i>Busilacchi 2013</i> this includes total of catch estimates for Mer, Masig and Erub Islands. The Finfish Working Group (FWG) agreed in July 2016 that the catch figures from the <i>Busilacchi 2008</i> research are the best estimates of Traditional take of finfish. While originally reported by CSIRO as 12 t this was further refined to 5.155 t. At FFRAG meeting 4, the RAG recommended that an estimate of 10 t be used for decision making noting data was only from three islands, the number of TIB fishing endorsements has increased and effort creep may be occurring. At FFRAG meeting 8, the RAG accepted advice from industry members and the TSRA member that estimate should be increased to 15 tonnes to account for anecdotal information that 10 tonnes would be an underestimate.
Recreational	5	Previously, the RAG advised that, based on QDAF survey (2013) which included TS, 2 t was appropriate. At FFRAG meeting 8, the RAG agreed to recommend the estimate be increased to 2 t having regard for accepted industry member advice that the recreational boat numbers have increased over time, with a lot more contractors resident in Torres Strait taking boats out to communities to fish in their spare time. Following FFRAG meeting 8, QDAF advised AFMA that under the 2019-20 Queensland state-wide recreational fishing survey, there were only seven catch
		only one record of a coral trout and none for Spanish mackerel.
Charter	Likely to be minimal	Available QLD logbook records show Charter boat line catches are low. Logbook records for the period between 1995 and 2014 report a total of 19.58 tonnes of mixed species taken from Torres Strait waters. The RAG has advised, based on the available evidence from QDAF logbook data, that charter catches are likely to be minimal.
PNG catch sharing	0	Catch sharing arrangements have not been entered into for Spanish mackerel. PNG-NFA declined to enter into catch sharing arrangements under the Treaty for 2020-21 fishing season.

4 Management

4.1 Spanish Mackerel & Grey Mackerel Size Limits

Spanish mackerel size limit

- 62. Noting 'condition 7' of the Wildlife Trade Operation approval² for the fishery, the RAG reviewed the appropriateness of the current minimum size limit (MSL) of 75cm Total Length (TL) for Spanish mackerel (SM).
- 63. The RAG noted that:
 - a) size limits are typically applied in fisheries management to allow fish spawn at least once before being fished. In doing so, size limits can offer an additional safeguard against fishing impacts on the reproductivity capacity of a stock;
 - b) the minimum length at maturity for female Spanish mackerel is approximately 90cm TL.
 - c) female SM reach maturity at 2 years of age or older. The length distribution of sampled Torres Strait female SM of a verified age of at least two years was reviewed (see Attachment D). This sampled length distribution revealed that 50% of female SM reach maturity by 103.5c.
 - d) the estimated proportion of Spanish mackerel catch in the Fishery that comprise fish below the estimated length at maturity (90cm TL) and the current MSL (75cm TL) is very low (approximately 3.7%) (Langstreth J.C. and O'Neill M.F., 2020). This level of take is not considered to pose a risk to the sustainability of the stock. The fishery is overwhelmingly based on fish sized above 90cm TL and total fishing mortality is limited by the Total Allowable Catch (TAC).
 - e) Spanish mackerel is known to school in size specific cohorts. As reported to AFMA, the sunset sector actively moves between schools to avoid catching fish less than 90cm to meet market demands. In contrast, Traditional Inhabitant industry members advised that the TIB sector does not have the same operational flexibility to move to new grounds to target different schools. The TIB sector fish from small boats (typically 6 m or less) and are generally restricted to fishing within their community waters. Members advised that different sized mackerel are available locally at different times in the season;
 - f) there is some evidence in the biological sampling data collected to date, to indicate that the TIB sector may catch smaller fish on average when compared to the sunset sector. However, the data also showed that the significant proportion of fish were still above 90cm TL; and
 - g) it is likely that the post-release survival rates for this species is low, meaning that fish returned to the water would likely not survive.
- 64. Having regard for available information on the biology of the stock, catch information for the fishery, and an understanding of fishing practices and capacity, the RAG **recommended** that the minimum size limit for Spanish mackerel be retained without change on the basis that:

² The Torres Strait Protected Zone Joint Authority must review the appropriateness of the current minimum size limits for Spanish Mackerel in the Torres Strait Finfish Fishery.

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- a) arrangements in the fishery are effective in managing risks to the stock from fishing given the very low level of catch taken in the Fishery of fish sized between the estimated length at maturity (90cm TL) and the current MSL (75cm TL);
- b) the relative size structure of catches in the fishery continue to be monitored overtime and the risk to the stock be reassessed as necessary; and
- c) an increase to the minimum size limit would likely have a disproportionate impact on the TIB sector. Given the RAG's advice in (a) above, a size limit increase may impact the pursuit of other management objectives under the Act, specifically to develop and implement licensing policy, to the desirability of promoting economic development and employment opportunities for traditional inhabitants.

Grey mackerel size limit

- 65. The RAG reviewed the appropriateness of the current minimum size limit (MSL) of 50cmTL for Grey mackerel.
- 66. The RAG noted that:
 - a) the minimum length at maturity for female grey mackerel is approximately 75cm TL;
 - b) female grey mackerel reach maturity at 2 years of age or older. The length distribution of sampled grey mackerel of a verified age of at least two years was reviewed (see Attachment D). This sampled length distribution revealed that 50% of female grey mackerel reach maturity by 84.2cm;
 - c) a size limit of 75cm TL would align with the current understanding of species' biology, and allow fish to spawn at least once before being fished;
 - d) grey mackerel is generally not taken in the fishery;
 - e) although fishing for grey mackerel in the fishery is rare, having a size limit provides a safeguard against risk to the stock if fishing effort was to increase; and,
 - f) unlike Spanish mackerel and commensurate with the level of fishing for the species, grey mackerel is not subject to a TAC or stock assessment process;
- 67. Having regard for available information on the biology of the stock, catch information for the fishery, the RAG **recommended** that size limit for grey mackerel be increased to 75cm on the basis that:
 - a) the size limit is the sole species-specific management measure in place for the species and should therefore align with minimum length at maturity which is understood to be 75cm.
- 68. Noting the administrative steps required to change a size limit, AFMA sought advice from the RAG on how urgently the size limit variation should be implemented. The RAG advised that given the level of fishing pressure on this species and therefore risk, it did not consider it an immediate priority. AFMA advised that it would likely be a more efficient and effective use of management resources to progress the size limit change, if agreed by the PZJA, when a package of amendments is next proposed for the *Torres Strait Fisheries Management Instrument No. 14*.

4.2 East Coast Finfish Harvest Strategies

69. The RAG noted a presentation by QDAF member Ash Lawson on the Reef Line Harvest Strategy 2020-2025. This presentation was noted in the context of building knowledge in

developing a Harvest Strategy. This knowledge will assist the RAG in developing harvest strategies within the Torres Strait Finfish Fishery over the next two years.

70. A copy of the presentation can be reviewed in Attachment E.

4.3 Western Line Closure

- 71. The RAG noted an update from AFMA and industry members Rocky Stephen, John Tabo Jr, and Tenny Elisala on recent planning sessions to progress targeted communications in Gudamalugal communities on the recommended opening of the Western Line Closure.
- 72. The RAG reviewed the plan of action for communications and approval process for removing the closure. As discussed at previous meetings the RAG noted the following points that will need to be addressed in the lead up to the recommended opening:
 - a) The area of the opening will need to be defined;
 - b) What are the aspirations of the Gudamalugal communities for a commercial reef line fishery? What species does the community want to target? Are minimum size limits required for currently unregulated fish species?
 - c) What are the merits of the various research options available to support the opening of the fishery?
 - d) What are the likely implications for Traditional fishing? These will need to be mitigated.
- 73. AFMA agreed to produce fact sheets to be distributed to Gudamalugal communities in the lead up to the scheduled community meetings in March 2022.
- 74. It was raised that understanding the size of the fishery resource will inform the most appropriate management approach, as well as inform investment in fishery infrastructure. Scientific members recommended conducting a survey of the fishery either before opening, or plan to conduct a survey as soon as possible after an opening of the fishery (adaptive management/data monitoring approach).
- 75. If the Western Line Closure is to be opened, a survey to establish CPUE for the fishery will also be critical in assessing the health of the fishery. Such research will also inform decisions to avoid impacts on Traditional fishing.
- 76. The representative from Malu Lamur advised that a resolution has been reached within the Gudamalugal Nation islands that the boundary of the 'top hat' area should be drawn north of Buru (Turnagain) Island. Malu Lamar are to be invited to join in the next round of targeted consultations.

5 Research

5.1 Environmental Drivers

77. The RAG noted a presentation by Dr Rik Buckworth on the environmental drivers component of the now completed project Spanish mackerel stock assessment, with appraisal of environmental drivers (project number 2019/0831). The projects proposals can be reviewed in Attachment F.

- 78. The RAG noted advice from Dr Buckworth that a significant hindrance to the appraisal of environmental drivers was the lack of access to relevant data.
- 79. Dr Buckworth described the key findings of the research as follows:
 - a) We were not able to link catch rates or recruitment of Torres Spanish mackerel with environmental factors (but note, some are already accounted in the standardisation for assessment);
 - b) Spanish mackerel have a fairly long (2-4 years) and complex period to recruitment: it will probably remain difficult to define environment-recruitment relationships; and
 - c) This is a real 'needle in a haystack" you could keep searching until you find an apparently strong relationship with another variable or resolve relationships that interact.
- 80. Dr Buckworth recommend that further research in this area should not be attempted unless local data can be sourced. Specifically, desirable data includes:
 - a) River flow data from the Fly River area, which is close to the assumed habitat of juvenile fish in the stock; and,
 - b) Rainfall and chlorophyll 2 data sourced from closer to the main spawning site at Bramble Cay.
- 81. Having regard for the outcomes of the preliminary research showing that it will likely be very challenging to discern clear environmental drivers and advice on data needs to support further meaningful data analysis, the RAG recommended:
 - a) that this line of inquiry be treated as a 'watching brief';
 - b) as far as practical the RAG is to keep abreast of possible sources of data that may support future research; and
 - c) AFMA to continue liaise with relevant PNG Government agencies during fisheries bilateral meetings to request access to relevant environmental data (for example rain fall data from the Fly River region).

5.2 Torres Strait Finfish Fishery: Coral Trout and Spanish Mackerel Biological Sampling 2021-2024

- 82. The RAG noted a presentation by Andrew Trappett (QDAF) on the *Torres Strait Finfish Fishery Coral Trout and Biological Sampling 2021-2024* (project number 2020/0814). This project will build upon data from previous biological sampling projects. The presentation provided a summary of results achieved from preceding biological sampling programs, and detailed the objectives of this newly funded project (refer to FFRAG 9 meeting papers).
- 83. A copy of the presentation can be reviewed in Attachment G.
- 84. The RAG were asked to provide advice on 'outreach' ideas to maximise community awareness and engagement with the project. The goal of increasing awareness is to maximise TIB sector participation in providing samples. The following suggestions were made:
 - a) A video could be produced in both English and local Language to promote the project. This video could be circulated throughout the eastern island communities;
 - b) The project team suggested that they could provide a chest freezer in communities specifically to assist TIB participation in the project; and

- c) Flyers could be produced in Creole language and posted on community notice boards, and handed out by industry members in the region.
- 85. It was noted that tissue samples could be collected through this program for a potential fullscale close-kin mark-recapture (CKMR) study for Torres Strait Spanish mackerel. It was also raised in discussion that histological analysis could be conducted on collected samples to verify sex data for sampled fish frames.

5.3 Designing a Close-Kin Mark-Recapture Study for Torres Strait Spanish Mackerel

- 86. The RAG noted a presentation by Dr. Ashley William's (CSIRO) on the status of the project *Designing a Close-Kin Mark-Recapture study for Torres Strait Spanish mackerel* (project number 200817). A copy of the presentation can be reviewed in **Attachment H**.
- 87. The RAG noted that this project will design a full-scale mark-recapture project that would undertake genetic sampling to identify close genetic relationships between captured fish. This information can be used to extrapolate accurate calculations of the size of the entire spawner biomass.

5.4 Developing an Approach for Measuring Non-Commercial Fishing.

- 88. The RAG noted a presentation by Tim Skewes on the outcomes of the project *Developing an approach for measuring non-commercial fishing in the Torres Strait* in order to improve fisheries management and promote sustainable livelihoods. A copy of the presentation can be reviewed in **Attachment I**
- 89. Refer to **Figure 1** (below) for a summary of the project's milestone's to date, and proposed timeline of activities moving forward.
- 90. This project can be considered the 'scoping stage' of an overarching research plan to develop an approach for measuring non-commercial catch in the TSFF. The outcome of this scoping project is a list of recommendations for further research and development to achieve this goal.



Figure 1. Milestones and timeline of activities relating to project Developing an approach for measuring non-commercial fishing in the Torres Strait in order to improve fisheries management and promote sustainable livelihoods.

91. The project made the following recommendations:

- a) Proposed monitoring method = Fisher self-reporting using a monitoring app
- b) Include complementary household-based monitoring (to support the app)
- c) Apply a strict data security and information flow system
- d) Implementation should be overseen by Traditional Inhabitants and include equitable representation for gender and region
- e) Implement the monitoring program in a staged way
- f) Consider developing a new Traditional Fishery Harvest Strategy
- g) Apply a modified version to the recreation fisher sector
- 92. David Brewer (project team member) excused himself from the RAG discussion relating to advice to be provided on the project recommendations.
- 93. The RAG noted that the Torres Strait Scientific Advisory Committee (TSSAC) considered the projects outcomes and recommendations at its 79th meeting on 9-10 June and agreed that if the project proceeds beyond the scoping stage, it should do so in a phased approach as follows:
 - 1. Phase 1:
 - Community consultation and sign on (re engaging community regarding the suggested monitoring method to gauge support).
 - App design and development options (including data collection and storage options, and what data may be collected beyond non-commercial catch of commercial species (such as other species, environmental etc)). This process should be through co-design with communities and Government to meet stakeholder needs).
 - 2. Phase 2:
 - Develop App, database and data flow infrastructure
 - Community rollout pilot (on some communities).
 - Community rollout full-scale (to all communities).
- 94. The RAG supported the TSSAC advice and **recommended** that the priority is to go back to the communities (Phase 1 style approach) before proceeding with the implementation of the recommended app-based monitoring program.
- 95. The RAG noted that there is already positive community interest in this project. Additionally, the majority of community members are well placed to utilise apps. The uptake of smartphone/app use has increased, especially since routine COVID19 protocols have required the use of the technology.
- 96. The RAG noted that it is important to consider potential difficulties in collecting consistent data from the community as the app progresses in development, and that this will need to be accounted for. Additional methods may need to be implemented to ensure adequate uptake in community reporting. This could be achieved by providing various means for people to report catch, such as uploading photos, or implementing an incentive system to prevent sampling fatigue in the community.
- 97. It was also noted that parallel sampling will need to do be conducted alongside the early phase of community reporting in order to validate the data. This will account for any biases which may be present in data received from community fishers.

5.5 Climate Change Impacts on Torres Strait Fisheries

- 98. The RAG noted a pre-recorded video presentation by Dr Leo Dutra on the *Climate variability and change relevant to key fisheries resources in the Torres Strait a scoping study* (climate change scoping project) and were asked to provide advice on the project recommendations for further research as outlined in Attachment 5.5b of the agenda paper. A copy of the presentation can be reviewed in **Attachment J**.
- 99. Having regard for both the recommendation of the 'Climate variability' project and the outcomes of the Environmental Drivers research undertaken by Dr Buckworth (discussed under Agenda item 5.1) the RAG recommended future research investment prioritise physical data collection. Both projects highlight the importance and need to establish long-term, local environmental monitoring. The RAG considered all other recommendations for future research under the 'Climate variability' project as desirable.
- 100. The RAG noted advice from an industry member that climate change is believed to have already impacted fishers at Mer. It was reported that sardines have disappeared from the area. These species are important culturally, as a food source and as bait for commercial and traditional fishing.
- 101. The RAG noted that project by Fulton et al (2021)- Guidance on Adaption of Commonwealth fisheries management framework to climate change (FRDC project 2016-059) was recently released. The RAG noted that this project will be important to review in the context of Dr Leo Dutra's presentation on the climate change scoping project. The models that Dr Dutra and the project team propose to develop (described in the video presentation) can be used to support the adaptation process highlighted in Fulton et al (2021).

5.6 Finfish Fishery Research Priorities

- 102. The RAG discussed the current status of research priorities since the last meeting. **Table 6**, below, contains updated advice against each priority. Noting that most essential research priorities previously identified for the Fishery are being addressed, further RAG advice is needed on progressing a harvest strategy for the fishery, and other desirable research needs are contingent on work being progressed in other projects/jurisdictions first, the RAG recommended that a catch rate standardisation project for coral trout as the highest research priority for funding in 2022-23. The RAG also supported the ERA has an essential priority, noting the WTO (Wildlife Trade Operation) conditions for the fishery.
- 103. The Harvest Strategy is also to be progressed as a high priority. However, progression of the Harvest Strategy is subject to further discussion and advice from the RAG at FFRAG 10 meeting on 18-19 November 2021.
- 104. The RAG noted that 'Environmental drivers' project number 2019/0831 was recently completed. The RAG noted that additional projects may be progressed in the future based on whether new local data can be sourced

Table 6. Research priorities for the Torres Strait Finfish Fishery as updated at FFRAG 9 meeting on 14-15 October 2021.

Research need	Objectives and component tasks	Priority as at 2020-21 (essential/desirable)	Status (as of September 2021)	FFRAG 9 advice
Biological sampling (Spanish mackerel and coral trout)	Project funded for age, sex and length data for Spanish mackerel to support stock assessment.	Essential	Multiyear project funded for 2021/22 – 2023/24 (project number 2020/0814).	No change. The advised that this is research need remains an essential priority. The need is currently being addressed through a funded project.
Spanish mackerel stock assessment	Need for ongoing assessment of key commercial species.	Essential	Multiyear project funded for 2021/22 – 2023/24 (project number 200815).	No change. The advised that this is research need remains an essential priority. The need is currently being addressed through a funded project.
Harvest strategy development	Strategy with harvest control rules and agreed reference points required to support management. It is a condition of the FF WTO that by 30 June 2023 a HS must be developed for the fishery. As per FFRAG 9 advice it was noted that the optimum ratio of B _{MSY} (maximum sustainable yield) to B _{MEY} (maximum economic yield) will need to be taken into account as part of the harvest strategy process. FFRAG supported a desktop study (e.g. applying Pascoe et al. work to the Torres Strait Spanish mackerel stock c.f. QDAF east coast work) to determine the optimum ratio between B MSY and B MEY and the appropriate proxy economic target for the fishery.	Essential	Previous scope and components were not funded. New scope to be developed as needed and requires an indicative cost estimate.	The RAG advised that this remains an essential priority. However, further RAG advice is required to develop a work plan to finalise a harvest strategy. This will include the identification and scoping of any further research needs. It was noted that harvest strategies for Spanish mackerel and coral trout would be different and therefore may be addressed in separate work plans. The RAG advised that the future work to develop the harvest strategies should examine the optimum ratio of B _{MSY} (maximum sustainable yield) to B _{MEY} (maximum economic yield). This is work is no longer considered a standalone research need.
Management Strategy Evaluation (MSE) of draft harvest strategy	Requirements of Cwth HS Policy and Guidelines to undertake MSE prior to implementation.	Essential	Not currently funded. Detailed scope to be developed as needed.	The RAG recommended that this research need be changed to essential noting that it is both best practice and Australian Government Policy to undertake MSE testing of potential harvest strategy options. As detailed above, further RAG advice is required to develop a work plan to finalise a harvest strategy (ies). This will include the identification and scoping of any further research needs.
Ecological Risk Assessment (ERA)	an ERA must be undertaken for the TS Finfish	Essential	Not currently funded. Estimated cost \$20,000	The RAG advised that this research need remains an essential priority. To be progressed by AFMA under AFMA's broader ERA contract with CSIRO.

Research need	Objectives and component tasks	Priority as at 2020-21 (essential/desirable)	Status (as of September 2021)	FFRAG 9 advice
Alternative index of abundance for Spanish mackerel – scoping study	Develop an alternative to CPUE data to provide stock status/abundance	Essential	Multiyear project funded for 2021/22 – 2023/24 (project number 200817).	No change. The RAG advised that this research need remains an essential priority and is currently being addressed through a funded project. The funded project is designed to evaluate the feasibility of the CKMR genetic technique method for the Fishery.
Coral trout stock assessment development	 RAG has noted work required to further develop the preliminary stock assessment and address the range of uncertainties identified. The additional data priorities are: analysing the identified 1994-95 CSIRO survey data examining improved TIB catch and effort data incorporating underwater visual survey data if conducted. Undertake further habitat mapping work Collect fishery independent data 	Desirable	Not currently funded. Identified data priorities to be addressed prior to scoping.	The RAG clarified that this research need should only be considered for funding once the identified data priorities have been addressed. The RAG further advised that in the interim, CPUE trends in the fishery should be analysed to assess the status of the fishery. The RAG identified this work as a separate research need (see below). The RAG also noted that future stock assessment needs for the fishery would be guided by the harvest strategy.
Coral trout catch- per-unit-effort standardisation	Catch Per Unit Effort is an important input into the assessment and may be used to monitor the performance of the Fishery in years without a full assessment being undertaken. Having an agreed CPUE standardization is the first necessary step towards using CPUE to inform management decisions. A small project is required to further refine the current CPUE standardisation methods and to update the CPUE time series with new catch and effort data. The CPUE series is to be based on: • any recommended refinements of the CPUE standardisation methodology developed through the AFMA funded project: Harvest Strategy of the Torres Strait Finfish Fishery (project number: 2016/0824); and •all available catch and effort data.	Essential	Previous application not funded. Previous proposal sought funding of around 12k.	In the absence of a stock assessment and harvest strategy for coral trout, the RAG recommended further work be undertaken as a priority, to update the standardised CPUE analysis for coral trout. In consultation with the RAG, the project would refine the standardisation method as needed and produce an updated CPUE time series. This analyse would inform the RAG's assessment of the fishery.

Research need	Objectives and component tasks	Priority as at 2020-21 (essential/desirable)	Status (as of September 2021)	FFRAG 9 advice
Spanish mackerel stock structure	Define the spatial scale of management and connectivity of Torres Strait populations of SM with adjacent areas (Gulf, Qld, Coral Sea, PNG) potentially through collection of samples for genetic relatedness.	Desirable	Multiyear project currently funded for 2021/22 – 2023/24 (project number 200817).	No change. The RAG advised that this research need remains a desirable priority and is currently being addressed through a funded project. A specific objective of the funded CKMR project is to assess the stock structure of the Spanish mackerel fishery. This project will design a full-scale mark-recapture project that would undertake genetic sampling to identify close genetic relationships between recaptured fish. This information can be used to extrapolate accurate calculations of the size of the entire spawner biomass.
Estimating catches outside the commercial fishery	Acquiring data of catch taken from non-commercial fishers.	Essential	Relevant research project funded and completed (project number 190827). Project recommendations are under consideration.	The RAG noted that this research need may continue to be addressed through the PZJA's broader need to develop an approach for measuring non-commercial catch across Torres Strait Fisheries. The RAG therefore did not recommend scoping a Finfish Fishery specific research project currently. The RAG recommended that this priority be reassessed as relevant research is completed.
Shark depredation	Study to investigate increased shark interaction with fishery operations and depredation impacts on Finfish Fishery catch rates (how to capture and track over time or investigate potential mitigation options).	Desirable	Not funded or scoped.	The RAG advised that this is not a priority research need at this time. The RAG recommended that this priority be reassessed as relevant research is completed in other fisheries (jurisdictions).
Otolith morphology	Developing an index of mackerel ages based on the shapes and sizes of otoliths recorded	Desirable	Not funded or scoped.	The RAG advised this not priority research need at this time and can be removed from the research plan. This is because an alternative ageing technique (epigenetic ageing) is instead being assessed by project number 200817 (CKMR).
*Optimum ratio of B _{MSY} (maximum sustainable yield) to B _{MEY} (maximum economic yield)	*Info added to harvest strategy table. While stakeholders may select a higher future target reference point (e.g. B60) to support good catch rates and stock sharing, noted this will mean a trade-off for a lower RBC as less harvest will occur to keep more fish in the water and less boats will be active in the fishery. A project could attempt to determine the optimum ratio between B MSY and B MEY and the appropriate proxy economic target for the fishery.	Desirable	Not funded or scoped.	The RAG advised that this research need should be addressed as part of any broader work to develop a Harvest Strategy and can be removed as a stand-alone item from the research plan.

6 FFRAG Priorities and date for next meeting

- 105. The RAG elected to defer discussion on FFRAG priorities to FFRAG 10 meeting.
- 106. The RAG noted that FFRAG 10 meeting is scheduled for 18-19th November 2021, and that the FF Working Group meeting is scheduled for 25 November 2021.
- 107. The meeting closed at 1730 hrs Friday 15 October 2021

7 Other business

108. No other items of business nominated or discussed.

Attachments

- A FFRAG 9 agenda as adopted.
- **B** Spanish mackerel 2020 stock assessment presentation.
- **C** Presentation of the additional objectives of Spanish mackerel stock assessment.
- **D** Length-at-age distributions for Spanish mackerel and grey mackerel.
- E Presentation on the QDAF Reef Line Fishery Harvest Strategy 2020-2025.
- **F** Presentation by Dr Rik Buckworth on the 'environmental drivers' component of the now completed project *Spanish mackerel stock assessment, with appraisal of environmental drivers.*
- **G** Presentation by Andrew Trappett (QDAF) on the Torres Strait Finfish Fishery Coral Trout and Biological Sampling 2021-2024.
- **H** Presentation by Dr. Ashley William's (CSIRO) on the status of the project *Designing a Close-Kin Mark-Recapture study for Torres Strait Spanish mackerel*
- I Presentation by Tim Skewes on the project *Developing an approach for measuring noncommercial fishing*
- J Presentation by Dr Leo Dutra on the *Climate variability and change relevant to key fisheries* resources in the Torres Strait a scoping study (climate change scoping project).

Attachment A

9th MEETING OF THE PZJA TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP (FFRAG 9)

Thursday 14th (9am-5pm) - Friday 15th October 2021 (9am-5pm)

Face to Face Meeting + Video Conference - Cairns

Venue: Novotel Cairns Oasis Resort

DRAFT AGENDA v2

1 PRELIMINARIES

1.1 Acknowledgement of Traditional Owners, Welcome and Apologies

The Chair will welcome members and observers to the 9th meeting of the FFRAG.

1.2 Adoption of Agenda

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

1.5 Out-of-Session Correspondence

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

2 UPDATES FROM MEMBERS

2.1 Industry & Scientific Members

Industry and scientific members will be invited to provide a verbal update on matters concerning the Torres Strait Finfish Fishery, in particular, providing comment on fishing patterns, behaviours, prices, and market trends this season.

2.2 Government Agencies

The FFRAG will be invited to note updates from AFMA, TSRA and QDAF on matters concerning the Torres Strait Finfish Fishery.

2.3 PNG National Fisheries Authority

The FFRAG will be invited to note a verbal update from the PNG National Fisheries Authority if a representative is in attendance.

2.4 Native Title

The FFRAG will be invited to note a verbal update from Malu Lamar (Torres Strait Islander) Corporation RNTBC if a representative is in attendance.

3 STOCK ASSESMENT

3.1 Review of data inputs to support the 2021 Spanish mackerel stock assessment

The RAG will be invited to discuss and provide advice on data inputs (including total harvests, standardised catch rates, fish age compositions) for the 2021 Spanish mackerel stock assessment and recommended model analysis to calculate the Recommended Biological Catch (RBC).

3.2 Update on Additional Objectives of the Torres Strait Finfish Fishery Spanish Mackerel Stock Assessment Project

The RAG will be invited to note and discuss an update from Dr Michael O'Neill on the additional objectives of the project *Torres Strait Finfish Fishery Spanish mackerel stock assessment* (project number 200815) to:

- a) Compare and evaluate spawning biomass ratio and RBC results from the custom and Stock Synthesis software; and
- b) Streamline the Spanish mackerel stock assessment system (completed by year 3 of the project).

3.3 Estimates of Spanish Mackerel and Coral Trout Catch Taken Outside the Fishery

The FFRAG are to discuss and provide advice on best estimates of Spanish mackerel and coral trout catches taken outside the fishery to the Finfish Fishery Working Group and PZJA. This includes catches taken for traditional use (kai kai), recreation, charter fishing and PNG catch sharing.

4 MANAGEMENT

4.1 Spanish Mackerel & Grey Mackerel Size Limits

The FFRAG will be invited to discuss the size limits of Spanish mackerel and grey mackerel in the context of the WTO condition, neighbouring jurisdictions, and size-at-maturity data.

4.2 East Coast Finfish Harvest Strategies

Queensland Department of Agriculture and Fisheries (QDAF) are invited to present a verbal presentation on the *Reef Line Harvest Strategy 2020-2025*. The QDAF rep is also invited to provide an update on the development of the East Coast Spanish Mackerel Fishery harvest strategy.

4.3 Western Line Closure

The FFRAG will be invited to note the update provided by the Australian Fisheries Management Authority (AFMA) on the progression to date against the action arising from FFWG 2020 to remove the western line closure in the 'top hat' area.

5 RESEARCH

5.1 Environmental Drivers

The FFRAG will be invited to note and discuss a presentation by Dr Rick Buckworth on the environmental drivers component of the now completed project: *Spanish Mackerel stock assessment, with appraisal of environment drivers* (project number 2019/0831).

5.2 Torres Strait Finfish Fishery: Coral Trout and Spanish Mackerel Biological Sampling 2021-2024

The FFRAG will be invited to note an update from the QDAF project team on the current biological sampling project (project number 200814). The project team will be presenting via video conference.

5.3 Designing a Close-Kin Mark-Recapture Study for Torres Strait Spanish Mackerel

The FFRAG will be invited to note a presentation by Dr Ashley Williams on the status of the Close-Kin Mark-Recapture study (project number 200817). This presentation will be a brief introduction to the project, with an in-depth presentation scheduled for RAG 10. Dr Williams will be presenting via video conference.

5.4 Developing an Approach for Measuring Non-Commercial Fishing.

The FFRAG is invited to note a presentation from Mr Kenny Bedford on the outcomes of the project: *Developing an approach for measuring non-commercial fishing in the Torres Strait in order to improve fisheries management and promote sustainable livelihoods* (project number 190827).

5.5 Climate Change Impacts on Torres Strait Fisheries (subject to CSIRO's availability)

The FFRAG is invited to note a presentation from CSIRO on the outcomes of the project *Scoping a future project to address impacts from climate variability and change on key Torres Strait Fisheries* (project number 190830).

5.6 Finfish Fishery Research Priorities

FFRAG will be invited to discuss and provide advice on the annual and five-year research plans for the Finfish Fishery and recommend research priorities to FFWG and the Torres Strait Scientific Advisory Committee research priorities for funding in 2022-23.

6 FFRAG PRIORITIES AND DATE FOR THE NEXT MEETING

FFRAG members will be invited to discuss future priorities for management of the Finfish Fishery.

The FFRAG will review dates and venues for FFRAG 10 (18 November 2021) and be advised of upcoming meetings of the FFWG (24 November 2021) and PZJA meeting to decide next season's sustainable catch limits (January 2022).

7 OTHER BUSINESS

FFRAG members will be invited to discuss other business for consideration.

The Chair must approve the attendance of all observers at the meeting. Individuals wishing to join the meeting as an observer must contact the Executive Officer – Chris Boon (christopher.boon@afma.gov.au)

Attachment B Department of Agriculture and Fisheries



Torres Strait

Scomberomorus commerson

Spanish mackerel

Review of data inputs for stock assessment.

FFRAG meeting #9, October 2021



Australian Government

Australian Fisheries Management Authority







Agenda – outcomes needed!

- 1. Review the data for 2021.
- 2. Select the data treatments for stock assessment.
- 3. Endorse methods.

=



Stock assessment



List of data treatments in 2020.

Aspects to review for 2021 ffrag 7 8 oct 2020 meeting record.pdf (pzja.gov.au) 1 Total harvests: (2) Two methods for historical estimates 1940-1988. One Taiwanese IUU harvests. • 2. Standardised catch rates:

- Tender/dory data (out) ٠
- Qld east coast fishing power offset (in) •

3. Fish age frequencies:

- All years with fish age or length data
- 4. Natural mortality rate (M; maximum age = 13.5 years)
 - 0.3, 0.35, 0.4 per year (in)
 - 0.25, 0.45 per year (out) ٠

Number of treatments?

(1)

(1)

(3)
2021 RAG list of assessment items



Black font – completed; Red font - outstanding; Blue font – to review

	-	Actioned
1.	Iotal annual harvests (tonnes):	
	 Established time series of TIB harvests. 	\checkmark
	 Standardise AFMA and DAF data scripts. 	\checkmark
	 Revise average fish weights in Sunset tonnages. 	\checkmark
	Review harvest estimates 1940 - 1988.	\checkmark
	 Keep the Taiwanese gill net harvest. 	\checkmark
	• 100 t per year for 1979–86, then reduced annually to zero tonnes by 1992.	
	 Assess logbook over reporting of fish harvest (paper fish). 	\checkmark
	Review the logbooks of Mr Snowy Whitaker, AFV Trader Horn.	×
	• Find old licencing data to better understand the vessels active pre-1989.	×
2.	Standardised catch rates (Sunset):	
	Assess all boats and subsets of boats.	\checkmark
	 Include annual increase in fishing power from Qld north-east coast. 	\checkmark
	Spatially classify harvests.	\checkmark
	 Re-examine the number of dories reported. 	√ ×
	Categorise fishing skippers and dory drivers.	×
	What are the main influences on standardised catch rates.	

2021 RAG list of assessment items



Actioned

- 3. Biology:
 - Using Torres Strait data.
 - Select new age frequency data.
 - Select natural mortality rates.
 - Spawner recruitment steepness

- 4. Stock assessment model (custom):
 - Demonstrated methods and model to the RAG.
 - Define the data treatments (analyses).
 - Stock forecasts assuming constant harvests.
 - Set the method for calculating RBCs.
 - Design RBC decision tables.
 - Dissect the depletion levels up to 1989, and catch history.
 - Stock Synthesis bridging analysis.
 - Retrospective analyses.

X

X

X



Data item 1 – Total annual fish harvests

• Review harvest estimates.



Data - estimated combined harvests (all fishing sectors)



Year	IUU t
1978-79	0
1979-80	100
1980-81	100
1981-82	100
1982-83	100
1983-84	100
1984-85	100
1985-86	100
1986-87	100
1987-88	83
1988-89	67
1989-90	50
1990-91	33
1991-92	17
1992-93	0

Data – Sunset harvest tonnes



Leased commercial harvest of Spanish mackerel (Sunset sector

Tonnes of fish (t)



S

milling

Sunset nominal effort by fishing year







Data – harvest tonnes

FishYear	FishYearLabel	TIB	Traditional	Sunset	Recreational	Charter	PNG	Total
1940	1940-41	0	2	0	0	0	0	2
1957	1957-59	0	2	34	2	0	0	38
1959	1959-60	0	2	52	2	0	0	56
1960	1960-62	0	2	40	2	0	0	44
1962	1962-75	0	2	70	2	0	0	74
1975	1975-76	3	2	68	2	0	0	75
1976	1976-77	3	2	81	2	0	0	88
1977	1977-79	3	2	69	2	0	0	76
1979	1979-89	3	2	57	2	0	0	64
1989	1989-90	3	10	214.694	4	0	0	231.694
1990	1990-91	4	10	181.7868	5	0	0	200.7868
1991	1991-92	1	10	193.8417	4	0	0	208.8417
1992	1992-93	2	10	173.172	2	0	0	187.172
1993	1993-94	3	10	121.4643	4	0	0	138.4643
1994	1994-95	5	10	192.3423	5	0	0	212.3423
1995	1995-96	2	10	181.7283	3	0	0	196.7283
1996	1996-97	3	10	157.247	4	0	0	174.247
1997	1997-98	4	10	181.1091	2	0	0	197.1091
1998	1998-99	4	10	166.6574	5	0	0	185.6574
1999	1999-00	9	10	167.5294	5	0	0	191.5294
2000	2000-01	5	10	163.5025	4	0	0	182.5025
2001	2001-02	8	10	107.7271	2	0	0	127.7271
2002	2002-03	7	10	129.4603	5	0	0	151.4603
2003	2003-04	13	10	137.2421	5	0	0	165.2421
2004	2004-05	14	10	224.813	3	0	0	251.813
2005	2005-06	10	10	277.2941	3	0	0	300.2941
2006	2006-07	14	10	171.2282	3	0	0	198.2282
2007	2007-08	7	10	105.2493	2	0	0	124.2493
2008	2008-09	6	10	77.0379	5	0	0	98.0379
2009	2009-10	8	10	89.0457	4	0	0	111.0457
2010	2010-11	8	10	70.7241	4	0	0	92.7241
2011	2011-12	2	10	89.1534	4	0	0	105.1534
2012	2012-13	3	10	90.6809	5	0	0	108.6809
2013	2013-14	1	10	116.449	4	0	0	131.449
2014	2014-15	2	10	81.3706	4	0	0	97.3706
2015	2015-16	2	10	85.6098	5	0	0	102.6098
2016	2016-17	3	10	89.6335	4	0	0	106.6335
2017	2017-18	2.281	10	74.6173	2	0	0	88.8983
2018	2018-19	6.425	10	57.7302	4	0	0	78.1552
2019	2019-20	2.454	10	54.0966	3	0	0	69.5506
2020	2020-21	3.129	15	28.8132	5	0	0	45.9422



Data item 2 – standardised catch rates

• Examine the data and effects on catch rates.

Data – Sunset nominal catch rates, boxplot

On each box, the line and central mark indicates the median, and the bottom and top edges of the box indicate the 25th and 75th percentiles, respectively. The whiskers extend to the most extreme data points not considered outliers, and the outliers are plotted individually using the '+' symbol. Y- axis was truncated at 100 fish. Only 2% of the data was above 100 fish, and the overall maximum catch per operation-day was 471 fish.

		Number of fish opera	ation-day						
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Fishing yea



Generalized linear model GLM – on Sunset catch rates

Number of fish per boat day ~

fishing year +

zone +

boat operation +

time of year (seasonality) +

lunar cycle +

wind direction and speed +

offset(log fishing power)

family = quasipoisson(link = "log")



Influence plots





Data – TIB catch rates



Wt of fish per boat day ~ fishing year + boat operation + time of year (seasonality) + EW wind direction and speed + crew

family = quasipoisson(link = "log")



Data item 3 – fish age frequencies

Data – Fish age frequencies

0.5

0.4

0.3

0.2

0.1





0.5 0.4 n = 205 fish aged 0.3 n = 205 lengths 0.2 0.1 0 8 10 11 12 13 0 1 2 3 4 5 6 7 9

b) 1978-79

















Data item 4 – fish biology





- This key parameter defines the capacity of Spanish mackerel to replenish itself.
 - It represents the number of new spawners produced by each spawner over its lifetime at low spawner abundance.
 - The value scales the proportion of virgin recruitment produced by a low 20% spawning biomass size.

• The parameter is currently estimated around 0.4 to best fit the data.





• Could Spanish mackerel have higher reproductive resilience, with many fish assessments assuming a steepness of 0.7?

- Do we introduce fixed values of steepness into our assessment design?
 - If yes, at what values?



Parameter correlations





Data item 5 – stock assessment model

• Define the data treatments.

List of data treatments for 2021. Number of treatments? Total harvests: 1 (2)Two methods for historical estimates 1940-1988. One Taiwanese IUU harvests. • 2. Standardised catch rates: (1) Tender/dory data (out) Qld north east coast fishing power offset (in) • TIB catch rates (?) • (1) 3. Fish age frequencies: All years with fish age or length data (in) Only years with fish age data (out) 4. Natural mortality rate (M; maximum age = 13.5 years) (3)0.3, 0.35, 0.4 per year (in) 0.25, 0.45 per year (out)

- 5. Steepness estimated
 - Estimated (in)
 - Fixed values (?)

(1)



Data item 5 – RBC method



How do we calculate the Recommended Biological Catch (RBC)?



- The RBC calculation accounts for:
 - The time lag.
 - Average fish recruitment (= 1) and the 2021-22 RBC at 94 t.

How do we form RBC advice?





2020 RBCs for six different reference points (Last years results)

No.	Name of RBC reference point	Biomass year for the RBC calculation	% of simulations below S ₂₀ over 12 years and 6 analyses Assuming average stochastic recruitment, and the constant median RBC t.	Median 2021-22 RBC tonnes (t) Over 6 analyses		
1	F _{MSY}	2021-22	12%	146		
2	F ₄₀	2021-22	12%	145		
3	F ₄₈	2021-22	9%	112		
4 F ₅₀		2021-22	8%	105		
5	Mean of F_{48} and F_{60}	2021-22	8%	94		
6	F ₆₀	2021-22	7%	75		



Last year's potential RBCs for all fishing sectors

No.	Name of approach 1940-model	Biomass year for the RBC calculation	% runs below S ₂₀ over 12 years and 6 analyses Assuming average recruitment	% runs below S ₂₀ over 12 years and 6 analyses Assuming reduced recruitment	Median 2021-22 RBC tonnes
1	Constant F _{MSY}	2021-22	12%	24%	146
2	Constant F ₄₀	2021-22	12%	23%	145
3	Constant F ₄₈	2021-22	9%	15%	112
4	Constant F ₅₀	2021-22	8%	13%	105
	Mean $\rm F_{48}$ and $\rm F_{60}$	2021-22	8%		94
5	Constant F ₆₀	2021-22	7%	9%	75



Supplementary slides



Heat map – number of data per boat operation

Number of days fished by boat and year



Data – Fish fork-length frequencies





Simple catch curves





Fishing year



Data sources – fish age-length

Table 1. History of Spanish mackerel age-length sampling in the Torres Strait.

Year	Data source	Description
1974-75	DAF, Qld.	Survey of Fisheries Resources - Torres Strait, 1974. Length data only from the Sunset sector.
1978-79	DAF, Qld.	The Fisheries Research Branch undertook biological age-length sampling of Spanish mackerel, from the Sunset sector. Fork length (FL, in cm), total weight (to the nearest 0.1 kg), sex and otoliths recorded. Samples were from Bramble Cay (McPherson, 1992).
1983-84	DAF, Qld.	The Fisheries Research Branch in Torres Strait conducted a FIRTA-funded pilot tagging program. Only five tag returns reported after 10 years. Length data only.
1998-99, and 1999-00	DAF, Qld.	Sampling conducted via a FRDC stock definition study conducted in Torres Strait in 1998 and 1999. Length data only from the Sunset sector.
2000-01 2001-02 2002-03	DAF, Qld.	Biological sampling of fish age, length and sex data. Monitoring of the Torres Strait Spanish mackerel fishery was from 2000 to 2002 and involved Sunset catch sampling from Bramble Cay. Sampling each year was for 14 days in October to coincide with the timing of peak catches and spawning activity (Begg et al., 2006).
2004-05	AFMA	AFMA trialled a voluntary fisher logbook designed to record lengths of Spanish mackerel caught by the Sunset commercial sector (Begg et al. 2006).
2005-06	JCU	The 2005-06 Spanish mackerel age-length data was from James Cook University (JCU) research – the Effects of Line Fishing (ELF) and Fishing and Fisheries (F&F) projects. The JCU projects provided individual fish age and length data on Spanish mackerel sampled from Torres Strait waters. The sampling was from Sunset vessels between 25 October 2005 and 3 November 2005. Dr Bruce Mapstone supplied the JCU data to DAF on 18/03/2020 under a Deed of Confidentiality.
2019-21	DAF, Qld.	Final reports for Torres Strait Spanish mackerel AFMA-2019/0832 (Langstreth et al, 2020) and AFMA-190851 (Trappett et al 2021). TIB and Sunset commercial sampling. Fish age and length.



Annual harvests – CDR report

- Catch disposal records (CDR) since 2018-19; TIB and Sunset boats.
 - This TDB02 CDR records verified landed information on fish catch weights. Based on converting fillet weights to whole fish weights.
- Notes on **Sunset CDRs** that are now available last three years.

Fishyear	N fish from logbooks	CDR weight (kg)	CDR mean fishwt (kg)	Monitoring mean fishwt (kg)
2018-19	8645	57730.18	6.677869	7.648
2019-20	6427	54096.64	8.417091	7.65
2020-21	4126	28813.2	6.983326	7.45



Department of Agriculture and Fisheries



Historical catch rates – McPherson, G. (1986)

McPherson, G (1986). The Torres Strait Spanish mackerel fishery: A review of Australian development, production and research.

Comments from McPherson (1986):

- A study of catch per unit effort data for one vessel that consistently fished in the Torres Strait region from 1968 to 1983 showed:
 - there has been a decline in fish numbers landed per fisher per day on an annual basis.
 - The decline was evident after 1980.
 - These changes coincided with an illegal Taiwanese gillnet fishery that entered TSPZ waters.



Mean catch rate Torres Strait Spanish mackerel



RAG action item 1. Pre 1989 Qld licensing data

- Meeting with Cameron Miller 11th October 2021.
- No electronic data. Only printed lists.
- For all commercial line fishing licenses. Fisheries not identified.
- Covering from 1983.
- One folder per year, with 100+ pages per folder.
- Each list contains 700 900 licences, showing a licence number, holder name, some vessel names.
- No data pre 1983.
- How can this data help improve the pre 1989 harvest estimates?



RAG action item 1. Screen shot of 1986 Qld licensing data

2 3 4	01/07/8	4			1 National State		VESSEL LICS X S	YMBOLS							PAGE
5	V47 V17 C														
5	LIC NO	SYMB SZ	2 LGT	H VESSEL NAME	SURNAME		GIVEN NAMES	LOCATION	SS DTDUE	C/WLIC C	S C/WDAT	E1 E2	E3 E4	E5 £6 £	1 E8 E8 E1
8 9	V02504F	FGJ	10.97	MACDONNA					I 311286 I 311286	B453397 Z11480D	I 311286 0	JDJD	S R S	T	
11	V01947J V01949F	FGQ 1 FGQ 2	5.03	TIDDLL					I 311286 I 311286	Z17712A Z17716D	0	K K			
3	V01946A V01948H	FGQ 3 FGQ 4	5.03 5.03						I 311286 I 311286	Z17714H	0	K			
5	V01950J V04460A	FGQ 5 FGQ 6	5,03 6,50						I 300687	Z330786	0	K			
	V04459H V00028K	FGQ 7 FGX	6.50 13.56	BIMBO					I 311286 I 311286	B453837 B453966	I 270287 I 311286	JDJE	S S		
	V02678F V000291	FHC	15+11 6+71	AUDERLE PALUMA					I 311286 I 311286	Z11486C Z17740G	0	JD	L	RS	
	V00030B	FHR	6+40 0,14	JOLLY WITCH					D 311284 I 311286	B451123 Z11490A	D 90585 0	J 1	S		
	V00032I	FHX 1	10.36	TALASEA					P 311285 P 311285	B451885 B452020	P 311285	K	D S		
	V02003F	FHX 2 FHX 4	4.30	COLUMN 11					P 311285 I 310886	B452019 B452900	P 311285	s K		-	
12	V000336 F	FH1 FH1 1	7.62	SANDY K.					I 311286 I 311286	Z11496K Z14898I		O K	SK		
	V00034E F	JF	12.80	TRACEY LEE DOUGLAS DALE		AN			I 311286 I 311286	B453243 B454030	J 31128	6 J	ES		
	V03083J F V04066E F	JL JL 1	15.09 4.50	SEA PEARL					I 300686 I 310786 I 310786	B453061 B452879 B452880	I 30078	6 K 6 K	3 1		


FishLife. James-Thorson_NOAA

<u>GitHub - James-Thorson-NOAA/FishLife: Estimate fish traits for all marine fish species</u> <u>globally</u>

To load into R command line: Sys.setenv(R_REMOTES_STANDALONE="true") options(download.file.method="wininet") remotes::install_github("james-thorson/FishLife" Library(FishLife)

Example code: Predictions = Plot_taxa(Search_species(Genus="Scomberomorus")\$match_taxonomy) Predictions[1] params = matrix(c("h","M", "G","In_MASPS"), ncol=2, byrow=TRUE) Plot_taxa(Search_species(Genus="Scomberomorus")\$match_taxonomy, params=params)



2020 stock assessment results



Median egg-production ratio over six analyses.





Median egg-production ratio for the six analyses.





Summary of analyses and estimates. Confidence intervals are in parentheses (95%).

Data	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6
Harvest	Polynomial, IUU	Polynomial, IUU	Polynomial, IUU	Logistic, IUU	Logistic, IUU	Logistic, IUU
Natural Mortality M	0.3	0.35	0.4	0.3	0.35	0.4
Steepness h	0.468 (0.42 : 0.521)	0.399 (0.361 : 0.442)	0.346 (0.317 : 0.379)	0.449 (0.405 : 0.498)	0.385 (0.349 : 0.427)	0.336 (0.307 : 0.37)
Unfished Recruitment R0 / 10 ⁶	0.113 (0.101 : 0.126)	0.151 (0.134 : 0.171)	0.201 (0.175 : 0.232)	0.121 (0.109 : 0.134)	0.162 (0.143 : 0.182)	0.215 (0.187 : 0.246)
Vulnerability age 50%	1.782(1.573:1.99)	1.78 (1.579 : 1.983)	1.77(1.589:1.967)	1.782 (1.563 : 2.005)	1.777(1.582:1.97)	1.765 (1.566 : 1.977)
Vulnerability age 95%	2.508 (2.204 : 2.832)	2.494 (2.195 : 2.811)	2.462 (2.191 : 2.75)	2.507 (2.196 : 2.841)	2.487 (2.195 : 2.784)	2.452 (2.187 : 2.726)
Log recruitment stddev (~CV)	0.365 (0.306 : 0.434)	0.354 (0.299 : 0.417)	0.359 (0.305 : 0.414)	0.369 (0.313 : 0.433)	0.362 (0.306 : 0.422)	0.365 (0.309 : 0.422)
Catch rate negLL	-42	-46.15	-52.304	-43.277	-48.032	-54.367
Fish age negLL	-162.581	-164.243	-164.88	-162.276	-163.698	-164.259
Fish age, annual eff sample size	137(11:574)	135(14:582)	132(18:587)	136 (11 : 569)	133(14:582)	130 (18 : 585)
Spawning ratio S ₁₉₈₉₋₉₀ / S ₀	0.397 (0.342 : 0.447)	0.432 (0.372 : 0.485)	0.467 (0.406 : 0.524)	0.366 (0.318 : 0.411)	0.401 (0.345 : 0.453)	0.437(0.378 : 0.491)
Spawning ratio S ₂₀₁₉₋₂₀ / S ₀	0.28 (0.032 : 0.463)	0.314 (0.034 : 0.497)	0.353 (0.066 : 0.547)	0.26 (0.033 : 0.437)	0.294 (0.038 : 0.472)	0.333 (0.089 : 0.508)



Recruitment deviations



Attachment C Department of Agriculture and Fisheries



Torres Strait

Scomberomorus commerson

Project outline 2021/22 – 2023/24

Torres Strait Spanish mackerel stock assessment.

FFRAG meeting #9, October 2021



ustralian Government

Australian Fisheries Management Authority





Project objectives:



- Conduct annual assessments for the next three years.
- The stock assessments will:
 - 1. Review datasets, FFRAG meeting 1. October.
 - 2. Review results, FFRAG meeting 2. November.
 - 3. Present advice to FFWG meeting 3. November.
 - 4. Publish a citable report by the following May.
 - 5. Assess the custom and Stock Synthesis (SS) software.
 - 6. Streamline the stock assessment system by year 3.

What is Stock Synthesis (SS)



- Age structured population model; by NOAA in the US.
- Flexible range of options for modelling fish populations.
- SS has been tested against other models.
- SS is functional with associated tools like r4ss.
- Facilitates sharing knowledge and common language.



One of the most used stock assessment packages in the world!

Example r4ss summary



\\lands\data\DAF\Fisheries\Assessment and <u>Monitoring\Stock</u> <u>Assessment\base\intermediate\spanish mack</u> <u>erel_ec\FINAL</u> <u>MODELS\scenario1\plots\SS_output.html</u>

Project stages for 2021-2022:





What is streamlining?

- Streamlining joins all the assessment steps by computer code, to generate the final report and presentation files.
- The expectation is for more rapid stock assessment. The work will enable different staff to produce repeatable stock assessments.
- A streamlined process means fewer delays in reviewing and publishing results. This reduces cost and time.



Aspect	Current custom model (not streamlined)	Streamlined stock synthesis (SS)	
Staff AFMA \$ to run. In-kind not compared.	\$30K – \$50K based on past budgets.	≤ \$20K per year.	
Version control	Yes	Yes	
Data access	Individual data files.	Direct databases access, or individual data files	
Data setup and filtering	FFRAG rules	FFRAG rules	
Coding - data inputs	Clear. Uses an excel file and user interface.	Clear. Uses code generating text files as input.	
Reporting	MS Word - manual	LaTex automating	
Model fitting	Maximum likelihood and MCMC	Maximum likelihood and MCMC	
Estimates key parameters	Yes	Yes	
Run different data scenarios	Yes	Yes	
Forecast	Yes	Yes	
Biomass target reference points	Yes	Yes	
RBCs	Yes	Yes	
Custom and SS results the same?	To be assessed by FFRAG.	To be assessed by FFRAG.	

Attachment D

Size limit information

Agenda item 4.1

Spanish mackerel

Torres Strait Spanish mackerel

Female TL cm LF for 2+ year olds





Total length (cm)

Torres Strait Spanish mackerel

Female TL cm maturity, from Begg et al 2006

Female length – maturity curve



Torres Strait Spanish mackerel

Cumulative length frequency

Cumulative LF – all fish and years of stock assessment data



Total length (cm)

Grey mackerel

Grey mackerel

Female TL cm LF for 2+ year olds

Female age at maturity \geq 2+ years μ = 84.2, σ ~6.2



Total length (cm)

Attachment E Department of Agriculture and Fisheries

Sustainable Fisheries Strategy 2017 – 2027



Queensland Governmen

Queensland Harvest Strategy Brief Update Ash Lawson

2021

Sustainable Fisheries Strategy 2017–2027



Queensland Government





Cycle of implementation



Sustainable Fisheries Strategy 2017–2027



Queensland Government

Reef line harvest strategy timeline



Sustainable Fisheries Strategy 2017–2027



Queensland Governmen

Main components of each harvest strategy

The fisheries objectives sets out aspirations for the fishery, the principle objective is to:

 Maintain all species at, or returned to, a target spawning biomass level that aims to maximise economic yield (MEY) for the fishery (typically 60% biomass).

Catch shares

 This harvest strategy aims to maintain the existing catch shares between sectors

|--|

Species	Commercial fishing*	Recreational fishing** (including charter)	
Coral trout 80%		20%	
Red throat emperor	60%	40%	
Indigenous commercial fishing development	5 to	nnes	

* The commercial catch share for coral trout is informed by the 2019 coral trout stock assessment, and for red throat emperor it is informed by the 10-year average of catch reported in the quota monitoring system.

- ** Recreational catch share is informed by the statewide recreation fishing survey (2010-2013).
- Decision rules are established to manage the harvest of target, byproduct and bycatch species

Schedule for assessment and review

• The harvest strategy sets out the schedule for stock assessment and management review for each species

Sustainable Fisheries Strategy 2017–2027



Queensland Governmen

Harvest strategy targets and reference points

Species	Stock assessment	Reference point
Coral trout	Yes 🗸	60% biomass
Red throat emperor	Yes 🗸	60% biomass
Other species	Intermittent	Catch trigger

As biomass is not available for most secondary species, other reference points will trigger management action:

- if the annual commercial harvest exceeds 20 tonnes for an individual species and
- if the annual commercial harvest has increased to 1.5 or 2 times above levels from the 2011–2015 average.





The harvest strategy is set up to consistently increase the TAC from the limit reference point of 20% (where the TAC = 0) up to the target reference point of 60%

Sustainable Fisheries Strategy 2017-2027





Secondary and byproduct species management

₹





Due to the unprecedented and significant impacts of COVID-19 on the reef line fishery, it has been decided to set aside the harvest strategy decision rules for 2020–21 to support the social and economic performance of the fishery. The TACC will remain at 1163 tonnes for 2020–21 and will be reviewed for 2021–22.

Maintaining the TACC will not affect the sustainability of stocks, given the significant under catch of coral trout for the current season and likely ongoing depressed market demand and transport logistics faced by the commercial industry.

Sustainable Fisheries Strategy 2017–2027



Coral trout

Common coral trout at 59% biomass → TAC of 1073 tonnes required to reach 60% biomass (after applying 13% discount factor and scaling up by 4.5% for other species of coral trout)



Sustainable Fisheries Strategy 2017–2027

Coral trout

- Estimated recreational harvest at 228 tonnes (21% of TAC) did not reach 25% catch share trigger → no change to possession limits required
- Current TACC at 1163 tonnes but recommended reduction to 857 tonnes (80% of TAC) → TACC reduced to 963 tonnes due to 200 tonne maximum change buffer



Sustainable Fisheries Strategy 2017–2027



Queensland Governmen

Red throat emperor

 RTE at 72% biomass → TAC of 930 tonnes required to rebuild to 60% (discount factor built into model)



Sustainable Fisheries Strategy 2017–2027

Red throat emperor

- Estimated recreational harvest at 123 tonnes (13% of TAC) did not reach 45% catch share trigger → no change to possession limits
- Current TACC of 611 tonnes but recommended reduction to 558 tonnes (60% of TAC) → TACC reduced to 558 tonnes





Other secondary species

- Triggers are for management action are:
 - Annual commercial harvest exceeding 20 tonnes AND
 - Annual commercial harvest increasing to 1.5 or 2 times above 2011–2015 average
- These triggers weren't reached for any secondary species → no management action



Sustainable Fisheries Strategy 2017–2027



Spanish mackerel harvest strategy timeline



Sustainable Fisheries Strategy 2017–2027



Queensland Governmen
Attachment F

Environment and Spanish Mackerel in Torres St

Rik Buckworth¹, Michael O'Neill² and Andrew Trapett³

¹Sea Sense Australia Pty Ltd, ²Dept Agriculture & Fisheries Qld, ³Australian Fisheries Management Authority



October 2021





Australian Government

Australian Fisheries Management Authority

Context

- Why look at environment?
 - We saw declining catch rates, despite reduced catches how much is the effect of fishing? Might other things – like the weather –affect the Torres Strait mackerel stock and catch rates ?

Context: Torres St catch rates to 2018 (M O'Neill)



 Strong drop even though catches very reduced

Data to 2020– Standardised catch rates SM02 and TSF01 logbooks; CIs $\approx \pm 3$ fish



1.167

cal year

Data – TIB catch rates



Wt of fish per boat day ~fishing year+boat operation +time of year (seasonality) +EW wind direction and speed +crew

family = quasipoisson(link = "log")

Environmental effects can be important

- The FFRAG asked "given declining catch rates, despite reduced catches how much is the effect of fishing? Might other things – like the weather – affect the Torres Strait mackerel stock and catch rates ?"
- We would like to understand whether catch rates are sending a clear signal about abundance
- We discussed drought in the Fly River area as a potential driver of mackerel abundance
- There were similar patterns of catch rates across Torres Strait, Qld E coast, Gulf of Carpentaria, NT Top End, WA

Similar patterns in catch rates across northern Australia



LARGE PELAGIC FINFISH FIGURE 1.

a) Annual statewide commercial catch (t) for the three large pelagic indicator species and b) Annual catch rate of Spanish mackerel in the MMF, by management area, with dotted line around each representing +/- standard errors.

Lewis, P. and Brand-Gardner, S. (2018). Statewide Large Pelagic Finfish Resource Status Report 2017. In Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17. The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. Pp. 32-36

NT



Figure care of Dr Mark Grubert, Department of Primary Industry & Resources, NT

Weather/ environment effects

- Catches and catch rates can vary 'with the weather' (the environment)
 - 'weather' affects fishers, as well as how fish behave, where they go and how they grow and survive e.g. wind, moon
- Recruitment –new fish entering the fishery might also be affected by environmental factors
 - Temp
 - Rain
 - Productivity (which might be affected by river flow etc)
 - Regional climate SOI, IOD, Madden-Julian, Australian Monsoon Index

Life History of Spanish mackerel



Stage, When

What information is available??

- We could not obtain suitable data from the Fly River area:
 - No response from P-NG Buraeu of Meterology
- Satellite temp data
- Rainfall from Horn Island
- Regional SOI

Data

- We could not obtain data from the Fly River area:
 - No response from P-NG Bureau of Meterology
 - No response from the Ok-Tedi people in P-NG
- Sea Surface Temperature data from the US NOAA* satellite data
- Rainfall data (monthly totals) from Horn Island (BoM other sites patchy data)
- Southern Oscillation Index monthly values were also from BoM
- Standardised CPUE values and recruitment anomalies were from the assessment

* National Oceans and Atmospheric Adminsitration Extended Reconstructed Sea Surface Temperature (SST) <u>V5: NOAA Physical Sciences Laboratory</u>) (Reynolds et al. 2007), which provides a reconstructed monthly mean

Catch rates did not appear to be strongly related to Sea Surface Temperature –NOAA data

Monthly mean In(CPUEst) X In (Sea Surface Temp)

 $R^2 = 0.0501$



CPUEst and Sea Surface Temperature- no real relationships (but intriguing)





SST: Mean of Hot month Dec-Mar values CPUE: mean of following main season Jul-Nov

Correlations (R ²)							
Lag (years)	0	1	2	3			
CPUE	0.0031	0.0305	0.0104	0.001			

Lack of relationships between Recruitment anomalies and Sea Surface Temperature at Bramble Cay

Correlations (indicated by R² values) between In(CPUE) and Recruitment Anomalies, and In(SST) for the Hot months (December to March) of each year.

The very low values indicates that there were **no** relationships

Lag (years)	0	1	2	3
Recruitment anomalies	0.0042	0.0059	0.0026	0.0027

CPUEst and Wet* season rain- no apparent relationships





Rainfal

CPUst

Correlations (R ²)							
Lag (years)	0	1	2	3			
CPUE	0.0011	0.0038	0.0075	0.0246			

* The preceding Wet, Oct-Apr

Recruitment and Wet season rain fall



 Some of the peaks seem to line up – but others don't – correlations not significant

Correlations (R ²)			
Lag (years)	0	1	2	3
Recruitment anomalies	0.0048	0.0475	0.0262	0.0214

Southern Oscillation Index (SOI) influence on catch rates



 Some of the peaks seem to line up – but others don't ...

Southern Oscillation Index (SOI) had no apparent influence on recruitment over the long term



Southern Oscillation Index (SOI) had no apparent influence on catch rates over the long term

Correlations (R²) between In(CPUE) for the season, and SOI peak months. The very low values indicates that there were **no** relationships

Month/ Lag	0	1	2	3
January	0.0492	0.00003	0.0326	0.0608
February	0.0086	0.0085	0.0027	0.0015
March	0.0157	0.0002	0.0399	0.0398

Southern Oscillation Index (SOI) had no apparent influence on recruitment anomalies over the long term

Correlations (R²) between recruitment anomalies and SOI peak months. The very low values indicates that there were **no** relationships

Month/ Lag	0	1	2	3
January	0.0139	0.0312	0.0007	0.0134
February	0.0039	0.0155	0.0002	0.0002
March	0.0426	0.029	0.009	0.0007

Conclude

- We were not able to link catch rates or recruitment of Torres Spanish mackerel with environmental factors (but note, some are already accounted in the standardisation for assessment)
- Spanish mackerel have a fairly long (2-4 years) and complex period to recruitment: it will probably remain difficult to define environment-recruitment relationships
- This is a real 'needle in a haystack" you could keep searching until you find an apparently strong relationship with another variable or resolve relationships that interact.

Where to?

- Do not proceed further until we can be sure of availability of information/ data for <u>local</u> environmental factors –Fly River flow, rainfall, tidal data etc from close to the fishery.
- Maintain a watching brief –there are always new ideas, there will be more data in time and new techniques are evolving.

finis

Supplementary slides

SST and Recruitment anomalies - little apparent relationship



Attachment G Department of Agriculture and Fisheries



Torres Strait Finfish Fishery: Coral Trout and Spanish Mackerel Biological Sampling

Finfish RAG Presentation 14-15 October 2021



Collaborators: Torres Strait fishers and communities, Fish Receivers, Fisheries Qld (QDAF), AFMA, TSRA, PZJA Finfish RAG, Torres stock assessment team.



Overview



- 1. Project objectives
- 2. Biological sampling update
- 3. Genetic sampling update
- 4. Project challenges
- 5. Communications and extension
 - seeking RAG feedback

Part 1: Project objectives - recap

- Collecting representative
 length measurements from
 commercial catches
- Collecting fish frames for lab study:
 - Length
 - Sex
 - Age growth rings in
 - ear-bones (otoliths)



- Catch composition
 - 4 key coral trout species
- Both **TIB** and **Sunset** fishers

and fish receivers

Data provision to support

stock assessments

Reporting back findings

(PZJA and communities)



Recap: data and samples

2019-20 season

- 1475 SM measured
- 41 SM catches



- 225 SM sex/age
- 125 SM genetic samples taken

2020-21 season

- 2304 SM measured
- 52 SM catches
- 302 SM sex/age
- 292 SM genetic samples taken

- 716 CT measured
- 15 CT catches



• 140 CT sex/age

2020-21 Spanish mackerel results

- 2304 measured from 52 catches
- 302 frames sampled for length, sex, age
- Most were 88 to 106 cm FL
- Mainly 2+ to 4+ age groups (80%)
- Similar age structure to 2019-20 and older sampling



Figure 10. Length structure of the commercial Torres Strait Spanish mackerel catch in 2020-21. TIB and Sunset sectors combined. N-value (n=3091) is the number of fish scaled to account for subsampling.

Figure 14. Age structure of the commercial Torres Strait catch in 2020-21. TIB and Sunset sectors combined. N-value (n=3091) is number of fish represented.

Full report available: <u>https://www.pzja.gov.au/torres-strait-biological-sampling-program</u>

Department of Agriculture and Fisheries

2020-21 coral trout results

- 716 measured from 15 catches
- 140 frames sampled for length, sex and otoliths taken
 - Most common coral trout
 47cm 57cm FL
- 26 common CT aged (preliminary look)
 - Range from 4-12 years old
- No blue spot trout sampled



Figure 15. 2020-21 species composition of catches from coral trout catches.



Figure 16. Length frequency analysis of Torres Strait coral trout species from 2020-21 sampling (common coral trout n=75, passionfruit coral trout n=84, barcheek coral trout n= 13).

General Work Plan

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Engagement	Stakeholder Liaison					Stakeholder Liaiso			ı &		
		otane					Fisher Payments				
Community					Vicit 2						
visits			VISICI		VISIL Z						
Biological		Pr	ocessing	: sex, len	igth meas	sures, tal	ke otolith	s, storage	э,		
Sampling			chen	n-lab pre	p of trou	it otolith	s for agei	ng.			
Agoing						Training	Ageing	Training	Ageing		
Ageing						SM	SM	Trout	Trout		
Applysis and	Data analysis ar							is and			
Analysis and	Data entry and checking Provision to St						Stock				
reporting									A	ssessme	ent
Project team	Q1		Q2			Q3			Q4		
meetings	Meet		Meet			Meet			Meet		
Milestone	#1		#2							#3	
Monsoon						Monsoo	n]			

Part 2: Sampling Update

- 2021-22 Spanish mackerel lab sampling so far:
 - 95 frames processed
 Length, sex, otoliths taken
 - 44 rep. catches measured
 - 94 genetic samples taken
 - 619 heads in storage
- Focus: Liaison with stakeholders, fishers and fish receivers





Part 3: Genetic sampling

- Genetic samples from all SM
- Close Kin Mark Recapture study
- 667 samples sent to CSIRO
- 619 heads (Jul, Aug, Sep, Oct) with more being collected



Part 4: Project challenges

- Converting support into data
- Incentives for engagement
- How to best give knowledge back to communities
- Fisher payments
- Routine data collection by businesses
- Sampler "fatigue"
- Logistics and comms


Part 5: Communication & Extension

Project Baseline

- ✓ Results poster
- ✓ Project flyer
- ✓ PZJA webpage (AFMA)
- ✓ Community visits
- ✓ SMS alerts (AFMA)
- ✓ Comm. notices, IBIS screens
- ✓ Project team meetings
- ✓ RAG-WG / TSSAC presentations

✓ Lab tours





Extension Opportunities

- Social media
- Radio 4MW
- Project summary videos
- Chest freezers in communities
- Streamlined payment options (vouchers)
- PZJA industry members supporting role
- Wapil collaborate on data collection/education.
- Education present at schools, other community groups.
- Promo material e.g. hats, shirts, keyrings etc.

Reminder Mer and Erub 2021 Sampling

Date	Community
Mon 18 Oct	Mer
Tue 19 Oct	Mer (arrive Erub 3pm)
Wed 20 Oct	Erub
Thu 21 Oct	Erub
Fri 22 Oct	Erub
Date	Community
Date Mon 29 Nov	Community Mer
Date Mon 29 Nov Tue 30 Nov	Community Mer Mer (arrive Erub 3pm)
Date Mon 29 Nov Tue 30 Nov Wed 1 Dec	Community Mer Mer (arrive Erub 3pm) Erub
Date Mon 29 Nov Tue 30 Nov Wed 1 Dec Thu 2 Dec	Community Mer Mer (arrive Erub 3pm) Erub Erub

Please keep any frames and pass on to project staff.

Collect for lab or sample on the spot.

Thank You

Questions, Comments

Jo Langstreth, Ph. 07 4241 1245 Andrew Trappett, Ph. 0488 021 694

https://www.pzja.gov.au/torres-strait-biological-sampling-program



Attachment H

Australia's National Science Agency

Designing a close-kin mark-recapture (CKMR) study for Torres Strait Spanish mackerel

Ashley Williams | TSFFRAG Meeting 14-15 Oct 2021

Ashley Williams¹, Mark Bravington¹, Pierre Feutry¹, Shane Baylis¹, Rasanthi Gunasekera¹, Ben Mayne¹, Rik Buckworth², Andrew Trappett³

¹CSIRO Oceans and Atmosphere, ²Sea Sense Australia Pty Ltd, ³Fisheries Queensland QDAF



Australian Government

Australian Fisheries Management Authority

Outline

- Background
- Brief introduction to CKMR
- Project overview
- Planned activities



Background

- Stock assessments indicate declining trend in abundance
- CPUE data provide index of abundance in stock assessment
- Does CPUE provide a reliable index of abundance?
 - Factors not captured in standardisation e.g. environmental, technological advances etc.
 - Gaps in spatial and temporal coverage
 - Hyperstability
 - Reliability of reported data
- Close-Kin Mark-Recapture (CKMR) is an alternative approach to estimate abundance *fishery independent, so no need for any fisheries data*!





What is CKMR?

- New method that uses modern genetic techniques to identify closely related pairs (kinship pairs)
- Kinship pairs can be Parent-Offspring-Pairs (POPs) or Half-Sibling-Pairs (HSP)
- Number of kinship pairs found in a population used to estimate absolute spawning biomass, mortality, connectivity
- Likely to find many POPs in small population: Few POPs in large population



What do we need for CKMR?

- Small tissue sample from juveniles & adults over a few years
- Information on the ages and/or sizes
- Two assumptions:
 - 1. At birth, every fish had 1 living mother and 1 living father
 - 2. We can reliably find Parent-Offspring-Pairs (POPs) and Half-Sibling-Pairs (HSPs) with genetics



Parent-offspring pair (POP) cartoon



Parent-offspring pair (POP) cartoon



Parent-offspring pair (POP) cartoon





CKMR in practice



Sample many different cohorts -> <u>time series</u>

Compare each sample to every other sample -> many pairs

Use all samples together in a <u>single</u> population model



Project overview

4 components:

- 1. Estimate level of connectivity between Spanish mackerel in Torres Strait and surrounding jurisdictions
- 2. Evaluate feasibility of collecting a large volume of Spanish mackerel tissue samples from Torres Strait fisheries
- 3. Evaluate epigenetic ageing for Spanish mackerel
- 4. Develop close-kin mark-recapture (CKMR) model to **design** a full-scale CKMR application for Spanish mackerel



1. Connectivity



- Evaluate connectivity between TS and:
 - QLD east coast
 - QLD Gulf of Carpentaria
 - Papua new Guinea
 - Northern Territory?
- ~50 samples per location
- Genotype each fish and use single nucleotide polymorphisms (SNPs) to evaluate connectivity



2. Tissue sampling from fisheries



- Total ~700 tissue samples
- > 400 samples from TS





3. Epigenetic ageing

- CKMR needs some information on age
- Length is OK for young fish, but not for older fish
- Otoliths are good, but need many samples (1000's) for CKMR, so expensive!
- Recent research shows age can be estimated well from DNA in tissue samples
- Needs to be calibrated for Spanish mackerel
- Lower cost than otoliths
- Therefore, no large-scale otolith sampling required for CKMR



4. CKMR model

- CKMR model is similar to stock assessment model same population dynamics
- Use current information on biology and estimated population size (from stock assessment) as starting point
- CKMR model will be a "simulation" to work out:
 - The best sampling designs (i.e. how many fish, what sizes, from where?) to get reasonable precision of estimated parameters
 - The associated costs and resource requirements for these sampling designs

Summary: Sampling XXXX adults and YYYY juveniles across Z years should give very useful estimates of absolute abundance and mortality, at a cost of \$\$\$



Planned activities

Dec 2021 – Milestone report for connectivity of Spanish mackerel

Feb 2022 – Preliminary evaluation of epigenetic ageing for Spanish mackerel

May 2022 – Milestone report for CKMR population model

Jun 2022 – Final report to AFMA



Thank you

Oceans & Atmosphere

Ashley Williams Principal Research Scientist

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Australia's National Science Agency



Attachment I



Developing an approach for monitoring the non-commercial catch in Torres Strait

(November 2019 - December 2020)

Kenny Bedford, Tim Skewes, David Brewer

October 2021

Torres Strait Non-commercial catch monitoring

Background

- Fisheries are critically important to Torres Strait
 - Culturally
 - -Socially
 - Economically
- Catches from all sectors required for sustainable management
 - -TVH
 - -TIB
 - Traditional
 - Recreational
 - -Charter

Commercial 🗸

Non-commercial ?





Background – Commercial species

- Need for a Recommended Biological Catch (RBC) estimate
- Current non-commercial sector estimates are limited and out of date:
- e.g. Spanish mackerel

Source of catches	Expected catch (t)	Source/comments
Traditional	10	FFRAG estimate via Busilacchi (2005) for 3 islands only >10 years out of date.
Recreational	2 (estimate)	QDAF rec fishers survey advised 'likely to be minimal'
Charter	minimal	QDAF logbooks show low catches
PNG catch sharing	0	No catch arrangement under Treaty for 2018-19



Background – Traditional species

- Important for community health and sustainability
- Concerns about status of important food species
- No long-term trend data
- Information on Traditional catches is out of date



Courtesy of Lala Gutchen



Project scope

To recommend an approach to estimate the non-commercial fishery catch:

- Focused on commercial finfish and TRL
- Other important traditional fishery species
- Not including dugong and turtle







Project Objectives

1. Review past non-commercial catch monitoring approaches





Project Objectives

- 1. Review past non-commercial catch monitoring approaches
- 2. Review stakeholder needs





Project Objectives

- 1. Review past non-commercial catch monitoring approaches
- 2. Review stakeholder needs
- 3. Deliver an approach for collecting and delivering non-commercial catch data





Pre-project survey of TO Representatives

"Do you support the implementation of a Non-commercial fishery monitoring project?"



Key feedback

- Assuring community members that there is little risk to future fishery access
- Communicating the benefits for sustainable fisheries



Project Advisory Committee

- Function to help guide the projects interpretation and delivery of information
- 2. Members
- 3. Meetings
- 4. Advice



Courtesy of Lala Gutchen



Project Advisory Committee

Membership:

PAC Member	Affiliation
Councillor Francis Pearson	Poruma Island Traditional Owner; TSIRC Councillor, Protected Zone Joint Authority (PZJA) consultative Traditional Inhabitant representative
John Morris	Masig Island Traditional Owner; PBC Chair
Jon Tabo	Murray Island Traditional Owner; PZJA consultative Traditional Inhabitant representative
Frank Loban	James Cook University, Badu Island Traditional Owner, Zendath Kes Fisheries Interim Director
Councillor Rocky Stephen	Ugar Island Traditional Owner; TSRA Member, STIRC Councillor, PZJA consultative Traditional Inhabitant representative
Natasha Stacey	Charles Darwin University, Indigenous fisheries and livelihoods researcher
Stephan Schnierer	Southern Cross University, Indigenous fishery researcher
AFMA executive officers	Georgia Langdon/Lisa Cocking



Project Advisory Committee Advice

- Don't start with a complex process. Build connections etc first
- Emphasise the importance of the data for sustainable fisheries and communities
- Be clear about how the information can empower the community
- Be aware of the role of women
- Consider recommendation re a capacity building process (could be funded and supported by FRDC* (Indigenous Reference Group)



Project approach/methods

1. Review of past approaches/methods

- 2. Collation and review of data and stakeholder needs
- 3. Analysis of monitoring options
- 4. Recommendations of expert Advisory Committee
- 5. Report with recommendations





Past monitoring approaches (Torres Strait)

14 studies from 1976 – 2018 (2 on PNG side)

Focus

Dugong and turtles	6
Broader marine community catch	7
Non-commercial catch of TIB fishers	1

Duration

1 year	6
2 years	6
Five years or more	2



Past monitoring approaches (Torres Strait)

14 studies from 1976 – 2018 (2 on PNG side)

Locations of studies

Erub	7
Mabuiag and Masig	6
Remainder (TSPZ)	4 or 5
Hammond and Thursday Islands	1

Who

Independent researchers	4
PhD students	3
CSIRO	5
AFMA	1


Previous Catch Estimates (Torres Strait)

Community Catch	1985 – 1986	1991 – 1993	2005 – 2006	2014
estimates	Masig	TSPZ	Erub, Masig and	Erub (TIB Only)
(t/yr)	(Poiner and Harris, 1991)	(Harris et al., 1995)	Mer	(French <i>et al.,</i> 2014)
			(Busilacchi, 2008)	
Total catch	49.7	847.0	223	5.7
- Commercial	15.9	184.8	46	
- Traditional	14.0	662.2	177	
S.M Total	20.1	14.2	9.2	0.9
- Commercial	10.2	-	5.5	
- Traditional	9.9	-	3.7	
C.T Total	3.0	1.9	28.0	3.9
- Commercial	1.4	-	23.0	
- Traditional	1.6	-	5.0	
T.R.L Total	6.2	131.8	-	0.6
- Commercial	2.7	121.2	-	
- Traditional	3.5	10.6	-	



Monitoring approaches – Traditional catch

19 studies (14 Torres Strait + 5 National)

Survey type	Primary method	Supplementary
1. Creel surveys - Census.	2	0
2. Creel surveys - Periodic sampling.	8	1
3. Fisher or household interviews.	4	13
4. Fisher/household self-reporting.	7	0
- School based	(2)	
- Fisher based	(2)	
- Fisher electronic	(1)	
- Household	(2)	



Monitoring approaches

Survey type	Strengths	Weaknesses
1. Creel surveys - Census.	Most accurate	Labour intensive
	 Biological data collected 	Difficult to implement
2. Creel surveys - Periodic	 Species specific data 	Less precise
	Lower cost	• Biases
3. Interviews	Moderate cost	Less accurate
	 Auxiliary data 	 Low participation rates
4. Self-reporting	Precise	 Low participation rates
	Cheapest	 Data security
	 Use new technology 	



Monitoring approaches – lessens learned

The factors that most studies identified as key for conducting a successful monitoring program included:

- 1. A high degree of local involvement
- 2. Engaging key local people
- 3. Good communication with local community members
- 4. Sufficient resources to maintain adequate sampling levels



Past approaches (Recreational fishing)

Survey type	Local	Regional	State	National
Mail	-	-	1	-
Telephone	-	2	3	-
Diary, logbooks	1	2	6	-
Intercept	26	3	-	-
Complemented	8	7	9	1
Total	35	14	19	1



Past approaches (Recreational fishing)

Recent approaches and emerging technologies:

- 1. Technology-based self reporting
- 2. Community based monitoring (Citizen science)
- 3. Remote surveillance
- 4. Expert elicitation
- 5. Chain referral sampling





Fisheries Monitoring Apps

- 1. Infofish ("Track my fish")
 - Fishing comps, citizen science



October 2021

Torres Strait Non-commercial catch monitoring

2. "Recfishwest" - Trout monitoring



Qld recreational fishing app



Open the Mac App Store to buy and download apps.

QLD Fishing 2.0 (4+) Department of Agriculture, Fisheries and Forestry Designed for iPhone ***** 3.3 • 15 Ratings Free

iPhone Screenshots





October 2021

Fisheries Monitoring Apps

3. FRDC Project:

FRDC 2020-056 - Evaluation of a smart-phone application to collect recreational fishing catch estimates, including an assessment against an independent probability-based survey, using South Australia as a case study

- Commenced in 2021
- SA Fishing App developed by PIRSA
- Aims to understand how accurate and representative smart phone app data is



Project approach/methods

- 1. Review of past approaches/methods
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Stakeholder needs

Stakeholder groups

- Traditional Inhabitants
- Fishery managers
- Stock assessment scientists
- National stakeholders

Needs categories

- Data needs
- Program requirements, constraints and risks



Courtesy of Lala Gutchen



Traditional Inhabitant	• Annual catch information for all fished species (~200 species) by the community (Priority 1)
data needs	Seasonal patterns in catches (Priority 2)
	 Location of catches (reef scale) (Priority 2)
	 Fishing effort and gear (Priority 2)
Fishery managers data	Annual estimates of the non-commercial catch of commercially important species. (Priority 1)
needs	 Annual catch of all other species in the Traditional fishery (potentially ~200 species) (Priority 2)
	• Catch and product use/catch use by community groups (TIB fishers, women, children etc) (Priority 2)
	 Location of catches (logbook zones) (Priority 2)
	 Conversion ratios for fishery product through processing chain (Priority 2)
Scientific data needs	Annual (and seasonal), non-commercial catch (including discards) of commercial species such as
	Spanish mackerel, coral trout (4 species) and TRL (Priority 1)
	Annual catch of other species in the Traditional fishery (Priority 2)
	 Fishing effort and gear type (Priority 2)
	 Marine species size/weight/age and gender information (Priority 2)
	 Location of catches (logbook zones) (Priority 2)
	 Fishers' observations on catch tends and fishery biology and ecology (Priority 2)
National data needs	 Improved data on Aboriginal and Torres Strait Islanders fisheries resource use (Priority 1)
	Information of monitoring program implementation, utility, and limitations (Priority 2)

Guidance on Adaptation of Commonwealth Fisheries management to climate change.

E.A. Fulton, E.I van Putten, LXC. Dutra, J. Melbourne-Thomas, E. Ogier, L. Thomas, N. Rayns, R. Murphy, I. Butler, D. Ghebrezgabhier, A.J. Hobday (August 2021)

One of the management options/recommendations:

"Respond and manage as a stock (i.e. across jurisdictions), this requires monitoring of relevant variables for stocks of interest. Even where tactical management and annual assessment is constrained to key commercial species, information should still be collected, where possible, on secondary (e.g. byproduct) and bycatch species so that it is possible to rigorously assess a species at a later date if there is concern that climate impacts have occurred."



Method feasibility	 Needs to be technically easy for community members to provide data (Priority 1) Approach needs to be logistically feasible, and relatively straight forward to implement (Priority 1)
Data reliability	 Data is comprehensive, representative and accurate (Priority 1)
OH&S requirements	 Overall program must meet implementing agencies OH&S standards (Priority 1)
Social and cultural acceptance	 Program is socially and culturally acceptable to Torres Strait Islander communities (Priority 1) Monitoring program can be co-designed with communities (Priority 1) Program needs to build trust based on shared aspirations, recognition of past experiences, transparency, legitimate local control, and information security (Priority 1) Data collection should be accompanied by comprehensive agreements, including ethics and program rules (Priority 1)
TEK security	 Data management responsibility sits with communities or their representative leadership/bodies (Priority 1) Data is held in a secure database (Priority 1) Identity of individual fishers and fishing places/practices is protected (Priority 1)
Social equity (e.g., gender, age)	• Social equity of catch, effort and catch use information (TIB fishers, women, children etc) (Priority 2)

Project approach/methods

- 1. Review of past approaches/methods
- 2. Collation and review of data and stakeholder needs
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Monitoring options – assessment

Monitoring strategy options->			Self-reporting, monitoring app	Self-reporting, daily datasheet	Self-reporting, periodic datasheet	Roving observers	Embedded observer	Periodic roving survey	
Criteria	Score range (1-5)	Min (0-5)	Criteria weight (1 to 5)	Score	Score	Score	Score	Score	Score
COST			5	4.0	3.0	4.0	4.0	3.0	4.0
Financial cost*	\$50k - \$200k	0	5	2	1	1	3	5	3
Fisher recording effort*	1 min - 15 min/d	0	5	2	5	3	1	1	1
BENEFIT			5	4.8	4.3	3.8	4.2	4.3	2.6
T.O. data needs	Not met - met	4	5	5	4	4	4	4	3
Fishery manager data needs	Not met - met	4	5	5	5	4	5	5	3
Scientific data needs	Not met - met	0	4	5	5	4	5	5	3
National data needs	Not met - met	0	2	5	4	4	4	4	2
Capacity building	Low - high	0	3	4	3	3	2	3	1
FEASIBILITY			5	4.3	4.3	4.0	3.3	3.7	3.3
Method feasibility	Low - high	4	5	4	4	4	3	3	3
Data reliability	Low - High	4	5	4	4	3	3	4	3
Satisfies OH&S requirements	Low - high	4	5	5	5	5	4	4	4
CULTURE			5	4.4	4.0	4.0	3.6	4.0	3.6
Social and cultural acceptance	Low - high	4	5	5	5	5	4	5	4
TEK security	Low - high	4	5	4	3	3	3	3	3
Social equity	Low - high	0	4	4	4	4	4	4	4
SUSTAINABILITY			2	4.0	4.0	4.0	2.0	4.0	3.0
Environmental harm*	Low – high	0	2	2	2	2	4	2	3
OVERALL SCORE				4.3	3.9	4.0	3.6	3.8	3.4
MANDATORY UNMET				0	1	2	3	2	5

Monitoring options – assessment criteria







Project approach/methods

- 1. Review of past approaches/methods
- 2. Collation and review of data and stakeholder needs
- 3. Analysis of monitoring options
- 4. Project Advisory Committee comments
- 5. Project recommendations



Project recommendations

- 1. Method = Fisher self-reporting using a monitoring app
- 2. Include complementary household-based monitoring
- 3. Apply a strict data security and information flow system
- 4. Implementation should be overseen by Traditional Inhabitants and include equitable representation for gender and region
- 5. Implement the monitoring program in a staged way
- 6. Consider developing a new Traditional Fishery Harvest Strategy
- 7. Apply modified version to recreation fisher sector



Non-commercial catch monitoring implementation



Non-commercial catch monitoring implementation

4. Community consultation and sign on

- Develop communication and consultation strategy
- Carry out initial consultation with communities:
 - Hold community workshops
 - Co-design of governance structure
 - Co-design of data collection and information feedback
 - Co-design of complemented sampling strategy
 - Co-design of pilot program

Non-commercial catch monitoring implementation

5. App design and development options

- Identify and engage potential App developers
- Identify and engage potential database designers
- Design specifications for App
 - Design data needs and data entry format
 - Specify Information feedback format
- Specifications for complemented sampling strategy
- Scope and cost App development, data base, pilot and fullscale implementation options



Thank you

Kenny Bedford, Tim Skewes, David Brewer

October 2021

Torres Strait Non-commercial catch monitoring



Australian Government Australian Fisheries Management Authority



Attachment J

Australia's National Science Agency

Scoping a future project to address impacts from climate variability and change on key Torres Strait Fisheries

Presentation to Torres Strait Scientific Advisory Committee Cairns, 9th June 2021

Leo Dutra On behalf of CSIRO Team: Leo X.C. Dutra, Éva E. Plagányi, Rob Kenyon, Trevor Hutton, Nicole Murphy, Laura K. Blamey, Steven Edgar and Christian Moeseneder



Australia's National Science Agency

Background and need of the project

Project objectives

Produce a literature review and expert-based summary about expected climate implications for key Torres Strait fisheries; and, considering these

Provide detailed technical specifications, spatial scales (grain-size and extents) and costings for a future data framework that will be needed to meet the common data requirements of subsequent fishery-specific modelling that would address future climate variability and change scenarios for TS fisheries.



Warming Oceans Are Reshaping Fisheries

Marine species are gradually moving away from the equator into cooler waters, and, as a result, species from warmer waters are replacing those traditionally caught in many fisheries worldwide. Scientific studies show that this change is related to increasing ocean temperatures.

Subtropic and temperate ocean



From 1970 to 2006, as open temperatures were rising, catch composition in the subtropic and temperate areas slowly changed to include more warm-water species and fewer cool-water species.



➤ Temperate/cool-water fish)

Tropics



In the tropics, the catch composition changed from 1970 to 1980 and then stabilized, likely because there are no species with high enough temperature preferences to replace those that declined.



These shifts could have negative effects including loss of traditional fisheries, decreases in profits and jobs, conflicts over new fisheries that emerge because of distribution shifts, food security concerns, and a large decrease in catch in the tropics.

This graphic presents concepts from: Cheung, W.W.L., R. Watson and D. Pauly. 2013. Signature of ocean warming in global fisheries catch. Nature. DOI:10.1038/nature12156.

The thermometers are representative of trends in ocean temperature over time and the fish are representative of trends in catch composition over time. They do not represent specific values. Please consult the results section of Cheung et al. (2013) for exact data points.

Graphic by The Pew Charitable Trusts' ocean science division, www.pewenvironment.org/research-programs



Need for the report

Climate change signal is clear

Some semi-quantitative assessments of climate change impacts and vulnerability but limited quantitative assessments

Review and synthesise information to understand potential CC impacts on fisheries



Scope modelling and data framework to support quantitative assessments of climate change impacts on fisheries



Fisheries investigated in this report

Fishery	Common name	Scientific name	Fishery type
Tropical Rock Lobster	Tropical Rock Lobster	Panulirus ornatus	C, S
Prawns	Brown tiger prawn	Penaeus esculentus	С
	Blue endeavour prawn	Metapenaeus endeavouri	С
Finfish	Spanish mackerel	Scomberomorus commerson	C, S, R
	Common coral trout	Plectropomus leopardus	C, S, R
	Bar-cheek coral trout	Plectropomus maculatus	C, S, R
	Passionfruit coral trout	Plectropomus areolatus	C, S, R
Beche-de-mêr	Sandfish	Holothuria scabra	С
	Black Teatfish	Holothuria whitmaei	С
	Prickly Redfsih	Thelenota ananas	С
	Curryfish	<i>Stichopus herrmanni</i> and <i>S. vastus</i>	С
	White Teatfish	Holothuria fuscogilva	С
Turtle	Green Turtle	Chelonya midas	S
	Hawksbill Turtle	Eretmochelys imbricata	S
Dugong	Dugong	Dugong dugon	S

Fishery type: C (commercial), S (subsistence), R (recreational) (from: Johnson and Welch 2016), plus additional holothurians Prickly red and White Teatfish given their increasing economic value and harvest.



Environmental setting





source: http://www.tsra.gov.au/news-and-resources/annual-reports/annual-report-2016-2017/section-report-of-operations/where-we-operate

Climate

Influenced by considerable ocean and climate variability

- Monsoon
- ENSO
- Extreme weather events
 - Changes in sea level
 - Marine heatwaves
 - Extreme rainfall (waves, storm surges)



(a) Australian rainfall in 1998 La Niña (May 1998 to March 1999), (b) the 1997 Super El Niño (April 1997 to March 1998), (c) the 1982 Super El Niño (April 1982 to February 1983) and (d) the 2002 El Niño Modoki (March 2002 to January 2003). (c) Bureau of Meteorology, https://theconversation.com/explainer-el-nino-and-la-nina-27719.



Bathymetry and circulation





Complex & shallow

High energy and strong tidal currents Poorly understood water circulation

Connects habitats

Larvae dispersal



Methods

Literature search to identify what we know about climate change predictions and impacts on fisheries in TS Identified environmental drivers that affect recruitment, growth, mortality rates, catches and relevant habitats for selected fisheries Synthesise information in report and identify databases



Desirable model features

Suite of desirable model features

Ambitious list.

Consideration of specific high priority questions that need addressing

- some of the features we overview may be essential,
- others are not or may simply be stretch objectives that could be built on at a later stage





Data framework

identifies how the physio-chemical and ecological data should be managed and delivered to support the development of models





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Main findings
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What do we know about impacts on fisheries

Localised and climate change impacts

Localised impacts in Torres Strait

Minimal, but exist in specific locations

Main drivers

- Urbanisation
- Connect to markets

Risks

- Increase in land-based runoff
- Pollution
- Changes in water flow
- Oil spills





Fisheries and habitats

Minor impacts

Generally in good condition

Well managed



Human impacts

Oil contamination

Small areas

'Oceanic Grandeur' (1970)

Risk of ships running aground



Mangrove cutting



Boigu, Dauan and Mabuiag islands



Alteration of hydrology

Local die-offs of mangroves



Water quality

- Maintenance issues in some Sewage Treatment Plants
 - Boigu and Iama
- Chemical leachate
 - Saibai and Boigu Islands
- Sediment runoff from Fly River
 - Saibai, Dauan and Boigu
 - Risk of metal contamination



Past examples of over-harvest of marine species

Over-harvest of marine species



This Photo by Unknown Author is licensed under CC BY-SA

Declining populations of Hawksbill and Green Turtles in Torres Strait

- Overharvest in neighbouring nations
- Potential overharvest of eggs (neighbouring nations and Torres Strait)
- Potential decline of Green turtles due to failing hatchling production in GBR



Climate Change

Temperature change since 1951



Source: https://data.giss.nasa.gov/gistemp/maps/index_v4.html



This Photo by Unknown Author is licensed under <u>CC BY</u>

Climate change impacts in Torres Strait

Higher seas

Warmer atmospheric and ocean waters

More acidic waters

Changes in ocean circulation

No single 'most important factor' affecting all fisheries



Brad Marsellos, CC BY-NC-SA https://theconversation.com/rising-seas-pose-a-cultural-threat-to-australias-forgotten-people-34359



Summary (CMIP6)



CMIP6 ensemble broadly agree with those from CMIP5 Predictions are becoming less uncertain Temperature change: botter

Temperature change: hotter post 2050





Climate change in Torres Strait

Climate Change Attributes	Prediction 2030*	Prediction 2090*	Recent updates
Annual Mean Surface Temperature	0.8±0.2°C	3.2±0.6°C (2.8 – 5.1°C)	3.5-6.5°C by 2090 (Grose et al. 2020)
(1995-2019)			
Annual Rainfall (1995-2019)	0% (-3.2±7.2)	0% (-5.6±17)	
Sea Level Rise	0.12m (0.06 – 0.18m)	0.61m (0.41 – 0.84)	0.84m (0.61-1.1m) by 2100 (IPCC 2019a)
Sea Surface Temperature (Annual)	0.7 °C (0.5-1°C)	2.6°C (2.3 – 3.6)	
Ocean pH	-0.07 (-0.08 – -0.06)	-0.31 (-0.31 – -0.26)	





Extreme climate events

<u>Heat waves</u>: the number of hot days can triple in the region by the end of the century

Heavy rainfall: expected to increase (but highly uncertain)

Cyclones: more intense and less frequent



Current and future climate change projections for Australia Wet Tropics for RCP 8.5 (CSIRO-BOM 2015).

Interconnected habitats





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Supporting fisheries





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Drivers

































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Proposed modelling framework

Quantifying impacts

Why use models?



- 1. Interactions (fisheries & ecosystems
 - Impacts of climate change scenarios
 - Impacts of changes in catchment conditions and rainfall
 - Impacts of incidents
 - Support development of strategies
 - Evaluation of alternative adaptation options



Simulation requirements





Assessment of data availability

297 data records

Assessment of available data

Fisheries, marine species, habitats, geology and physiochemical water quality parameters

Significant information

- Datasets are sparse
- Opportunistic data collection (except TRL)
- Improvements in data collection of catches of all commercially fished species since the Torres Strait Fish Receiver System has been mandated on 1 December 2017

Recent mapping of mangroves, seagrasses and coral reefs (Carter et al. 2018; Duke et al. 2015; Lawrey and Stewart 2016)

Recent survey data on substrate and species (Murphy et al. 2021, Plagányi et al. 2020b)

Assessment of available data

Fisheries, marine species, habitats, geology and physiochemical water quality parameters

Recent mapping combined with improved catch and survey data offer valuable opportunity to develop models to explore impacts and adaptation options

Assessment of data

Physical and biogeochemical processes

- Physical and biogeochemical cycles and processes
 - Remote sensing and hydrodynamic models from 2000-2010
 - Limited physical long-term observational data
 - hydrodynamic models and data used to construct them are outdated

Coherent data collection:

- Appropriate spatial and temporal coverage
- Reduce uncertainties
- Validate and improve models





Assessment of data

Physical and biogeochemical processes

Opportunity to use available data

Temperature, rainfall, storms & cyclones (e.g. AIMS / BoM / QDISITIA stations, remote sensing, surveys)

Primary productivity, nutrients, phytoplankton, ocean acidification, salinity (downscaled GCM need to be supplemented by observations)





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Modelling climate change impacts with the available data

Start modelling work sooner rather than later

Sufficient data to start modelling

Build models in a step-wise fashion

Communicate model results and obtain feedback from stakeholders



Modelling climate change impacts with the available data



How (now)

- Extend and link current
 biological models of key species
 (BDM, TRL, dugongs) and links to
 habitats
- Add current known environmental drivers (e.g. SST)
- Recommended: data collection & hydrodynamic model



Future modelling (~2-3 years)



Gradually add other species (e.g. finfish, turtles) and improve habitat modelling

Link with preliminary hydrodynamic model outputs (add complexity)



Spatial scale

All important fishery areas in Torres Strait

 Regional scale coarser grid for hydrodynamic model (Plaganyi et al. 2018)



Spatial scale

Quadrants defined in the Tropical Rock lobster survey

- Primary spatial units for ecological modelling
- Finer-scale (RECOM) hydrodynamics


Spatial scale

MSE sub-areas (Plagányi et al. 2020)

Finer spatial

- Localised
 oceanographic
 drivers
- Ecological processes



Data framework



Data framework





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Key recommendations

- 1. Prioritise physical data collection and further strengthen and expand a large-scale monitoring program for Torres Strait that would support the identification of long-term trends and improve understanding about local and regional processes affecting habitats, species and fisheries, and to support the development of models.
- 2. Staged approach in the development of an integrated ecosystem modelling framework to investigate the impacts of climate and local changes on fisheries in Torres Strait, via coupling together:
 - a) Development and implementation of data framework to support future modelling efforts in Torres Strait
 - b) Development of integrated ecological or socio-ecological models capable of integration with a regional hydrodynamic model
 - i. start by combining existing data and models (TRL, BDM, and dugongs) into an integrated spatial MICE, which will form the basis for a hybrid MICE-ATLANTIS ecosystem model;
 - ii. Dedicated regional hydrodynamic model, including physics and biogeochemistry for Torres Strait, for example similar to eReefs.



Preliminary costs for future project(s)

The cost of a future project that will produce the <u>over-arching data framework</u> is approximately 0.4-0.5 FTE for 1 year or rough estimate of A\$120k

Development of an <u>integrated modelling framework: C</u>ombine existing data and models (TRL, BDM, and dugongs) into an integrated spatial MICE. This would require approximately 0.5-0.7 FTE over each of 2 years, or rough estimate of \$460k.

Development of a <u>regional hydrodynamic modelling platform</u> would require approximately 0.3-0.5FTE over each of 2 years, or rough estimate of \$350k

Monitoring program to collect physical data (e.g. temperature, salinity, currents, surface elevation): 2 deployments, 2 months each over wet and dry seasons would require approximately 0.45-0.6 FTE plus fieldwork expenses, or rough estimate of \$160k



Thank you

Oceans & Atmosphere

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