

**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)

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 - 15 October 2021
PRELIMINARIES Welcome and Apologies	Agenda Item 1.1 For NOTING

RECOMMENDATIONS

1. That the Resource Assessment Group **NOTE**:
 - a) an acknowledgement of Traditional Owners;
 - b) the Chair's welcome address;
 - c) apologies received from members unable to attend.

2. As of 30 September 2021, no formal apologies have been received.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting No. 9 14 - 15 October 2021
PRELIMINARIES Adoption of Agenda	Agenda Item 1.2 For DECISION

RECOMMENDATION

1. That the Resource Assessment Group consider and **ADOPT** the draft agenda.

BACKGROUND

2. A first draft annotated agenda was circulated to members and observers on 14 September 2021.
3. The western line closure was removed from the AFMA update and added as an additional agenda item as requested by TSRA and TI member.
4. The draft agenda was revised to include minor comments from members and recirculated on 01 October 2021.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 - 15 October 2021
PRELIMINARIES Declarations of Interest	Agenda Item 1.3 For DECISION

RECOMMENDATIONS

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

BACKGROUND

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

Table 1. FFrag member and observer Declarations of Interest to be updated at the meeting. Interests declared by those persons at the previous FFrag meeting (4-5 November 2020) and FFWG meeting (25 November 2020) are shown.

Name	Position	Declaration of interest
Members		
David Brewer	Chair	<p>Director – Upwelling P/L (David Brewer Consulting).</p> <p>Honorary Fellow - CSIRO</p> <p>Chair - Torres Strait Finfish RAG</p> <p>Scientific member – Torres Strait Finfish Working Group</p> <p>Scientific member – Northern Prawn Fishery RAG</p> <p>Current consultancies with Quandamooka Yoolooburrabee Aboriginal Corporation.</p> <p>Co-investigator on Torres Strait non-commercial fish fishery project funded by TSSAC with RAG member Kenny Bedford.</p>
Rock Stephen	Industry member	<p>Councillor for Ugar.</p> <p>Chairperson of Kos and Abob Fisheries Ugar.</p> <p>Works with brother in a commercial fishing business on Ugar.</p> <p>Eastern cluster representative on the PZJA Finfish RAG & Working Group.</p> <p>Torres Strait Scientific Advisory Committee.</p> <p>Does not hold a TIB licence.</p> <p>TSRA Board member for Ugar TSRA Finfish Quota Management Committee.</p> <p>Member of Zeneth Kes Fisheries company.</p>
John Tabo Jr	Industry member	<p>Commercial coral trout fisher (TIB).</p> <p>Holds a Torres Strait Traditional Inhabitant Boat Licence.</p> <p>Member of the Torres Strait Regional Authority Finfish Quota Management Committee.</p> <p>Newly elected board member for MDW Fisheries Association on Mer Island.</p> <p>Member of the Zeneth Kes Fisheries company.</p>
Tenny Elisala.	Industry member for Gudumalagal.	TSRA Ranger Dauan, TIB licence holder.
Paul Lowatta	Industry Member	TIB industry member, Finfish RAG

Name	Position	Declaration of interest
Kenny Bedford	Industry Member	Runs a consultancy business which has delivered projects relevant to Torres Strait fisheries. Board member of Zeneth 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 scientist for TSSAC recommended two-year project for Spanish mackerel stock assessment work. 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, no pecuniary interests as an individual, TSRA holds fishing licences on behalf of traditional inhabitants.
Ashley Williams	Scientific Member	Recently moved to CSIRO in 2020. Continued work with ABARES as a fishery scientist under Department of Agriculture and Water Resources. Involved in previous Torres Strait research.
Rik Buckworth	Scientific Member	Independent Fisheries Scientist with Sea Sense Consultancy, adjunct at Charles Darwin University, ex NT Fisheries, AFMA Northern Prawn RAG, Principal investigator on a proposal seeking funding for TS Spanish mackerel assessment work. Chair of NT Research Advisory Committee for FRDC. Chair of Northern Territory Aquaculture Management Advisory Committee.
Permanent Observers		
Casual Observers		

Name	Position	Declaration of interest
Quinten Hirakawa	TSRA officer	TSRA project officer, TIB licence holder – 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.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 - 15 October 2021
PRELIMINARIES Actions arising & meeting record	Agenda Item 1.4 For NOTING

RECOMMENDATIONS

1. That RAG **NOTE**:
 - a) the progress of actions arising from previous FFRAG meetings; and
 - b) draft meeting record of the FFRAG 8 meeting on 4-5 October 2020 as circulated for member comment on 11 November 2020.

KEY ISSUES

Actions arising

2. Progress against the actions arising from previous FFRAG meetings are detailed in **Table 1**.

Meeting record

3. The draft meeting record from FFRAG 8 was circulated for member comment on 11 November 2020 with the period for comments to close on 20 November 2020.
4. No member comments were received and the final FFRAG 8 meeting record was circulated to members on 23 November 2020.

Table 1. Status of actions arising from previous FFRAG meetings.

Number	Agenda item	Action	Status update
FFRAG 8, Action 1	4.1 Logbook review TSF01	AFMA to complete project work with industry members in 2021 with a view to implementing a new logbook for the 2021-22 season.	Ongoing – AFMA has not progressed this item due to the limited availability of stakeholders and 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. AFMA to progress with the view to implement a new logbook for the 2022/23 season.
FFRAG 7, Action 1	2.1 Review of data inputs	QDAF to investigate whether older licensing data might be available to understand vessels and years active during the pre-1989 phase of the TSFF.	In progress – Actioned by QDAF. Note verbal update at FFRAG 9
FFRAG 7, Action 2	2.1 Review of data inputs	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.	In progress – enquiry sent by AFMA on 27 October 2020. AFMA to provide a verbal update at FFRAG 9.
FFRAG 6, Action 1	2.2 Coral trout RBC	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).	In progress – Added to agenda for RAG discussion and advice at FFRAG 9. In addition, this action has been actioned through Project Number: 2019/0827 . Update to be presented at FFRAG 9.
FFRAG 5, Action 1	2.1 RAG Updates	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.	In progress – AFMA to provide verbal update at FFRAG9

Number	Agenda item	Action	Status update
FFRAG 5, Action 2	2.1 RAG Updates	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.	Ongoing – AFMA encourages all fishers to contact 07 4069 1990 to check their contact details are correct.
FFRAG 5, Action 3	2.1 RAG Updates	AFMA to update the FFRAG on the outcomes of Torres Strait case study fisheries adaption to climate change case study 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).	In progress – RAG to note presentation from Leo Dutra on Project Number: 190830, <i>Climate variability and change relevant to key fisheries</i> .
FFRAG 5, Action 5	3.1 Harvest strategy and 5.2.2 Spanish mackerel stock assessment.	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 - To be addressed under renewed future Harvest Strategy project
FFRAG 5, Action 6	5.2.2 Spanish mackerel stock assessment	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 – AFMA continues to support fishers with catch reporting through the Fish Receiver System and will conduct initial consultation with Whaphill Project trainees at Erub on 27-28 Oct 2020.
FFRAG 5, Action 7	5.2.2 Spanish mackerel	FFRAG are to consider retrospective analyses for Spanish mackerel and how these can be built in to the assessment	Ongoing – AFMA to provide verbal update at FFRAG 9 after consulting with stock assessment team.

Number	Agenda item	Action	Status update
	stock assessment		

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 - 15 October 2021
PRELIMINARIES Out of session correspondence	Agenda Item 1.5 For NOTING

RECOMMENDATIONS

1. That the RAG **NOTE** the correspondence sent out-of-session since the last FFRAG 8 meeting held on 4-5 November 2020.

BACKGROUND

2. The following correspondence was circulated out-of-session since the last FFRAG meeting held on 4-5 November 2020 (FFRAG 8). Copies of this correspondence can be requested at any time from the FFRAG Executive Officer.

Date	Item
11 November 2020	For comment - AFMA circulated the draft meeting record from FFRAG 8 to members for comments, which were due on 20 November 2020.
17 November 2020	For information only – AFMA advised the FFRAG about the 2020-21 TSSAC call for research proposals for Torres Strait Fisheries.
23 November 2020	For information only – Following member comment, AFMA circulated the final meeting record of FFRAG 8 which was held 4-5 November 2020.
23 December 2020	For information only – AFMA forwarded updates from Fisheries Queensland regarding charter fishing on the QLD East Coast.
27 January 2021	For information only – AFMA advised FFRAG members that the WTO approval for the TS Finfish Fishery had been re-approved until 1 November 2023.
29 January 2021	AFMA advised FFRAG members of an opportunity for industry members to offer assistance with a research project run by Dr Mark Grubert of NT Fisheries who was seeking tissue samples of mangrove jack fish to look at stocks structure/connectivity of mangrove jack across northern Australia.
8 February 2021	For information only – AFMA advised the FFRAG about the outcomes of the PZJA meeting held on 28 January 2021 where the PZJA agreed to the 2021-22 fishing season TACs for Spanish mackerel and coral trout in line with FFRAG and FFWG advice.
20 May 2021	For comment – AFMA circulated the full proposals for three finfish related research projects that were supported by the TSSAC for funding in 2021-22. Comments on the three proposals were due by 27 May 2021.

25 May 2021	For comment – AFMA circulated a copy of the full proposal for the Finfish stock assessment research project seeking comments from FFRAG members by 31 May 2021. Circulation also included the letter from TSSAC to the PI, emails between AFMA and PI, and the cover letter outlining changes to the full proposal.
14 June 2021	For comment – AFMA circulated an update to members regarding the TSSAC finfish fishery research projects seeking comments by 17 June 2021. AFMA also announced video conference scheduled for Thursday 17 June 2021 to discuss TSSAC feedback on the Close Kin Mark Recapture feasibility study.
14 June 2021	AFMA circulated a Microsoft Teams meeting invite for a short tele/videoconference scheduled for 17 June 2021 for FFRAG members to discuss and provide further advice on the full proposal for the Close Kin Mark Recapture research project.
15 June 2021	AFMA forwarded on comments from Rik Buckworth (FFRAG member) on the Close Kin Mark Recapture research project proposal ahead of the RAGs tele/videoconference scheduled 17 June 2021.
17 June 2021	AFMA circulated a summary of the tele/videoconference of RAG members who met to discuss the Close Kin Mark Recapture research project proposal. Any final comments or advice on the proposal was due by 18 June 2021.
23 June 2021	For information only – AFMA circulated a copy of the revised project proposal for the Close Kin Mark Recapture project following advice from FFRAG on 17 June 2021. Final FFRAG comments were due on the revised proposal by 25 June 2021.
17 August 2021	AFMA sought availability of members for meeting dates for FFRAG 9 (proposed 14-15 October 2021) and FFRAG 10 (18-19 November 2021).
14 September 2021	For comment – AFMA circulated draft agendas for FFRAG 9 and FFRAG 10 to RAG members and advised that AFMA has invited industry members to participate in a workshop on the afternoon of the 15 October to discuss non-FFRAG related matters.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 - 15 October 2021
UPDATES FROM MEMEBRS Industry and Scientific members	Agenda Item 2.1 For DISCUSSION

RECOMMENDATIONS

1. That the RAG:
 - a) **NOTE** any updates provided by industry and scientific members;
 - b) **DISCUSS** strategic issues, including economic trends, affecting the management and development of Torres Strait fisheries.

BACKGROUND

2. Verbal reports will be provided by industry and scientific members under this item. The FFRAG Chairperson may also welcome a short report from any invited participants from industry at this agenda item.
3. It is important that the Finfish RAG (and also the Finfish Working Group (FFWG)) develop a common understanding of any relevant matters within adjacent jurisdictions and what issues if any, are having the greatest impact on industry and the management of fisheries. Such understanding will ensure proceedings of the FFRAG and FFWG are focused and may more effectively address each issue.
4. FFRAG members are asked to provide any updates on trends and opportunities in global markets, processing and value adding. Industry is also asked to contribute advice on economic and market trends where possible. Scientific members are asked to contribute advice on any broader strategic research projects or issues that may be of interest to the Torres Strait industry in future.
5. At the previous meetings of the FFRAG and associated FFWG, members discussed a range of strategic issues affecting the management and development of Torres Strait fisheries which are summarised below.

Finfish RAG 5

6. The RAG noted during this discussion that, in considering the future of the Fishery, the impacts of climate change will be a priority and there is a need for:
 - Improved understanding of RAG members in interpreting climate change trends and impacts
 - Data collection on impacts of climate change
 - Need for the Torres Strait communities and PZJA advisory groups to be kept abreast of:
 - key developments and research across the broader Great Barrier Reef
 - how stakeholders can receive information on research and
 - data trends and how these developments may impact the Torres Strait.

7. The RAG noted that there is dashboard temperature tracking available for the Torres Strait through The Australian Institute of Marine Science, which would likely be a useful tool for fishers to track changes in water temperature (e.g. being used by Tropical Rock Lobster fishery in relation to avoiding cray deaths in cages in hot water during transit).
8. RAG also noted that remote sensing information was available on the National Oceanic and Atmospheric Administration (NOAA) website regarding water temperature anomalies which stakeholders could freely access. Suggestion was made that the FFRAG should be monitoring trends and anomalies rather than absolute water temperature values.
9. FFRAG noted a number of updates from industry members:
 - Fishers on Ugar have had little participation in the Finfish Fishery for the last six months due to unfavourable weather. Recent mackerel fishing has resulted in a range of different sized fish present in the catches.
 - Erub Community Freezer is back online and presently purchasing finfish species from community fishers (TIB).
 - A round of community visits have been undertaken by AFMA along with PZJA industry members. Focus of this round was to provide feedback to communities about the fish receiver system and data collection.

Finfish RAG strategic issues for industry from 2019

10. At the 27-28 June 2019 industry harvest strategy meeting the following advice was provided by an invited participant, Mr Egon Stewart, an active fisher holding a sunset licence:
 - Mr Stewart reported that this season (the 2018-19 season), for both Coral Trout and Spanish mackerel, was better than the previous season, despite bad weather and fishing time lost due to engine issues. The Group noted the differences in fishing behaviour between boats that targeted live or fillet coral trout. Generally, live trout boats will heavily fish one area quickly to minimise transit time of the live trout. Fishers that target trout for fillet tend to fish slowly, moving between different areas. Mr Stewart reported that depredation by sharks appears to have increased, particularly at Bramble Cay when targeting Spanish mackerel. Whilst Mr Stewart was unable to estimate the amount of catch that was being taken, he noted that after one fish was taken that the fish went off the bite. The Group considered that shark depredation, and the potential effects of shark depredation on catch per unit effort (CPUE) may be important to the stock assessment. Mr Stewart noted that it would be difficult to quantify the number of fish taken and the impact of a depredation on potential catch rates. The Group considered that given the impact that depredation may have on CPUE and the reliance on CPUE for the stock assessment, that gaining an understanding of the impacts of shark depredation was of important.
11. At their 13-14 March 2019 meeting (FFRAG 4) no formal updates (industry, government or research) were tabled noting the focus of the meeting agenda was placed on progressing stock assessments for mackerel and coral trout.
 - At their 19-20 November 2018 meeting (FFRAG 3), the following industry updates were noted:
Traditional Inhabitant Industry members are expecting an increase in finfish take as infrastructure improves and more community freezers come back into service.

- Good catches of Spanish mackerel have recently been taken from Ugar with good catch rates.
- Industry encouraged AFMA and TSRA to work on getting licences issued to fishers from the 1 July season start date for the 2019 season. AFMA advised that the transfer of some licences was delayed to ensure all obligations under the Native Title Act 1993 were met.
- Industry responded to a query from AFMA about reports it had received of increasing shark depredation on mackerel grounds – industry advice is that shark predation has always been an issue in Torres Strait but the intensity may vary yearly. QDAF and NT fisheries both echo reports from fishers on increasing shark numbers and interactions with commercial fisheries.

12. At their 9-10 November 2017 meeting (FFRAG 1) the RAG raised the following points:

- The RAG noted updates provided by members on strategic issues that may be affecting the adjacent Queensland east coast and the Torres Strait finfish stocks.

Queensland east coast finfish strategic issues

Vessel monitoring systems

- It was noted that the Queensland Vessel Monitoring System project was now in a trial stage with units fitted to both primary vessels in a number of fisheries (as per the Torres Strait) but also to dories – unlike in the Torres Strait. QDAF advised that they are waiting for trial data to come in for review in 2018.

East coast coral trout and reef-line species

- It was advised that the east coast coral trout TAC was nearly entirely now caught (96 per cent of 917 t) and that no over-catch was allowed under management regulations.
- 2017 catch rates appear to have been good despite a 2016 cyclone.
- A theory was reported whereby a cyclone may trigger a drop in water temperature which impacts the coral trout metabolic rates which in turn affects their availability as they will not take baits as readily. It was noted that fish are seen to be present after a cyclone but their availability seems to be affected.
- QDAF advised that east coast coral trout assessment is planned to be updated every five years and was due to be updated in 2018 (stock status and reference points are to be examined).
- It was noted that east coast stock assessment team was reviewing the options for monitoring for coral trout to support the assessment and TAC setting. The project team are comparing the costs and benefits of fishery independent line fishing surveys (to support the age structured assessment model) and are comparing this to port sampling or crew based fishery dependent data. It was noted that Australian Institute of Marine Science survey data (underwater diver abundance surveys) had been powerful and useful data for the east coast coral trout assessment.

East coast red throat emperor

- It was advised that catches of red throat emperor and other reef line species remain low with most fishers focusing on live coral trout with some red throat emperor taken as by-product.

- 2018 will see an updated east coast Red Throat Emperor assessment which will be the first update to the assessment in about a decade.

East coast Spanish mackerel

- It was reported that around 50 per cent of the east coast Spanish mackerel TAC was taken during the last season with this seasons catches appearing to be good (up 31 per cent for the season to date; around 20 per cent of the TAC had normally been filled by this time in previous seasons).
- Finfish RAG will be updated on the outcomes of the east coast Spanish mackerel assessment which is being updated in 2018. It was advised that the new east coast VMS data will likely have a huge benefit in boosting the usefulness of the assessments spatial data (particularly the time spent searching for fish) can be used by assessment scientists for analysis.
- It was noted that the east coast Finfish Harvest Strategy includes decision-rules based on a CPUE model for the commercial sector only and does not apply to recreational sector. Under the Sustainable Fisheries Strategy Queensland will move to have explicit account for catches taken from all sectors under the harvest strategy.

Torres Strait strategic issues for industry

- Kos and Abob Fisheries on Ugar Island are preparing a business plan to guide development of their business over the next few years, especially for when the Ugar freezer is upgraded. The intent of this plan is to ensure that the freezer can run as a viable, commercial business.
- An industry member advised that there is a strong need for TACs to be set at levels that provide enough product to support business.
- Erub Island has seen a spike in finfish catches over the past few weeks before the meeting due to improved weather.
- With good prices and demand for product there is reportedly some interest among the Traditional Inhabitant Boat (TIB) sector in entering the finfish fishery but this would be dependent on infrastructure to support this.
- Both Erub and Mer communities would likely have some recorded data of recent finfish commercial catches.
- More fishers on Mer Island were taking coral trout with good prices being offered from buyers.
- Mer Island women were also engaging in finfish fishing with their partners to boost their household incomes.
- Malu Lamar advised that fishers in the TIB sector need to have a firm understanding of what the TAC is for their sector. The representative advised that the next few seasons would likely result in an increased take from the TIB sector as fishers move across from the beche-de-mer fishery to target finfish. Suggested that young TIB fishers such as Mr Allan Passi from the Mer Community be invited to the Finfish RAG to help increase understanding of fisheries science among the sector and facilitate community understanding.
- TIB sector fishers have an increased understanding of the value of logbooks and good data for management of their fishery.

13. Meeting observer, TSRA board member Mr Yen Loban, noted that it was of high importance that the TIB sector supplies catch data to AFMA to support decision making and to ensure that the balance is understood between non-traditional inhabitant and TIB sector catches

Finfish Working Group strategic issues

14. At their 15 March 2019 meeting the FWG noted the following general updates from industry members and observers:

- Traditional inhabitant advice that infrastructure to support fishing business remains the key strategic challenge for Traditional Inhabitant Boat sector of the fishery given remote communities. FWG noted that TSRA infrastructure improvements will likely see community freezers reopening within 12 months which may not have much impact on the fishery over the next 2019-20 season (starting 1 July 2019). This likelihood of renewed infrastructure is reported to be increasing interest in finfish within the central cluster who historically had harvested a lot of finfish. Ugar community reports strong catches of Spanish mackerel with 3-4 tonnes of mackerel reported caught over two-three month period working to privately owned chest freezers.
- There is some general interest from Torres Strait based seafood businesses and within western communities in investing in finfish with several business buying or seeking to buy commercial fishing boats with reports that 2 to 4 boats are in the process of entering the fleet on Badu Island. This interest has reportedly been in response to the 2017-18 season low Total Allowable Catch (TAC) for Tropical Rock Lobster, as well as small TACs for beche-de-mer, and potential removal of the reef-line western area closure. Some operators may be looking to fish finfish as a contingency,. It was considered that these western communities would likely be seeking to establish markets for finfish in the near future.

15. The industry observer from the sunset sector advised:

- The fishing operation was mainly targeting mackerel to supply the local domestic market with the Sydney Fish Market buying some whole mackerel for export to the Asian market.
- Torres Strait fishery appears to be in good health generally. The operation has been taking their allocated catch in recent seasons with less skilled dory drivers available but have been taking more time to take the same harvest.
- Beach price for mackerel fillets remains steady at around \$16.50 / \$17.50 kg but may peak to support market demand around Chinese new year (\$26/kg for whole, un-bled fish under 10 kg).
- Species substitution was reported as an issue in some markets where other mackerel species such as grey mackerel was being on sold as Spanish mackerel when availability is low. Industry are supportive of a national standard for seafood labelling to address this concern.
- There is concern from some buyers in taking large sized mackerel from Torres Strait due to more northerly, warmer waters which may have increased associated risks of ciguatera poisoning. The group noted ciguatera had not previously been a problem for Torres Strait sourced mackerel.
- The key strategic issue for the industry was the increasing costs on a number of parts of fishing operations including:

- Concern over rising fuel and bait prices.
 - Cold storage fees (\$20 per time to access stored catches)
 - Packaging (cartons and liners) prices increasing \$4,000 over five years (\$6,000 per season, now \$10,000).
 - Rising freight prices both southwards – product leaving Torres Strait via barge – but also now for northbound freight to resupply the fishing operation which until recently was free to fishing businesses shipping substantial amounts of catch southwards.
 - Crews were still generally reporting round figures for effort (hours fished per session) in logbooks. AFMA urged fishers to help improved the standardisation of the catch rates by supplying the most accurate data in daily fishing logbooks.
16. The FWG advised that it would be interested in examining more economic detail on similar fishing operations as a full package including costs, beach prices for catch and lease prices for access (noting the *2016 Finfish Action Plan* is a resource providing info on economic drivers in the fishery) with a view to increasing FWG understanding of the economic viability of the fishery.
17. At their 20 March 2018 meeting the FWG welcomed updates from industry and other stakeholders on activities and strategic issues occurring in the Torres Strait Finfish Fishery and also on issues from other relevant fisheries:
- It was considered that the outcomes of the TSRA infrastructure initiative would likely increase participation within the Ugar Community in the Torres Strait Finfish Fishery.
 - Ugar community has been engaging with TSRA initiatives such as direct export of seafood product from Torres Strait.
 - Available Sydney Fish Market price data shows strong market prices for Spanish mackerel with a clear spike in prices corresponding with Chinese New Year.
 - Erub Community Freezer is intending to make its recent finfish catch data available to AFMA and the PZJA groups for consideration.
 - The TSRA Finfish Quota Management Committee has seen increased interest from the sunset sector in leasing access to the Torres Strait to catch coral trout.
 - The FWG noted that recent seasons on the Queensland East Coast fishery have seen the Total Allowable Catch almost totally filled with lease prices reaching \$6/kg corresponding with peak demand to fill orders for Chinese New Year at the end of the season. It was noted that, based on harvest control rules in place, a likely 200 t increase to the East Coast trout quota in 2018 there may be a decrease in interest from fishers wanting to access the Torres Strait Finfish Fishery reef-line sector. The QDAF member offered to circulate the recent Queensland Finfish Working Group communique for the interest of the FWG.
<https://www.daf.qld.gov.au/business-priorities/fisheries/sustainable-fisheries-strategy/fishery-working-groups/-coral-reef-fin-fish-fishery-working-group/communiques/communique-6-7-march>
 - QDAF member advised that consultation is underway on proposed amendments to the *Queensland Fisheries Act* to implement changes including stronger compliance powers and penalties. <https://www.daf.qld.gov.au/business->

[priorities/fisheries/sustainable-fisheries-strategy/changes-to-queenslands-fisheries-legislation](#)

- QDAF advised that workshops are being held in Queensland on social and economic indicators for East coast fisheries. These workshops are focused on what data can inform social or economic analyses and how can these data be collected and reported. The FWG noted that the findings from these workshops can help inform the development of Torres Strait harvest strategies.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14-15 October 2021
UPDATES FROM MEMBERS Government Agencies	Agenda Item 2.2 For NOTING

RECOMMENDATIONS

1. That the Resource Assessment Group (RAG):
 - a) **NOTE** the update provided by the Australian Fisheries Management Authority (AFMA) below;
 - b) **NOTE** the progress to date against the Wildlife Trade Operation (WTO) conditions for the Finfish Fishery as summarised in **Table 1**;
 - c) **NOTE** any additional verbal updates provided by Queensland Department of Agriculture and Fisheries (QDAF); and
 - d) **NOTE** verbal updates provided by the Torres Strait Regional Authority (TSRA).

AFMA UPDATE

Torres Strait Finfish Fishery

2. At its 28 January 2021 meeting the Protected Zone Joint Authority (PZJA) decided that the Total Allowable Catches (TAC) for the Torres Strait Finfish Fishery (TSFF) will be 74 tonnes for Spanish mackerel and 135 tonnes for coral trout. The PZJA decision was in line with advice from the Torres Strait Finfish Resource Assessment Group and Torres Strait Finfish Working Group.

Table 1: TAC allocation in tonnes for the 2021/22 Torres Strait Finfish Fishery season.

2021-22 fishing season TACs and catch allowance by sector

Species	Agreed TAC	Sunset sector catch share	TIB sector catch share
Spanish mackerel	74	50	24
Coral trout	135	25	110
Other reef-line species*	n/a	6	No limit

3. As at 1 Sept 2021, the following number of licences were registered:

Table 2: Number of licenses issued for the 2021/22 Torres Strait Finfish Fishery season.

Fishing season	Number of TIB licences			Number of Sunset licences
	SM	Reef line	Dual endorsed	SM/Reef line combined
2021/22	56	22	166	3

4. A total of 83 fish-receiver licenses have been issued as at 1st Sept 2021.

Wildlife Trade Operation (WTO) Approval under the EPBC Act 1999

5. The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the Australian Government to assess the environmental performance of all commercial fisheries, including those in the Torres Strait, and promote ecologically sustainable fisheries management. Approval under the EPBC Act is necessary for fisheries to be able to legally export commercially wild caught seafood from Australia. Such approvals may be subject to conditions applicable to the responsible management authority and fishers.
6. In October 2020 the Australian Fisheries Management Authority applied for export approval for the Torres Strait Finfish Fishery (TSFF) under the EPBC Act. The application was assessed and the fishery was declared Delegate for the Minister of the Environment, as an approved wildlife trade operation under Part 13A of the EPBC Act until 1 November 2023.
7. This approval was based on the 'Assessment of the Torres Strait Finfish Fishery December 2020', which was undertaken by The Department of Agriculture, Water and the Environment. This assessment contained 9 approval conditions to ensure ecological risks continue to be managed. The advice from the Delegate to AFMA on the WTO approval and the conditions imposed on the Torres Strait Finfish Fishery is provided as **Attachment 2.2a**.
8. AFMA invites both the Finfish RAG and Finfish Working Group (WG) to monitor progress against each condition and provide advice on addressing conditions. To assist the RAG and WG, **Table 3** provides a summary of relevant actions taken or proposed to address each condition.

Table 3. Progress to date against the Wildlife Trade Operation (WTO) conditions for the Finfish fishery. A copy of the advice to AFMA on the WTO approval is also provided as Attachment 2.2a.

WTO Conditions for the Finfish Fishery	Progress as of October 2021
<p>Condition 1:</p> <p>The Torres Strait Protected Zone Joint Authority must ensure that operation of the Torres Strait Finfish Fishery is carried out in accordance with management arrangements defined in the Torres Strait Fisheries Act 1984, Torres Strait Fisheries Regulations 1985, Torres Strait Finfish Fishery Management Plan 2013, Torres Strait Fisheries Management Instrument No. 14, Torres Strait Fisheries (Finfish) Management Instrument 2020, Torres Strait Fisheries (Furnishing of Logbooks) Instrument 2020 and in fishery permit conditions.</p>	<p>On track:</p> <p>The Torres Strait Finfish Fishery continues to be managed in accordance with management arrangements in force under the <i>Torres Strait Fisheries Act 1984</i>.</p>
<p>Condition 2:</p> <p>The Torres Strait Protected Zone Joint Authority must inform the Department of Agriculture, Water and the Environment of any intended material changes to the Torres Strait Finfish Fishery management arrangements that may affect the assessment against which <i>Environment Protection and Biodiversity Conservation Act 1999</i> decisions are made.</p>	<p>On track:</p> <p>There have been no material changes to management arrangements for the Fishery. As a result AFMA, on behalf of the PZJA, has not been required to inform the Department.</p>

WTO Conditions for the Finfish Fishery	Progress as of October 2021
<p>Condition 3:</p> <p>The Torres Strait Protected Zone Joint Authority must inform the Department of Agriculture, Water and the Environment of any intended changes to fisheries legislation that may affect the legislative instruments relevant to this approval.</p>	<p>On track:</p> <p>AFMA, on behalf of the PZJA, will inform the department of any intended changes to the fisheries legislation and subordinate instruments.</p>
<p>Condition 4:</p> <p>The Torres Strait Protected Zone Joint Authority must provide reports to the Department of Agriculture, Water and the Environment annually as per Appendix B of the Guidelines for the Ecologically Sustainable Management of Fisheries - 2nd Edition.</p>	<p>On track:</p> <p>AFMA, on behalf of the PZJA, will provide the first annual report by 01 November 2021.</p>
<p>Condition 5:</p> <p>By 30 June 2023 the Torres Strait Protected Zone Joint Authority must complete an ecological risk assessment of the Torres Strait Finfish Fishery and develop an associated risk management strategy to address any risks identified in this assessment.</p>	<p>To be progressed:</p> <p>AFMA have yet to approach the CSIRO to undertake an ecological risk assessment for the fishery.</p>
<p>Condition 6:</p> <p>The Torres Strait Protected Zone Joint Authority must review the current measures applied to the management of the take of sharks in the Torres Strait Finfish Fishery to ensure that they are in line with Commonwealth best practice.</p>	<p>In progress:</p> <p>To be reviewed at FFRAG 10 meeting on 18 November 2021.</p>
<p>Condition 7:</p> <p>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.</p>	<p>In progress:</p> <p>To be reviewed at FFRAG 9 meeting on 14-15 October 2021</p>
<p>Condition 8:</p> <p>By 30 June 2023 the Torres Strait Protected Zone Joint Authority must develop a harvest strategy for the Torres Strait Finfish Fishery.</p>	<p>In progress:</p> <p>To be discussed/progressed at FFRAG 10 meeting on 18 November 2021.</p>
<p>Condition 9:</p> <p>The Torres Strait Protected Zone Joint Authority must ensure that there is a sufficient level of compliance measures in place to ensure the sustainable management of the Torres Strait Finfish Fishery, in accordance with the management arrangements in place for the</p>	<p>On track:</p> <p>To ensure AFMA's compliance efforts are targeted in the right areas an intelligence driven risk based approach, using Compliance Risk Management Teams (CRMTs) will be applied under the 2020-21 National Compliance and Enforcement Program. The 2020-21 Program will focus on four key areas, one of which is compliance within Torres Strait Fisheries, focusing on</p>

WTO Conditions for the Finfish Fishery	Progress as of October 2021
fishery, including the reporting of interaction with protected species.	quota evasion and reporting of threatened, endangered and protected (TEP) species. This document explains AFMA's compliance program priorities and objectives for the 2020-21 financial year (FY) and performance in the 2019-20 FY.

ABARES Fishery Status Reports

- Each year, the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) compiles fishery status reports which provide an independent assessment of the biological status of fish stocks and the economic status of fisheries managed, or jointly managed, by the Australian Government (Commonwealth fisheries). The most recent ABARES Fishery Status Report was released in 2020 and summarises the performance of the finfish fishery in 2018 and 2019, against the requirements of fisheries legislation and policy.
- In the 2020 report, both Spanish mackerel and coral trout are classified as not being overfished, and not subject to overfishing. The status of the Torres Strait Finfish and Fishery is summarised in the table below.

TABLE 16.1 Status of the Torres Strait Finfish Fishery

Biological status					
Stock	2018		2019		Comments
	Fishing mortality	Biomass	Fishing mortality	Biomass	
Coral trout (<i>Plectropomus</i> spp., <i>Variola</i> spp.)					Management strategy evaluation testing suggests that current catches are below the level likely to lead to biomass declines. Most recent biomass estimate indicated a biomass above $0.6B_0$.
Spanish mackerel (<i>Scomberomorus commerson</i>)					Current fishing mortality rate is below that required to produce MSY. Most recent average estimate of biomass is above $0.2B_0$.

Economic status

Estimated net economic returns are not available for the fishery. The gross value of production declined in the 2018–19 fishing season, likely due to lower catch. However, participation from the Traditional Inhabitant Boat Sector increased in 2018–19, indicating a potential increase in the socio-economic benefits for Torres Strait Islander communities.

Notes: B_0 Unfished biomass. MSY Maximum sustainable yield.

Fishing mortality	■ Not subject to overfishing	■ Subject to overfishing	■ Uncertain
Biomass	■ Not overfished	■ Overfished	■ Uncertain

- ABARES fishery status reports can be accessed on the ABARES website at: <https://www.agriculture.gov.au/abares/research-topics/fisheries/fishery-status#sections>

Compliance outcomes for the 2020-21 season

12. AFMA has been delivering domestic compliance functions in the Torres Strait in accordance with the National Compliance and Enforcement Program. There are three (soon to be four) compliance officers based in the Thursday Island office delivering both domestic and foreign compliance outcomes.
13. In March 2020 all AFMA field duties were suspended due to COVID-19, however AFMA continued to monitor fishing operations via electronic means including vessel monitoring systems (VMS), remote monitoring, surveillance, intelligence and other sources of data.
14. AFMA recommenced limited operational field activities in August 2020 and continues to conduct these activities in accordance with best practise, mandatory social distancing and hygiene and in accordance with guidelines developed for field activities.
15. Despite some operational challenges in 2020, AFMA fisheries officers have delivered the following outcomes between July 2020 – June 2021:
 - a) 45 ports/freight hubs visits;
 - b) 68 fish receiver inspections;
 - c) 62 vessel inspections;
 - d) Joined our management team in 22 stakeholder / community meetings.
 - e) Regular monitoring of seafood movements throughout the Torres Strait and conducting further investigations in some cases;
 - f) 12 individuals were prosecuted for Torres Strait fisheries offences in 2020/21. None of these offences occurred within the finfish fishery.
16. To better target priority risks in Torres Strait fisheries, AFMA have established a specialised multi-disciplinary Compliance Risk Management Team (CRMT). Priority risks specific to the Torres Strait include unlicensed fishing, unlicensed fish receiving and non-compliance with catch/landing reporting to AFMA. Failing to report catch or landings is considered quota evasion and results in the undermining of the ongoing sustainable management of the Torres Strait Fisheries.
17. Further details are contained in AFMA's National Compliance and Enforcement Program document accessible on the AFMA website at: <https://www.afma.gov.au/domestic-compliance>. This document explains AFMA's compliance program priorities and objectives for the 2021-2022 financial year.
18. All stakeholders are encouraged to report any suspicious or illegal fishing activity involving your fisheries to AFMA, either directly to our Torres Strait office or CRIMFISH (1800 274 634).

Update to the Spanish mackerel management history document

Summary of Torres Strait Spanish mackerel fishery commercial fishing history

Figure1. Table of FFRAG reports and studies to understand major changes in the TSSMF over time. Events are colour coded according to the key below.

Management	Research projects	Stock assessments	Foreign fishing	Key history e.g boats active	Biological sampling
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Date	Event	Source
1942	Start of commercial fishing for Spanish mackerel, reportedly to supply Torres Strait Army Hospitals augment food supply during WW2. Army Fishing Unit (although mackerel catches were likely occurring for local consumption prior to WW2)	McPherson 1986 in Haines et. al summary of 1985 Port Moresby seminar
1945-1957	Skipper Snowy Whitaker was known to have a vessel prior to the Trader Horn after WW2. This might have been <i>AFV Saint Hillaire</i> or <i>AFV Sawfish</i> .	McPherson pers. comm. AFMA interview Oct 2020.
1957 to 1962	<i>AFV Winston</i> reportedly the major mackerel catching boat from 57-62 and the only Torres Strait fleet boat of a size and seaworthiness to fish at Bramble Cay. <i>AFV Winston</i> reportedly fished two dories for all years active. (<i>Geoff McPherson holds logbook data for AFV Winston and is reviewing</i>)	McPherson pers. comm. AFMA interview Oct 2020.
1957 to ~1969	<i>AFV Trader Horn</i> active in TSFF from 1957 working Spanish mackerel until it refitted as a prawn trawler in the late 60's. Once this vessel moved to prawn other mackerel boats entered the Torres Strait (skipper Snowy Whitaker was protective of his fishing marks and market).	Kenny Bedford report at FFRAG 7, McPherson pers. comm. AFMA interview Oct 2020.
1970s to 1980's	Four boats reported to be commonly working from Ugar at two sites with occasional fishing at Bramble Cay. One primary boat reportedly had 7-8 dories linked.	Rocky Stephen interview with father Daniel Stephen report given to FFRAG 7.
1974	Torres Strait Fisheries Survey including mackerel, Aboriginal and Torres Strait Island Commission engaged in the survey. (Need further details was this aboard <i>AFV Winston</i> as reported by McPherson?)	Begg et al. 2006
1975-1979	Catch data available from this time period from the Queensland Fish Board (or North Queensland Fish Board).	McPherson 1986
1974-1986	Taiwanese gillnet fishery operated in Australian EEZ from NW Shelf to north of Gulf of Carpentaria, 8-16km driftnets targeting shark, tuna and mackerel.	FRDC Report 1990 Analysis of Taiwanese Gill-net Data
1976-1993	Taiwanese gillnet fishery in operation in the adjacent Gulf of Papua under PNG licences. Mainly targeting sharks but known that up to 10% of catch was bony fishes from earlier years where catch reports are available. (Need to confirm date PNG licences stopped).	Chapau & Opnai, 1986 <i>"The Taiwanese Gillnet Fishery in the Gulf of Papua"</i> in Haines et. al

		summary of 1985 Port Moresby seminar.
1977-1982	TSSMF Research conducted aboard <i>AFV Winston</i> , scientist John Carlton (QLD Fisheries) and skipper Jack Jarret. Same vessel and procedures each year meaning this study is likely a good insight into the fishing at this time in history.	McPherson pers. comm. AFMA interview Oct 2020.
1979, November	Australian Fishing Zone (AFZ) ¹ declared as the NT gillnet fishery develops in late 70s. This declaration limited the impact of Taiwanese gillnet fishery. Taiwanese catch dropped from 25,000t of all species p.a. to 10,000 t for all species p.a. post 1979.	FRDC Report 1990 Analysis of Taiwanese Gill-net Data
Late 70s, early 80s	Thursday Island local Tony Tardent worked as a deckhand on AFV TRADER HORN.	Kenny Bedford report to FFRAG 7.
1984/1985	<i>AFV Winston</i> was sold by the Jarret family after fishing Torres Strait for X time period.	McPherson pers. comm. AFMA interview Oct 2020.
1985	Torres Strait Treaty established and Torres Strait Fisheries Act. Establishment of Torres Strait Protected Zone Joint Authority (PZJA) to regulate all fisheries in Torres Strait. Transferable licences issued to non-traditional inhabitants who could demonstrate history and commitment to fishing in Torres Strait. Licences subject to strict vessel replacement regulations related to vessel size. Vessels restricted to less than 20 m in length. Traditional inhabitants could obtain the commercial fishing license from PZJA. Ban on netting of Spanish mackerel. Minimum legal size of 45 cm TL for Spanish mackerel.	Begg et al. 2006
1985	Genetic variation and population structure of Torres Strait Spanish Mackerel.	Shaklee et al. 1985
1986	Aust. Govt. limits length of gillnets to 2.5km to lower risk to dolphins (<i>Signed Wellington Treaty?</i>) this makes the legal Taiwanese gillnet fishery uneconomical and it generally ceases soon after.	FRDC Report 1990 Analysis of Taiwanese Gill-net Data
1988	AFMA SM01 daily fishing logbook introduced – compulsory for non-islander and PNG fishers, replaces Queensland LF03 logbook	Begg et al. 2006
1990	AFMA SM02 daily fishing logbook introduced	Begg et al. 2006
1990	Skipper Tony Vass (FFRAG member) begins fishing Torres Strait mackerel until 2007 buyout.	
1992	IUU incident with two Taiwanese vessels <i>FFV Sheng Fu</i> and <i>FFV Hwa Si</i> , apprehended. One running aground at Turu Cay, ghost nets retrieved up to 10miles in length.	AFMA 2020 advice to Spanish mackerel project team.

¹ <https://www.agriculture.gov.au/fisheries/domestic/zone>

1998	Minimum size limit of 45cm TL introduced for Torres Strait for all mackerel species. Fishing methods restricted to trolling, hand-lining and drop-lining.	Begg et al. 2006
1999	Management transferred from QDAF to PZJA with AFMA engaged. . Traditional inhabitants required to hold a current Torres Strait Traditional Inhabitant Fishing Boat Licence (TIB) or Torres Strait Fishing Boat Licence for commercial fishing in TSPZ. Fishery expanded to include spotted, school, shark and grey mackerel in addition to Spanish mackerel.	Begg et al. 2006
2001 and 2002	Investment warnings issued by Aust. Govt. ahead of TSFF structural adjustment (6 Nov 2001 and 15 Feb 2002).	AFMA
2003	Voluntary islander docket book (TDB01) introduced 2003, in use until mandatory Torres Strait Fish Receiver System (AFMA CDRs) started in December 2017.	AFMA
2004	AFMA led (John Marrington) voluntary industry length frequency and sexing program provides 1789 samples (length and sexing only, no ageing data performed). Sampling methodology is available.	AFMA 2004 Torres Strait Mackerel Fishery Mackerel/Linefish Logbook Supplementary Information
2004	Minimum legal size increased to 75 cm TL for Spanish mackerel. Minimum legal size increased to 60 cm TL for spotted mackerel. Minimum legal size increased to 50 cm TL for school, shark and grey mackerel.	AFMA
2005	PZJA decision on total ban of gillnetting in the Torres Strait for commercial purposes.	AFMA
2006	Begg et al. First Stock assessment of Torres Strait Spanish mackerel.	Begg et al. 2006
2007	Structural adjustment and buyout - fishery access becomes 100 per owned by Traditional Inhabitants	
2013	<i>Torres Strait Finfish Management Plan 2013</i> implemented.	
2016	Assessment update for Torres Strait Spanish mackerel fishery.	O'Neill 2016
2017 (1 July 2017)	Vessel monitoring systems introduced in Torres Strait primary tender operation vessels. (TIB and TVH - no VMS on tenders or sole operating dinghies)	
2017 (1 Dec 2017)	TDB02 Catch Disposal Records become mandatory for all Torres Strait commercial catch (TIB and TVH-sunset sectors)	
2017 (Nov 2017)	PZJA Torres Strait Finfish Resource Assessment Group formed and inaugural meeting to progress Harvest Strategy	
2019	2019-20 Torres Strait Biological Sampling Program run (Project number 190832)	QDAF - Joanne Langstreth
2019	Non-commercial fishing in the Torres Strait	DML consulting - Kenny Bedford

	(Project number 190827) (completed in 2020-21 as extended by 1 year due to covid)	
2019	"Torres Strait Spanish mackerel stock assessment with appraisal of environmental drivers" (project number 190831) Year 1	M. O'Neill (QDAF) R. Buckworth (Seasense)
2020	2019-20 Torres Strait Biological Sampling Program run (Project number 190851)	QDAF - Joanne Langstreth
2020	"Torres Strait Spanish mackerel stock assessment with appraisal of environmental drivers" (project number 190831) Year 2	M. O'Neill (QDAF) R. Buckworth (Seasense)
2020	WTO 'approval condition 7' requires the PZJA to: <i>review the appropriateness of the current minimum size limits for Spanish Mackerel in the Torres Strait Finfish Fishery. (To be reviewed at FFRAG 9 Oct 2021)</i>	Delegate of the Minister for the Environment
2021	2019-20 Torres Strait Biological Sampling Program run (Project number 200814 – Year 1 of 3)	QDAF - Joanne Langstreth
2021	Torres Strait Finfish Fishery Spanish mackerel stock assessment (project number 200815 – Year 1 of 3)	M. O'Neill (QDAF) R. Buckworth (Seasense)
2021	Designing a close-kin mark-recapture study for Torres Strait Spanish mackerel. (project number 200817)	Ashley Williams (CSIRO)

QDAF UPDATE

19. The RAG are invited to note a verbal update delivered by Ash Lawson of QDAF.
20. A copy of the communique from the inaugural East Coast Spanish Mackerel Working Group held on 17 and 18 May 2021 in Brisbane is provided at **Attachment 2.2b**
21. A copy of the communique from the Queensland Reef Line Working Group meeting held on 22-23 April 2021 in Cairns is provided at **Attachment 2.2c**

TSRA UPDATE

22. The RAG are invited to note a verbal update provided by the TSRA.



Australian Government

**Department of Agriculture,
Water and the Environment**

32
Attachment 2.2a

Ref: 002068366

Mr Wez Norris
Chief Executive Officer
Australian Fisheries Management Authority
GPO Box 7051
CANBERRA ACT 2610

Dear Mr Norris

I am writing to you as Delegate of the Minister for the Environment in relation to the assessment of the Torres Strait Finfish Fishery under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In October 2020 the Australian Fisheries Management Authority applied for export approval for the fishery under the EPBC Act.

The application has been assessed and I have declared the fishery an approved wildlife trade operation under Part 13A of the EPBC Act until 1 November 2023. The list of exempt native specimens has also been amended to allow export of product from the fishery while the specimens are covered by the declaration as an approved wildlife trade operation.

The Part 13A declaration includes conditions and recommendation that were agreed by officials from AFMA and the Department of Agriculture, Water and the Environment as areas requiring ongoing attention. These are set out at **Attachment 1**.

I have also reaccredited the management plan for the fishery under Part 13 of the EPBC Act.

Please note that any person whose interests are affected by this decision may make an application to the Department for the reasons for the decision, and may apply to the Administrative Appeals Tribunal to have this decision reviewed. I have enclosed further information on these processes at **Attachment 2**.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'Laura Timmins'.

Laura Timmins
Delegate of the Minister for the Environment

23 December 2020

Part 13A conditions to the Torres Strait Protected Zone Joint Authority on the approved wildlife trade operation declaration for the Torres Strait Finfish Fishery – December 2020

Condition 1:

The Torres Strait Protected Zone Joint Authority must ensure that operation of the Torres Strait Finfish Fishery is carried out in accordance with management arrangements defined in the *Torres Strait Fisheries Act 1984*, *Torres Strait Fisheries Regulations 1985*, *Torres Strait Finfish Fishery Management Plan 2013*, *Torres Strait Fisheries Management Instrument No. 14*, *Torres Strait Fisheries (Finfish) Management Instrument 2020*, *Torres Strait Fisheries (Furnishing of Logbooks) Instrument 2020* and in fishery permit conditions.

Condition 2:

The Torres Strait Protected Zone Joint Authority must inform the Department of Agriculture, Water and the Environment of any intended material changes to the Torres Strait Finfish Fishery management arrangements that may affect the assessment against which *Environment Protection and Biodiversity Conservation Act 1999* decisions are made.

Condition 3:

The Torres Strait Protected Zone Joint Authority must inform the Department of Agriculture, Water and the Environment of any intended changes to fisheries legislation that may affect the legislative instruments relevant to this approval.

Condition 4:

The Torres Strait Protected Zone Joint Authority must provide reports to the Department of Agriculture, Water and the Environment annually as per Appendix B of the *Guidelines for the Ecologically Sustainable Management of Fisheries - 2nd Edition*.

Condition 5:

By 30 June 2023 the Torres Strait Protected Zone Joint Authority must complete an ecological risk assessment of the Torres Strait Finfish Fishery and develop a associated risk management strategy to address any risks identified in this assessment.

Condition 6:

The Torres Strait Protected Zone Joint Authority must review the current measures applied to the management of the take of sharks in the Torres Strait Finfish Fishery to ensure that they are in line with Commonwealth best practice.

Condition 7:

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.

Condition 8:

By 30 June 2023 the Torres Strait Protected Zone Joint Authority must develop a harvest strategy for the Torres Strait Finfish Fishery.

Condition 9:

The Torres Strait Protected Zone Joint Authority must ensure that there is a sufficient level of compliance measures in place to ensure the sustainable management of the Torres Strait Finfish Fishery, in accordance with the management arrangements in place for the fishery, including the reporting of interaction with protected species.

Recommendation 1:

The Australian Fisheries Management Authority to continue to work with the Department of Agriculture, Water and the Environment and the Protected Zone Joint Authority to implement changes to the *Torres Strait Fisheries Act 1984* to allow data reporting requirements to apply to all fishing sectors in the fishery.

Data collection requirements are to include:

- The total quantity of each target and non-target species removed from the fishery, including any catch discarded prior to landing to an authorised fish receiver;
- Catch and effort data, including location of all commercial fishing activity; and
- Interactions with protected species.

Progress and outcome of this recommendation to be included in annual reports required under condition 4.



Notification of Reviewable Decisions and Rights of Review¹

There is a right of review to the Administrative Appeals Tribunal (AAT) in relation to certain decisions/declarations made by the Minister, the Minister's delegate or the Secretary under Part 13A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Section 303GJ(1) of the EPBC Act provides that applications may be made to the AAT for the review of the following decisions:

- (a) to issue or refuse a permit; or
- (b) to specify, vary or revoke a condition of a permit; or
- (c) to impose a further condition of a permit; or
- (d) to transfer or refuse to transfer a permit; or
- (e) to suspend or cancel a permit; or
- (f) to issue or refuse a certificate under subsection 303CC(5); or
- (g) of the Secretary under a determination in force under section 303EU; or
- (h) to make or refuse a declaration under section 303FN, 303FO or 303FP; or
- (i) to vary or revoke a declaration under section 303FN, 303FO or 303FP.

If you are dissatisfied with a decision of a type listed above you may:

- by notice, provided in writing, request that the Minister or the Minister's delegate give you a statement in writing setting out the reasons for the decision as per section 28 of the *Administrative Appeals Tribunal Act 1975*. The Minister, or Minister's delegate may refuse to give you a statement of reasons if your application is made more than 28 days after the day on which you received this notice.
- apply to the AAT for independent merits review of the decision. The AAT undertakes *de novo* merits review. This means they take a fresh look at the facts, law and policy relating to the decision and arrive at their own decision. They decide if the decision should stay the same or be changed. They are independent of the Department.

Application for review of a decision must be made to the AAT within **28 days** after the day on which you have received the reviewable decision. However an extension of time for lodging an application may be granted by the AAT under certain circumstances. Please visit the AAT's website at <http://www.aat.gov.au/> or telephone 1800 228 333 for further information. The role of the AAT is to provide a review mechanism that is fair, just, economical, informal and quick.

Applications & Costs

Applications to the AAT are made by lodging an Application Form (Form 1). This can be found on the AAT's website at <http://www.aat.gov.au/>.

There are no strict timelines in which the AAT must review the decision, however the first conference between the parties will usually be held within 6 to 10 weeks of the application

¹ In accordance with the *Administrative Appeals Tribunal Act 1975* Code of Practice for Notification of Reviewable Decisions and Rights of Review

being lodged. The time frame for review of certain decisions can be expedited in some circumstances.

The cost of lodging an application for review is \$952 (as of 1 July 2020) (GST inclusive). You may be eligible to pay a reduced fee of \$100.00 if

- you are receiving legal aid for your application;
- you hold a health care card, a Commonwealth seniors health card or any other card issued by the Department of Social Services or the Department of Veteran's Affairs that entitles the holder to Commonwealth health concessions;
- you are in prison or lawfully detained in a public institution;
- you are under 18 years of age; or
- you are receiving youth allowance, Austudy or ABSTUDY.

You may also be eligible for a reduced fee if you can demonstrate to the AAT that paying the full fee would cause you financial hardship. Further information can be found on the AAT's website. Additionally, you can access information about legal assistance at <https://www.ag.gov.au/LegalSystem/Legalaidprogrammes/Commonwealthlegalfinancialassistance/Documents/LegalFinancialAssistanceInformationSheet.pdf>.

If you pay a standard application fee, most of it will be refunded if the case is resolved in your favour. The refund amount is the difference between the fee you paid and \$100. So, if you paid \$920, you get back \$820 and if you pay \$952, you get back \$852. There is no refund if you paid the lower application fee for certain taxation decisions or the reduced fee of \$100.

Contact Details

Further information or enquiries relating to the decision should be directed to:

The Director
Wildlife Trade Assessments Section
Department of Agriculture, Water and the Environment
GPO Box 858
Canberra ACT 2601
Telephone: +61 (0) 2 6274 1917
Email: sustainablefisheries@environment.gov.au

Alternatively you may contact the AAT at their Principal Registry or the Deputy Registrar, Administrative Appeals Tribunal in your Capital City or Territory.

Administrative Appeals Tribunal
Street address: Level 6, 83 Clarence Street, Sydney
Mailing address: GPO Box 9955, Sydney, NSW 2001
T: 1800 228 333 and (02) 9276 5000
F: (02) 9276 5599
E: generalreviews@aat.gov.au
W: <http://www.aat.gov.au>

Freedom of Information Request

You may make an application under the *Freedom of Information Act 1982* (FOI Act) to access documents. Further information can be found at <http://www.environment.gov.au/foi/index.html>. Please contact the Freedom of Information Contact Officer at foi@environment.gov.au for more information.

Spanish mackerel fishery Working Group

Communique 17-18 May 2021

The inaugural East Coast Spanish Mackerel Working Group met on 17 and 18 May 2021 in Brisbane. This was the first meeting of the newly appointed working group. The purpose of the meeting was to provide information on the Sustainable Fisheries Strategy, review the current management and stock issues and commence discussions on developing a harvest strategy for this fishery.

Members were invited to provide a general update from the region or the sector they represent. Several members commented on the issue of shark depredation, which is thought to be a wide-spread issue affecting other fisheries across multiple jurisdictions. Members generally agreed that large numbers of Spanish mackerel are lost to depredation and supported further research to quantify the extent of depredation, identify the species responsible and better understand what is driving the apparent increased prevalence of shark interactions.

Members also raised other issues that may impact on the abundance of Spanish mackerel, including seasonality and environmental drivers of recruitment such as water quality, urban development and oceanographic changes. While these may impact Spanish mackerel stocks, they are outside the control of Fisheries Queensland and need to be accounted for in management arrangements. Some members raised bycatch and discarding in other fisheries that are incidentally capturing Spanish mackerel and contributing to overall fishing mortality (for example, net fisheries). Other issues that were raised included the need to account for managing different types of recreational fishers – those that may incidentally catch Spanish mackerel (as part of reef line fishing activities) and those that may target Spanish mackerel, the abundance and management of bait fish and the need for management intervention in the short-term.

The working group noted information to help inform a shared understanding of the status of east coast Spanish mackerel stocks. It was noted that the commercial harvest has averaged 300 tonnes annually since 2004, however total harvest is well below the current total allowable commercial catch (TACC) for the species. It was noted that Fisheries Queensland's monitoring programs are picking up increased recreational fishing participation and current east coast Spanish mackerel recreational harvest is estimated to be approximately 170 tonnes.

The working group was provided a preliminary presentation on the results of the 2021 east coast Spanish mackerel stock assessment (not yet published) and how this will inform future decision making in the fishery. Fisheries Queensland advised the draft biomass for Spanish mackerel is estimated to be 17% of unfished biomass. The working group noted the limit reference point of 20% unfished biomass is the point below which a fishery is recommended to be closed under the Sustainable Fisheries Strategy and under National Guidelines. While there are some uncertainties, this is a complex stock assessment with good confidence about the outputs. Industry members noted concerns that a new stock assessment model was used, which produced lower biomass estimates than the previous assessment in 2018.

The working group noted that the stock assessment is currently undergoing independent scientific peer review, which will also be published in coming months. The working group requested more detail on projections for different rebuilding strategies for discussion at the next meeting. Given the stock is shared with New South Wales the working group felt it was important to invite them to attend the next meeting to discuss rebuilding strategies.

Fisheries Queensland provided a presentation on the methodology and outcomes from the BDO social and economic indicators report for commercial and charter fisheries. The working group noted the social and economic indicators dashboard that is available on the department's website is an important tool for businesses to view performance of the fishery. While the fishery's economic performance is not positive, all members agreed that this information is important in assessing the performance of the fishery, and when considering the economic impacts of management or other changes.

The working group were presented with an overview of the current management arrangements in place for Spanish mackerel. Given the low biomass estimate, the working group agreed that the management arrangements and fishing rules for all sectors would need to be reviewed to inform management interventions and a rebuilding strategy for this stock.

All members noted the importance of Spanish mackerel for local supply of fish, particularly in regional Queensland where the species is popular. Given the status of the stock, the working group asked about the feasibility of making changes ahead of the 1 July 2021 fishing season, starting in 6 weeks. Fisheries Queensland provided information on the process to review management of this stock and develop a harvest strategy ahead of the 1 July 2022 fishing season. The working group agreed that management change needed to be in place as soon as possible noting that it was likely to be significant and consultation with other stakeholders would be required. The working group noted the need for a number of meetings in 2021 to consider management options for further consultation later in 2021.

Fisheries Queensland provided information on the monitoring and research programs that are in place for the Spanish mackerel fishery. The working group noted the extensive monitoring data over a long time series for east coast Spanish mackerel, with 13% of the commercial catch represented in the data set over the last 10 years. This is higher than many other fisheries, and members noted the continued contribution of commercial and recreational fishers in volunteering this information and the good working relationship with the Fishery Monitoring team. The working group recognised the importance of the combined data collected from commercial fishers and recreational fishers, which provides more confidence about the science underpinning both the status and management of this stock. The working group were keen to see this level of monitoring continue.

The next meeting will be in late June or early July. Members have sought some information on rebuilding projections, how recreational harvest is calculated, release mortality, environmental influences, fishing effort (for example, standardised catch rates), targeting behaviour between the coral reef line and Spanish mackerel fisheries and biological information from monitoring and research. The next meeting will focus on working through possible management interventions, stock rebuilding strategies and initial development of a harvest strategy.

The Spanish Mackerel Working Group members are: Animal Science Queensland (Chair – Sian Breen), Fisheries Queensland (Director, Management and Reform – Kimberly Foster, Principal Fishery Manager – Tony Ham, Senior Fishery Manager – Darren Roy, Fisheries Manager – Ash Lawson, Fisheries Scientist – Joanne Langstreth, Queensland Boating and Fisheries Patrol – Chris Morrison), commercial fishing (Chris Hain, Tony Lanzi, Anthony Vass, Richard Gilmore), recreational fishing (Ryan Tully, Gary Powis, William Bowtell), Great Barrier Reef Marine Park Authority (Darren Cameron) and conservation sector (Debbie Chamberlain).

Reef line fishery Working Group

Communique 22-23 April 2021

The Reef Line Working Group met on 22-23 April 2021 in Cairns. This was the first meeting of the newly appointed working group. Former members were thanked for their contribution and new members were welcomed. The purpose of the working group meeting was to make a recommendation on the deferred harvest strategy decision for TACC setting for coral trout from 2020, provide recommendations for TAC setting for red throat emperor and to review the status and monitor the performance of the fishery based on 2020 data.

Fisheries Queensland provided a broad update on the implementation of the Sustainable Fisheries Strategy 2017-2027, more specific reform changes for the reef line fishery and conditions associated with wildlife trade operation accreditation for the reef line fishery, which has recently been approved to 18 January 2024.

Members were invited to provide a general update from their respective sectors. The commercial industry members provided updates on the impact of COVID-19 on the fishing sector. Export markets remain volatile and challenging. Increasing operation costs and little change in long-term beach price is generating concern about financial viability for fishing businesses. A combination of factors were raised that negatively influence confidence and wellbeing within the commercial fishing sector. Members agreed that the reef line fishery harvests a sustainable, line caught premium product and the industry is looking for support to promote the fishery both domestically and internationally to improve return on investment for participants. Industry welcomed the announcement of the vessel tracking working group and reiterated concern about ongoing costs and loss of productivity when units aren't reliable.

The Charter member provided an update on impacts to charter fishing businesses, stating that given their reliance on tourism, 2020 was effectively a write off for operators due to COVID-19 restrictions. With the reopening of domestic borders, the charter season in 2021 is flourishing, but relies on continued interstate tourism. The recreational fishing members noted that there has been more public interest in the management of Queensland's fisheries, with mostly positive conversation about arrangements in place. The Great Barrier Reef Marine Park Authority (GBRMPA) and conservation members supported the position that the fishery is in a good place, and that support for continual improvement is still required to address some remaining concerns.

Fisheries Queensland provided a 2020 calendar year update on the status of the fishery including revised standardised catch rates and harvest levels. The working group noted that while landings were slightly lower in 2020 than the 10-year (2011-2020) average, the impact of COVID-19 and disrupted domestic and international markets on harvest was less than expected.

Fisheries Queensland provided a refresher on the stock assessment undertaken for common coral trout in 2020. The working group noted the stock assessment estimated the spawning biomass for common coral trout in 2019 to be 59% of unfished levels, resulting in a Total Allowable Catch (TAC) of 1 073 tonnes to rebuild the stock to 60% spawning biomass. The working group then discussed improvements to the TAC's calculation process, in particular the transparent use and application of the recommended biological catch limit from the stock assessment, discount factors to account for uncertainty and the scaling factor to calculate an 'all coral trout' TAC. Based on the 2020 coral trout stock assessment and applying the harvest strategy decision rules a Total Allowable Commercial Catch (TACC) of 858 tonnes was recommended, a 305 tonne reduction from the current TACC of 1163. Fisheries Queensland

advised that the harvest strategy provides a maximum change rule of 200 tonnes, resulting in a final recommended TACC of 963 tonnes for the 2021-22 fishing season.

Industry members noted concerns that the reduction in the recommended TACC comes from a new stock assessment model which shows a lower biomass estimate than the previous model and had significant concerns with the potential economic impact on quota lease price associated with large TACC changes. The working group acknowledged the deterioration in the economic conditions of the fishery and the impost on commercial fishers imposed by a reduction in the TACC, but recognised the importance of following the harvest strategy process. The working group members supported adopting the final recommended TACC of 963 tonnes for the 2021-22 fishing season.

The working group agreed this would improve confidence in the management framework and the long-term sustainable outlook for the fishery. The working group then reviewed updated recreational and charter harvest estimates and noted that they were within the sector allocation decision rules, as such, no recreational or charter management changes were recommended. The working group noted this advice relates to the setting of the TACC for coral trout for the 2021/22 fishing season, and the working group will be asked to consider an updated stock assessment and provide advice on the coral trout TACC in 2022.

Fisheries Queensland provided a presentation on the 2020 redthroat emperor (RTE) stock assessment. The working group noted the stock assessment estimated the spawning biomass for RTE to be at 72% of unfished levels in 2019, resulting in a TAC recommendation of 930 tonnes to fish down to the 60% biomass target. Applying the sectoral allocations in the harvest strategy, a TACC of 558 tonnes was recommended, a net reduction in the historic (2004) TACC of around 53 tonnes. The working group then reviewed updated recreational and charter harvest estimates and noted that they were well below the sectoral allocation in the harvest strategy, and as such supported no change to recreational or charter management. The working group recognised that while the commercial and charter representatives on the working group do not target RTE, adopting the harvest strategy process is important and supported adopting the final recommended TACC of 558 tonnes for the 2021-24 fishing seasons.

Queensland Boating and Fisheries Patrol provided an update on fisheries and marine park compliance within the fishery, noting that compliance in the reef line fishery is generally good. GBRMPA also provided an update on compliance with marine park requirements, and the working group noted all sectors have had reported non-compliance issues with green zones and other fishing requirements within the marine park area. Working group members identified challenges with species identification, particularly for cod species, which can hinder compliance with fishing rules. The commercial sector identified that with vessel tracking now in place, a review of safe-anchorage requirements and clarification of zoning boundaries would assist the sector to be safer and more compliant. Industry members sought assistance from Fisheries Queensland to organise an out of session meeting with AMSA to discuss issues with marine safety and operational issues associated with line-of-sight restrictions on dories.

Fisheries Queensland provided a presentation on the methodology and outcomes from the BDO social and economic indicators report for commercial and charter fisheries. The working group noted the social and economic indicators dashboard that is available on the department's website is an important tool for businesses to view performance of the fishery. It was noted that the reef line fishery overall shows better performance compared to other Queensland fisheries, however, there are some businesses that are not working as efficiently as others. The recreational and charter members expressed the importance in measuring and

comparing the social and economic information from the recreational and charter fisheries alongside the commercial sector information. The conservation member noted it is also important to obtain accurate information on exported product for this fishery, beyond initial point of sale, to highlight the importance of wildlife trade operation export accreditation to this fishery.

All working group members agreed to the importance of this social and economic information in assessing the performance of the fishery, and when considering the economic impacts of management or other changes. Members noted that survey participation from the reef line fishery was 19% and agreed they would encourage greater participation in future surveys. Fisheries Queensland said this will be particularly important to help measure and inform understanding the economic impacts of the COVID-19 pandemic.

Fisheries Queensland provided an update on the new standardised commercial fishing reporting requirements that will commence on 1 September 2021. The working group noted the primary change for the reef line fishery is the introduction of a pre-trip notice that is required before commencing a fishing trip. Working group members asked clarifying questions and appreciated the use of worked examples throughout the presentation.

In considering the introduction of the TEP animal logbook, the conservation and GBRMPA member noted their concern that no take species that are not listed as TEP animals are not required to be reported in any logbook. Fisheries Queensland noted this will need to be discussed internally and will be added for discussion at the next working group meeting.

The working group noted a presentation and update on the new commercial fishing smartphone application (the app). The app will cover a range of fisheries and is designed to encompass the new reporting requirements coming into effect from 1 September 2021. The app also provides functionality to check whether vessel tracking units are operating and manual reporting functionality if a unit fails at sea. The working group noted the app will evolve over time with additional fisheries and enhanced features added. Fisheries Queensland outlined that engagement with industry through development of the app is a big focus and is seeking working group input on an engagement strategy. The working group noted that the recreational fishing app was released late last year and has now been downloaded more than 20 000 times. Feedback has been positive and the app is undergoing continual improvements and updates.

As part of general business, the working group discussed the following:

- Following the recent release of the 'Seaspiracy' Netflix documentary, James Cook University and AMCS both published responses to the documentary. Industry asked whether Fisheries Queensland will also respond, noting it would provide support to industry and defend Fisheries Queensland's management.
- A Vessel Tracking Working Group has been established to help support the departments broad review of the implementation and administration of vessel tracking. The group is primarily an industry consultative body to provide operational advice throughout the departments 18-month review process.
- Fisheries Queensland noted work is being undertaken into using vessel tracking data to validate and improve fisheries data and information (e.g. assisting in determining targeted effort, refining Fishery Monitoring survey areas and defining fishing footprints), and welcomes industry's idea of value adding through using vessel tracking data.

- There have been many requests throughout the meeting for government support in marketing and endorsing the reef line fishery and it was emphasised that industry has a large role to play in supporting and endorsing the fishery.

The working group noted that it would be useful to formally discuss and identify fishery research priorities in working group meetings. It was requested that members consider and keep track of research priority ideas and bring them to the working group meetings for tabling (e.g. shark depredation research).

The next meeting will likely be an online meeting during the October spawning closure to discuss recreational fishing survey results and Wildlife Trade Operation conditions that are due to be reported on to the Commonwealth in mid-2022. The next TAC setting meeting will be in March 2022 when the fishery will return to scheduled decision making under the harvest strategy with an updated coral trout stock assessment.

The Reef Line Working Group members are: Fisheries Queensland (Chair - Eddie Jebreen, Director (Management and Reform) – Kimberly Foster, Principal Fishery Manager – Tony Ham, Senior Fishery Manager – Ryan Keightley, Fisheries Manager – Chad Lunow), commercial fishing (Sean Stiff, Jake Kingdon, Chris Bolton, Susan Davenport) marketing/export (Barry Dun, Michael Wakeling), recreational fishing (Jason Bradford), charter fishing (Lynton Heffer) and Great Barrier Reef Marine Park Authority (Darren Cameron), conservation sector (Simon Miller) and external researcher (Prof. Morgan Pratchett).

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 - 15 October 2021
UPDATES FROM MEMBERS Papua New Guinea National Fisheries Authority	Agenda Item 2.3 For NOTING

RECOMMENDATIONS

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

BACKGROUND

2. A verbal report will be provided under this item.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 - 15 October 2021
UPDATES FROM MEMBERS Native Title	Agenda Item 2.4 For NOTING

RECOMMENDATIONS

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

BACKGROUND

2. On 7 August 2013 the High Court of Australia confirmed coexisting Native Title rights, including commercial fishing, in the claimed area (covering most of the Torres Strait Protected Zone). This decision gives judicial authority for Traditional Owners to access and take the resources of the sea for all purposes. Native Title rights in relation to commercial fishing must be exercisable in accordance with the *Torres Strait Fisheries Act 1984*.
3. Traditional Owners and Native Title representative bodies have an important role in managing Torres Strait fisheries. It is important therefore that the RAG keep informed on any relevant Native Title issues arising.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14-15 October 2021
SPANISH MACKEREL STOCK ASSESSMENT Review of data inputs to support the 2021 Spanish mackerel stock assessment	Agenda Item 3.1 For DISCUSSION & ADVICE

RECOMMENDATIONS

1. That the RAG:
 - a) **NOTE** a presentation from the Spanish mackerel stock assessment project team summarising data inputs, including newly available catch and biological data, that are available for use in the scheduled November 2021 stock assessment update; and
 - b) **DISCUSS** and **RECOMMEND**:
 - (i) key data inputs available for use in the 2021 stock assessment; and
 - (ii) model analyses to calculate the Recommended Biological Catch.

KEY ISSUES

2. The AFMA funded project “*Torres Strait Spanish mackerel stock assessment with appraisal of environmental drivers*” (project number 190831) has been completed. This project delivered two updates to Spanish mackerel stock assessments to support decision making in the 2020-21 and 2021-22 seasons.
3. The outputs of the 2020 stock assessment were delivered to the FFRAG and Working Group and advice from these committees was used by the Protected Zone Joint Authority (PZJA) at their 28 January 2021 meeting to decide a Total Allowable Catch (TAC) for the present 2021-22 season (1 July 2021 to 30 June 2022).
4. The PZJA set the Torres Strait Finfish Fishery TAC for Spanish mackerel for the 2021-22 fishing season at 74 tonnes.
5. A new project “*Torres Strait Finfish Fishery Spanish mackerel stock assessment*” (project number 200815) was approved in June 2021. Under this project, the scientist will conduct an annual assessment of the Spanish mackerel stock for the next three fishing seasons: 2021-22, 2022-23 and 2023-24. This in turn will support the FFRAG in making recommendations for TACs for subsequent fishing seasons: 2022-23, 2023-24 and 2024-25.
6. The first action of the project is to provide a 2021 stock assessment (using data up to 30 June 2021) (Table 1 below). This assessment will be reviewed by the RAG, Working Group and used by the PZJA at their planned January 2022 meeting to review the TAC for the next fishing season (2022-23 season starting 1 July 2022). Should further time be required by the FFRAG, e.g. if additional meetings are required by the committee, the PZJA TAC decision can potentially be deferred to a later out of session meeting in the first quarter of 2022.
7. There are three outcomes required from FFRAG9 for the 2021 Spanish mackerel stock assessment:
 - 1) Review the data for 2021.
 - 2) Select the data treatments for 2021.

- 3) Define the stock assessment model analyses to support setting a Recommended Biological Catch.
8. Best practice in the process of undertaking a fishery stock assessment is to consider available data sources and inputs and review how they are to be used in the model. The outputs of a stock assessment model of a fish stock (such as abundance of fish) are dependent on the agreed treatments and quality of data that are put into the model (blue and orange cells in the **Figure 1** overview below).
9. As per the usual process in undertaking a stock assessment, the project team have identified a number of data treatments which require review. A summary of assessment items for the FFRAG are summarised in **Table 2**.
- New assessment items, and previous items due for further review at RAG 9 include:
- GLM influences – effects of model terms on catch rate standardisations.
 - Spawner – recruitment steepness parameter.
 - Define the data treatments (analyses) for the stock assessment model.
 - Harvest estimates pre 1988 (Figure 2 below). RAG to discuss, and either agree to apply same assumptions as 2020 stock assessment, or amend if new information is available.
10. The project team are seeking RAG views on confirming how to treat these data as inputs into the model ahead of the 2021 stock assessment update which will be presented at the FFRAG 10 meeting on 18 November 2021.
11. The project team are seeking RAG views on reviewing the number of model runs performed in the 2021 assessment (recall that a range of **nine** specific agreed model analyses with a range of treatments/factors were presented in 2020 to support setting a Recommended Biological Catch) – **See Table 4 in background section**.

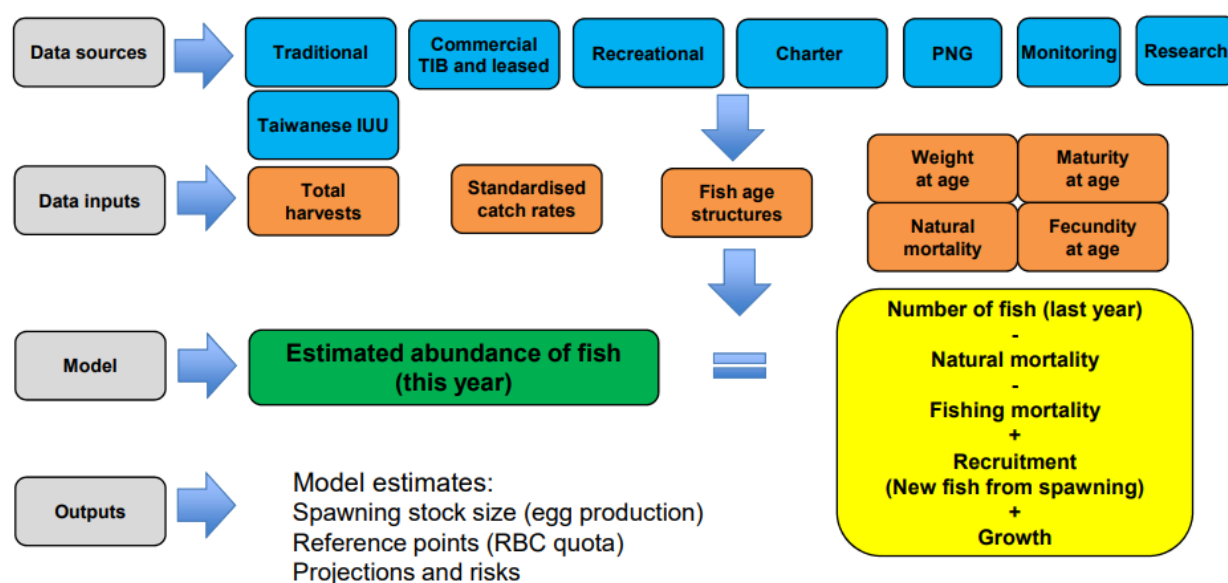


Figure 1. Overview of components of the 2020 Spanish mackerel stock assessment. *Source: Michael O'Neill QDAF presentation to FFRAG 8, 2020.*

PLAN OF ACTION

1) *Review the data for 2021.*

- The 2021 stock assessment will utilise data from the stock assessment in 2020 (**Table 1**). Pending any new advice from the RAG, the 2021 assessment will follow RAG advice given at FFRAG 7 2020, and will introduce new data which is now available. ***Refer to BACKGROUND section below for a summary of data input decisions reviewed by the RAG at FFRAG 7 (8th Oct 2020).***
- **Inputs into the 2020 stock assessment** included:
 - i. Catch and effort data from Sunset sector fishers Daily Fishing Logbooks (TSF01) from 1989 to June 2019.
 - ii. Catch data, and some limited effort data, from the Fish Receiver System (Catch Disposal Records (CDRs) – TDB02).
 - iii. Biological sampling data from the QDAF Long Term Monitoring Program 2000 to 2003 including length, sex and ageing data.
 - iv. Meteorological data including wind strength, wind direction and lunar phase.
 - v. 2019-20 season length, sex and ageing data from the funded project “*Torres Strait Finfish Fishery: Coral Trout and Spanish Mackerel Biological Sampling*”. The project provided 1592 length frequency measurements and ageing data from 255 fish for 2019-20 season.
 - vi. 2005 length measurements and ageing data from an older JCU sampling project.
 - vii. Older biological sampling data as summarised in **Table 1** below.
- **Newly available data** for the 2021 stock assessment include:
 - i. 2020-21 season length, sex and ageing data from the funded project “*Torres Strait Finfish Fishery: Coral Trout and Spanish Mackerel Biological Sampling*”. This project provided **2304 length frequency measurements** and **ageing data from 296 fish** for the 2020-21 season.
 - ii. 2020-21 season catch and effort data from TSF01 Daily Fishing Logbooks (Sunset sector only)
 - iii. 2020-21 Fish Receiver System catch data from TBD02 Catch Disposal Records (Traditional Inhabitant Boat sector and Sunset sector)

2) *Select the data treatments for 2021.*

- The 2021 stock assessment will lead on from data treatments selected for the 2020 stock assessment. Pending any new advice from the RAG, the 2021 assessment will follow RAG advice given at FFRAG 7 2020, and will introduce new data assessment items to review. ***Refer to BACKGROUND, Sections 1, 2 & 3 below for a summary of data treatment decisions reviewed by the RAG at FFRAG 7 (8th Oct 2020).***

- New data treatment assessment items for review in 2021 are:
 - i. GLM influences – effects of model terms on catch rate standardisations.
 - ii. Spawner – recruitment steepness parameter.

3) Define the stock assessment model analyses to support setting a Recommended Biological Catch.

- The project team are seeking RAG views on reviewing the number of model runs performed in the 2021 assessment. See **Table 3** for the model runs presented at FFRAG 8 (4-5 Nov 2020) to support setting a Recommended Biological Catch. **Refer to BACKGROUND, Section 4 below for a summary of stock assessment model decisions reviewed by the RAG at FFRAG 7 (8th Oct 2020).**

Table 1. History of Torres Strait Spanish mackerel biological sampling programs. *Source: Michael O'Neill QDAF.*

Fishing year	Data source	Description
1974-75	DAF, Qld.	Survey of Fisheries Resources - Torres Strait, 1974. Length data only from the commercial Sunset sector.
1978-79	DAF, Qld.	The Fisheries Research Branch undertook biological age-length sampling of Spanish mackerel, from the commercial Sunset sector. Fork length (FL, in cm), total weight (to the nearest 0.1 kg) and sex were recorded and otoliths sampled at sea from catches by commercial troll-fishing vessels from northern-stock fish at Bramble Cay in Torres Strait (McPherson 1992).
1983-84	DAF, Qld.	A FIRTA-funded pilot tagging program was conducted by the Fisheries Research Branch in Torres Strait. Only five tag returns were reported after 10 years. Length data only.
1998-99, and 1999-00	DAF, Qld.	Sampling conducted via a stock definition study conducted in Torres Strait in 1998 and 1999. Length data only from the commercial Sunset sector. A current FRDC study investigating the stock integrity of Spanish mackerel in northern Australian waters using otolith microchemistry, genetic and parasite techniques has indicated that there are possibilities of distinct assemblages of fish between Torres Strait and Western Australia. Sampling for this stock definition study was conducted in Torres Strait in 1998 and 1999.
2000-01 2001-02 2002-03	DAF, Qld.	Collected biological information of fish age, length and sex data. Monitoring of the Torres Strait Spanish mackerel fishery was conducted from 2000 to 2002 and involved commercial catch sampling from Bramble Cay (DPI&F 2005). Sampling was conducted each year for 14 days in October to coincide with the timing of peak catches and spawning activity (DPI&F 2005). Monitoring ceased in 2003 when recent studies suggested that Spanish mackerel in the Torres Strait formed a discrete stock from those in the Gulf of Carpentaria and along the east coast of Queensland (Lester et al. 2001, Moore et al. 2003, Ovenden 2004, Buckworth et al. 2005). Begg et al. 2006.
2004-05	AFMA	In 2004, 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. Torres Strait sampling includes waters north of 11 degrees south, including waters in the key mackerel fishing-ground of Bramble Cay in the northeast Torres Strait. The sampling was from SUNSET fishing vessels between 25 October 2005 and 3 November 2005. Dr Brue Mapstone supplied the JCU data to DAF on 18/03/2020 under a Deed of Confidentiality.
2019-20 and 2020-21	DAF, Qld.	Final report for Torres Strait Spanish mackerel AFMA-2019/0832. Langstreth et al. 2020 and 2021. TIB and Sunset commercial sampling. Age and length.

Table 2. FFRAG list of assessment items with colour coded status.

Black font – reviewed pre-2021. Green font – reviewed 2020. Red font – outstanding.

Blue font – new items for review in 2021.

Assessment item	Status
1. Total annual harvest tonnes	
Established time series of TIB harvests	✓
Standardise AFMA and DAF data scripts	✓
Revise annual fish weights in Sunset tonnages	✓
Review harvest estimates 1940-1988	✓
Keep or adjust the 100 t Taiwanese gillnet harvest 1979-1986	✓
Assess logbook over reporting of fish harvest (paper fish)	✓
2. Standardised catch rates	
Assess all boats and subsets of boats	✓
Include annual increase in fishing power from QLD East Coast	✓
Spatially classify harvests	✓
Re-examine the number of dories reported	✓
Categorise fishing skippers and dory drivers	
Re-examine the GLM influences – effects of model terms	
3. Biology	
Using Torres Strait data	✓
Select new age frequency data	✓
Select natural mortality rates	✓
Spawner – recruitment steepness	
4. Stock assessment model	
Demonstrated methods and model to the RAG	✓
Define the data treatments (analyses) – Re-review for 2021	
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	
Retrospective analyses	

Table 3. Summary of options presented to the FFRAAG as outputs from the 1940 model runs in the 2020 Spanish mackerel stock assessment update. Yellow highlighted approaches were those considered by the RAG as potentially appropriate RBCs for recommendation.

No.	Name of RBC approach	Biomass year for the RBC calculation	% runs below S_{20} over 12 years and 6 analyses		Median
	1940-model		Assuming average recruitment	Assuming reduced recruitment	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
5	Constant F_{60}	2021-22	7%	9%	75
6	Mean of F_{48} and F_{60}	2021-22	8%	N/A	94
7	Constant F_{MSY}	2019-20	8%	12%	99
8	Constant F_{40}	2019-20	8%	12%	97
9	Constant F_{48}	2019-20	7%	9%	77
10	Constant F_{50}	2019-20	7%	9%	73
11	Constant F_{60}	2019-20	6%	8%	53

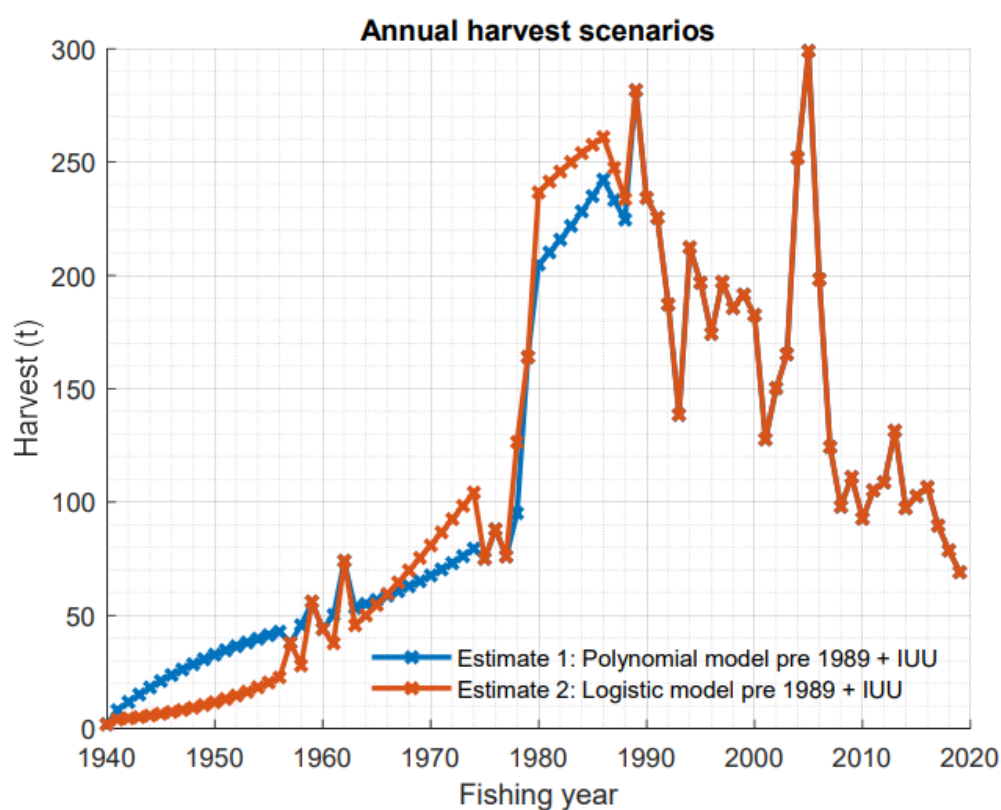


Figure 2. Example summary harvest rate data from the 2020 stock assessment. Source: Michael O'Neill, QDAF, FFRAAG 8, Nov 2020 presentation.

BACKGROUND

Extract from FFRAAG 7 meeting record 8th October 2020. Data input decisions for 2020 Spanish mackerel stock assessment.

Section 1 - Total Harvests

Revise average fish weights in Sunset tonnages

The project team sought advice from the RAG on whether to vary the current approach for assuming mean weight per fish in calculating harvest tonnages from daily fishing logbooks. The RAG noted that the model currently calculates total harvest from sunset logbooks by multiplying the number of fish reported in the logbook by a constant mean fish weight of 6.9 kg being applied to all years of catch data at present. The team proposed departing from this constant mean weight on the basis of newly available length frequency and ageing data which can now provide mean weight estimates for eleven years in the catch history (1974-75, 1978-79, 1983-84, 1998 to 2005 and 2019-20).

The RAG noted that there does not appear to be a great deal of range in the eleven different years where fish weights are now available, generally varying about one kilogram. The RAG noted an analysis showing that this new data rule would not have a significant change in the historical understanding of total harvest levels.

The RAG noted advice from Dr O'Neill on the representativeness of some of the newly available length and weight data. The RAG noted advice that the 1983-84 sampling data may have originated from a tagging study, meaning that it may, or may not, have had a different sampling methodology (e.g. might have been aiming to capture and release younger fish). The RAG noted that further investigation would occur to attempt to find the methods from this study. The RAG recommended that as a principle all available data should be incorporated into the model for now unless there was evidence to discard it as not representative.

To support the 2020 stock assessment the RAG recommended:

- **changing the constant assumed average fish weight data rule to apply a weighted-mean value to the years for which a mean fish weight was not available from catch sampling; and**
- **that the project team use total harvest values available from Catch Disposal Records (CDRs) from the 2018-19 season onwards noting these were verified weights in port.**

Review estimates of harvest tonnages 1940-1988

The RAG noted that prior to the introduction of the AFMA SM02 daily fishing logbook in 1989 that available catch and effort data for the fishery is patchy and for some sectors absent. The RAG noted the importance of developing an agreed catch history for the fishery based on the best available data, expert advice (including industry advice) and agreed assumptions. The RAG also noted that further improvements are likely over time as more information is gathered.

Attachment B summarises advice provided by RAG industry members at the meeting on historic vessels known to be operating in certain years. To assist the RAG in cataloguing these data to support future assessments AFMA proposes that this summary becomes a live document across meetings and can be updated as further investigations are carried out.

The historical harvest estimates catch series (1940-1988) recommended by the RAG at the meeting is outlined in **Table 3** below. RAG advice on data for each fishing sector is described in the following sub-sections below.

Sunset sector historic harvests

The RAG noted a table of older sunset harvest estimates from the project team based on available data from *McPherson et al.* (1986) (**Table 3** below). The project team questioned the completeness of these older data and sought advice from the RAG. It was noted that the 1957 to 1962 data was reportedly from a single boat only and that the 1975-1979 data was reportedly from the Queensland Fish Board (along with some processor data) and may not be complete. The number of boats represented in these data and operating in the fishery during these two periods is not clear.

Action item 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.

Action item 2: AFMA to request access to the logbooks of Mr Snowy Whitaker, *AFV Trader Horn* from the Townsville Maritime Museum where they are reportedly catalogued.

Action item 3: The RAG noted that the project team would consult with the author of the study that summarised these data, Geoff McPherson, out of session, that might lead to an adjustment of the figures based on advice received. Stock assessment team are to report the findings of this discussion back to the RAG.

The RAG did not recommend any changes to the historic sunset sector catches for the 2020 stock assessment noting that the project team would be seeking further advice from retired scientist Geoff McPherson out of session.

'TIB' sector historic harvests

RAG Traditional Inhabitant industry members recommended that the catch history should be amended to reflect a zero catch for the 'TIB' islander commercial catches prior to 1975, noting that island infrastructure did not exist prior to this time to support islander commercial fishing. Industry also advised that any active Traditional Inhabitant fishers prior to 1975 were likely working on non-indigenous boats.

Industry members were satisfied with the TIB harvest data and suggested for the project team to conduct further checking of older island freezer data to make sure it was reflected in the more recent harvests time series after 1989.

On the basis of the advice from the Traditional Inhabitant industry members, the RAG recommended the table of catches be amended to reflect zero tonnes of harvest from the TIB sector prior to 1975 as an input to the 2020 stock assessment model. The RAG supported the assumption of 3 t harvest to be input into the model per year for TIB sector from 1975 to 1988.

Traditional fishing

The RAG noted advice from Traditional Inhabitant industry members that the assumed figures for subsistence catch of Spanish mackerel appeared to be too high at 10 t per year. It was considered that, prior to the growth of the TIB commercial fishing sector, catches of Spanish mackerel for subsistence purposes were likely to be rarer or incidental while taking other species. Industry members advised that once more TIB fishers were out targeting mackerel for commercial purposes from the 1970s, catches of the species for subsistence would have also increased.

The RAG accepted this advice as the best available information and agreed to recommend that the traditional harvest of mackerel be revised from 10 t down to 2 t prior to 1975 as an input to the 2020 stock assessment model.

Recreational harvests

The RAG noted the 2 t estimate for recreational catches is based on modern QDAF led survey techniques and is applied consistently across all years as an input into the model. The RAG had no basis to deviate from this approach.

The RAG therefore recommended maintaining a 2 t recreational take of Spanish mackerel for all years in the 2020 stock assessment model.

Options for connecting the older historical catch data with the modern logbook time series.

The project team presented the RAG with four options (logistic, polynomial, log-linear and weighted mean) available to fit the assumed total harvests in the model to the pre-1989 data points of harvest estimates available from older sources (1957-1962 data from a single boat and 1975-1979 data from the Queensland Fish Board and some processors).

RAG scientific members advised that the log-linear and weighted-mean models should be disregarded as these approaches placed too much emphasis on the older uncertain points (1957-1962 and 1975-1979) in the time series.

Based on this advice the RAG recommended that both the logistic and polynomial approaches should be used as inputs to the 2020 stock assessment as they appeared to fit the available data historic data points well.

Table 3. *Summary of RAG advice on harvest estimates 1940 to 1988 to support the 2020 stock assessment. Yellow highlighted cells represent changes made from the 2019 assessment based on RAG advice.*

Year	Label	'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

Taiwanese Illegal, Unregulated, Unreported (IUU) harvests

The RAG noted that part of the historical catch series is the assumed harvest from Taiwanese drift-gillnet vessels reportedly operating across northern Australian from the late 70's, 80's and into the early 90's, with incidents, pursuits and apprehensions occurring through this time period. The RAG recalled a decision made in the 2019 assessment to inflate the time series of total harvests by 100 t for the years 1979 to 1989 to include this estimate of mortality on the stock in the model.

The RAG noted a presentation from Rik Buckworth (**Attachment D**) summarising known reports and information to support the inclusion of these data. The team sought RAG views on, continuing to account for possible IUU catches and if so, on the likely duration and magnitude of these harvests.

The RAG agreed:

- there was a sufficient weight of evidence to show that IUU fishing of Spanish mackerel did occur. This was chiefly based on the 1992 *Joint Advisory Council* advice of an apprehension of a drift net boat with a large quantify of catch in its hold and reported take of mackerel in March 1992 and reports from *McPherson 1986*.
- that the IUU catches should be accounted for in the stock assessment. If IUU catches are not accounted for, the stock assessment may overestimate the current biomass estimate through time which could then lead to over-harvesting.
- for the time series of harvests from Taiwanese IUU to be extended from 1986 to 1992-93 and to taper the catch down to zero by this point (i.e. extending harvest into 1990, 1991, 1992 reducing to zero tonnes to blend into the existing time series by 1993). Tapering was agreed based on the assumption that IUU fishing decreased as the presence of Australian fishing boats on the fishing grounds increased.

Section 2 – Standardised catch rates

Review of the number of dories reported in logbooks

The RAG noted that the stock assessment is run a number of times with different parameters (model runs) to examine how the model responds and to gauge for possible uncertainty in data which is put into the model. One issue being examined in the stock assessment update in 2020 is the available data on the number of dories used by a primary boat.

In the 2019 assessment some model runs included the dory number data while others excluded it. The RAG was asked to review the data on dory numbers and provide advice on how it should be treated in the next assessment noting uncertainties associated with some of these data.

The RAG noted that from 1989 to 2003 the reported number of dories were low, with data suggesting that a lot of boats reported 'zero' dories. The RAG queried whether the earlier year reports were 'null' values with no reporting conducted or whether they were actually reported by the operations as 'zeros' meaning the boats actually did not have any dories. The RAG noted

industry reports that dories were common through the recent history of the fishery (e.g. Tony Vass was fishing from 1990 to 2007).

The RAG considered that, in general, this data-set was unreliable and might be due to older logbooks (e.g. Queensland State 'LN' Daily Fishing Logbook and AFMA SM01 and SM02 which were used prior to the introduction of the present TSF01 logbook in 2003) used to collect catch and effort data may not have had a designated space for recording the number of dories fished.

RAG technical members advised that while the number of dories fished was likely to be an influential factor, the standardisation does take account of vessel effects, which would go some way to accounting for this variation within operations and between seasons.

Based on this advice, the RAG recommended not including the factor of number of dories in the 2020 stock assessment until further fact finding and investigation on the older data could be conducted.

Fishing power

The RAG reviewed the inclusion of the 'Fishing Power' effect (FP) on the time series of catch rates. The RAG noted that FP was the steady increase of the ability of an operation to catch fish based on improvements in gear and technology, such as echo sounders and Global Positioning Systems (GPS). The RAG noted that the previous 2019 assessment model runs both included and excluded FP as a factor. The project team was seeking RAG advice about whether to include FP, exclude FP, or present model runs with both options.

The RAG noted that the FP in the Torres Strait model was a calculation carried over from the Queensland East Coast stock assessment and, if applied yearly, would mean about a 23 per cent increase in FP from 1989 to present (0.955 to 1.187). The RAG noted advice from industry that prior to 1989 no one had GPS units, but by the mid 90's this technology was common across the fleet; meaning that FP has indeed been changing across the time series.

Based on this advice the RAG recommended that, for the 2020 stock assessment, fishing power should be included as a factor in the model in all model runs i.e. no model runs will be performed excluding FP.

Traditional Inhabitant Boat sector catch rates

For information only, the RAG noted that the upcoming assessment would present the first two points on the CPUE series. The RAG members commended the TIB industry for collecting this voluntary catch and effort data and welcomed the intention to further build this series over time.

The RAG noted that the TIB data points appeared to be in contradiction to the sunset catch rate series with the 2019-20 season catch rate lower than 2018-19. However, it was noted that 2018-19 may have been an outlier with very good catch rates and weather and that 2019-20 season had generally poor weather coupled with community freezers not being in operation.

Section 3 – Biology

Select fish age-frequency data

The RAG noted that the 2019 assessment only had fish ageing and length frequency data from QDAF led biological sampling from the years 2000 to 2005. The project team advised that RAG that a range of older fish ageing data (11 years in total) was now available from older research projects for possible inclusion as inputs to the 2020 stock assessment, based on RAG views on the usefulness of these new data.

The team advised that a potential issue with these data is that, for each year of sampling, data may have come from a different research project and may have different sampling methods, and may or may not be fully representative of the fishing effort. For example, the 1983-84 data were reportedly from a project that was attempting to target fish for tagging projects and might have been aiming to capture younger, smaller, stronger fish that would live for years and possibly be recaptured in future.

The RAG recommended that, on principle, all available ageing data should be incorporated into the model for now, unless there was evidence to discard it as being not representative. The RAG noted that future work may revisit these samples and that further information on the methods for these research projects that collected the data, may become apparent. But the RAG was comfortable using the data for now, noting that it does not appear to change drastically from year to year.

Finfish RAG recommended that all eleven years of available fish age and length data (Figure 1 below) should be included as inputs into the 2020 stock assessment.

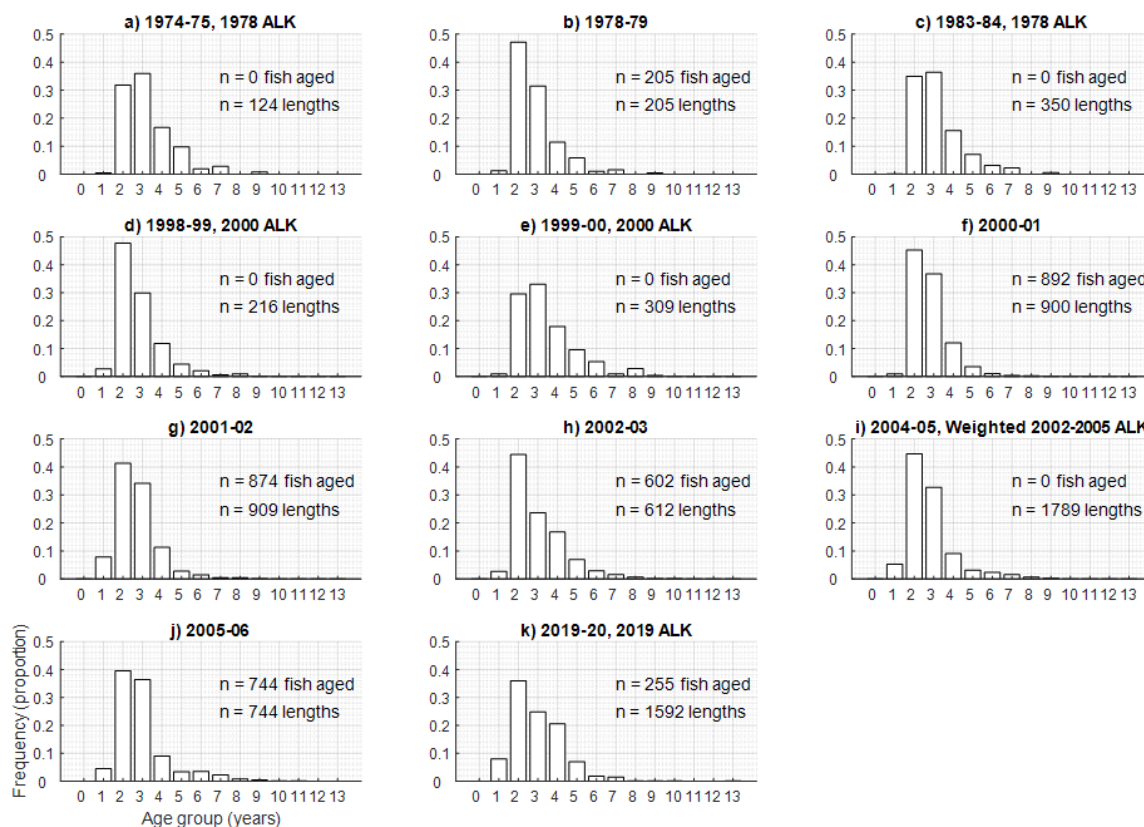


Figure 1. Age and length data for Torres Strait Spanish mackerel recommended by Finfish RAG for inclusion in the 2020 stock assessment.

Natural mortality rate

Prior to the 2019-20 round of biological sampling the oldest fish from Torres Strait ageing data (from 2000 to 2005 sampling rounds) was known to be 12 years old. The RAG noted that, with updated sampling information from 2019, it was now known that the oldest fish measured from Torres Strait was 13.5 years and that this data could be used to inform estimates of natural mortality rate of the stock (M). The RAG noted that an analysis could be performed (the *Then et al.* methodology¹) to give an indication of what a value for natural mortality might feasibly be based on information from hundreds of different fish species. Applying this methodology to the Torres Strait Spanish mackerel stock resulted in an estimation of $M=0.45$.

Some consideration was given by the RAG to the range of M values of 0.25, 0.35 and 0.45 as an alternative. But these were not recommended by the RAG as it was considered that 0.25 was likely too low of an estimate for M (based on not having any older fish in the age-sampling data, oldest fish of 13.5 years, not 20 years like the Queensland East Coast sampling data) and would likely result in an overly conservative population estimate.

Based on this advice the RAG recommended that the 2020 assessment model conduct model runs reusing the Natural Mortality (M) value of 0.3 from the 2019 stock assessment

¹ Then, A. Y., Hoenig, J. M., Hall, N. G., and Hewitt, D. A. 2015. Evaluating the predictive performance of empirical estimators of natural mortality rate using information on over 200 fish species. *Ices Journal of Marine Science*, 72: 82-92.

(which was considered as a good logical lower value estimate), 0.45 as a higher range estimate (based on the *Then et al.* methodology) and also recommended using an M of .375 as a mid-point model run. RAG recommended M values of 0.3, 0.375, 0.45 be used in the 2020 assessment².

Section 4 – The stock assessment model

Based on the RAG's advice on each data issue above, the RAG noted and agreed that nine separate model runs would be undertaken in coming stock assessment. The factors for each of the eight model runs is described in **Table 4** below.

The RAG noted that the project team would be meeting with retired Torres Strait Spanish mackerel scientist Geoff McPherson out of session during the week of 12-16 October 2020. This meeting would investigate and advise the team on whether to add an additional set of model runs with any adjusted figures (*McPherson actual catch history data* or *McPherson adjusted catch history data*) based on Mr McPhersons' advice.

Should these model runs be conducted, the RAG noted that **Table 4** would be expanded to 15 model runs to encompass this extra factor for consideration (an additional six runs might be performed as per runs 1-6 below but with adjusted historic catch data rather than actual).

Table 4. Analyses / model runs agreed by the RAG for the 2020 assessment.

Label	Fish weights	Catch rate series	Natural mortality rate (M)	Harvest pre-1989	Ageing data	Start year for data
1	Weighted average	No tenders and fishing power included	0.3	Historic catches actual + polynomial model + IUU tapered	All years	1940
2	Weighted average	No tenders and fishing power included	0.375	Historic catches actual + polynomial model + IUU tapered	All years	1940
3	Weighted average	No tenders and fishing power included	0.45	Historic catches actual + polynomial model + IUU tapered	All years	1940
4	Weighted average	No tenders and fishing power included	0.3	Historic catches actual + logistic model + IUU tapered	All years	1940
5	Weighted average	No tenders and fishing power included	0.375	Historic catches actual + logistic model + IUU tapered	All years	1940
6	Weighted average	No tenders and fishing power included	0.45	Historic catches actual + logistic model + IUU tapered	All years	1940

² Note that following FFRAG 7 the project team attempted to get the model to run using the RAG suggested M values of 0.3, 0.375, 0.45. As the model had issues running with the upper 0.45 value members were advised out of session that the values of 0.3, 0.35 and 0.4 would be used as an alternative. See **Attachment E** for the values used as inputs into the assessment.

7	Weighted average	No tenders and fishing power included	0.3	n/a	All years	1989
8	Weighted average	No tenders and fishing power included	0.375	n/a	All years	1989
9	Weighted average	No tenders and fishing power included	0.45	n/a	All years	1989

Method for calculating RBCs

The RAG noted that a time lag existed between the point for which catch data was available, the running of the stock assessment and the setting of a sustainable catch limit for the next season in advance of this time (**Figure 2** below). RAG advice was sought on maintaining the current approach or adopting a different method that forecast the RBC in the fishing season. The RAG noted that there is no single policy approach and that a number of important assumptions need to be agreed for the later approach. They include assumptions on the level of recruitment and catch expected in the future years.

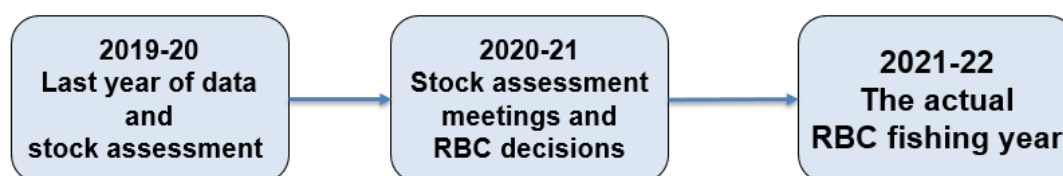


Figure 2. Illustration of the 12 month lag between available information and setting of a sustainable catch level.

Members noted that in the Southern Eastern Scalefish and Shark Fishery (SESSF) that the method for calculating RBCs varied. But for key species, where appropriate, a forecast was made of what the likely mortality would be in the intervening year and this was used to adjust the RBC accordingly. It was also noted that many SESSF species were managed under multi-year TACs and did not have assessments run every year.

The RAG recommended that forecasting should be developed and adopted as a best practice method for the TSFF. The RAG noted that, as an option, it could be assumed for Spanish mackerel that the entire sunset sector available TAC would likely be caught in the intervening year and a running average value of harvests could be used for the likely TIB sector catches (noting a higher value is put aside to support expansion of fishing effort).

Action item 4: AFMA to arrange an out-of-session meeting with the SESSF RAG chair and the Spanish mackerel stock assessment project team to discuss and report back to the RAG on options for setting an RBC using a forecasting method.

RBC decision tables

The RAG noted the approach used in the 2019 assessment, where a range of target reference point fishing mortalities were considered in recommending an RBC (F MSY, F 40, F 48, F 60), with the median value of all agreed model runs being used to select the RBC. It was also noted that the risk in setting an RBC was considered in terms of the number of model runs that would drop the stock below the default limit reference point of B20 (20 per cent of unfished biomass) over 12 years and 20 years (being three and five times respectively the average age of full maturity, 4 years). In 2019 the RAG also considered runs with a mean level of recruitment or a

depressed level of recruitment. The RAG recommended continuing this same approach for the 2020 assessment to maintain consistency.

Extract from FFrag 8 meeting record 4-5th November 2020. (RBC advice from the FFrag)

Agenda Item 3 – Stock assessments and RBC advice

3.1 Updated Spanish mackerel stock assessment 2020

The FFrag reviewed a presentation on Spanish mackerel stock assessment and model predictions (**Attachment A**). The presentation reported results up to the 2019-2020 fishing year, including information to review good analysis fits to all model data inputs. The RAG noted advice that, with newly available data, the model results now show an increase in catch rates and modelled recruitment. As a result, the model shows that the abundance (spawning biomass) of Torres Strait Spanish mackerel has increased since the last assessment performed in 2019.

The stock assessment

The RAG noted:

- a) that the stock assessment was based on the same annual age structured model (referred to as the 1940 model) as the last 2019 assessment, which uses all available harvest, catch rate data and fish age-frequency data. The update to this model included an additional year of harvest data (fishing year 2019-20) and an additional eight years of age-frequency data (this includes historical³ age-frequency data);
- b) that treatments to all data inputs into the assessment were applied in line with recommendations from FFrag 7 ([data meeting 8 October 2019](#)). This included advice on reconstructing a catch history for the fishery prior to 1989, including harvests for Illegal, Unreported and Unregulated foreign fishing, treating standardised catch rates (tender data to be excluded, fishing power to be included) and advice on using all newly available fish age-frequency data as inputs;
- c) in line with FFrag recommendations, nine specific agreed model analyses were performed rather than the 35 model scenarios run for the previous 2019 stock assessment update (summary table at **Attachment C**). Six of these model runs were for the 1940 model and three model runs were for the alternative exploratory model referred to as the 1989 model;
- d) the exploratory 1989 model was developed and investigated by the project team in line with recommendations from FFrag7. The purpose of this investigation was to examine whether the model would be informative if it only included data from the time when compulsory Sunset logbook data reporting commenced. That was from 1989;

³ Newly available age-length data for analysis included: 1974-75, 1978-79, 1983-84, 1998-99, 1999-00, 2004-05, 2005-06 along with the new year of data from 2019-20 season.

- e) confidence intervals were calculated to show the uncertainty of each analysis over 1000 simulated model runs. This was achievable in this assessment round, partly because more time was available due to the reduced number of model scenario runs requested.

Having considered the results of the 1989 model and advice from all scientific members, the RAG agreed that the 1989 model remained exploratory but worthy of further development overtime (refer to more detail below on the 1989 model). The RAG agreed that the 1940 model run provided the most reliable assessment of the stock and an acceptable basis to evaluate the status of the stock and to calculate a Recommended Biological Catch (RBC) for the 2021-22 fishing season.

The stock assessment results

Based on the six agreed 1940 model runs, the RAG noted that the results of the updated 2020 stock assessment show:

- a) The estimated 2019-20 median spawning biomass of Torres Strait Spanish mackerel was 30% (B_{30}), ranging between 26% (B_{26}) and 35% (B_{35}), of unfished biomass in 1940 (B_0). This represents a seven percent increase from the 2019 estimated spawning biomass for 2018-19 of 23 (B_{23}) percent (ranging between 14-37%) of unfished biomass in 1940 (B_0);
- b) None of the median biomass estimates from the six model scenarios were below the agreed limit reference point (B_{LIM} is defined as 20% of the 1940 biomass level ($0.2 \times B_0$)) although the lower confidence intervals of some model runs were below B_{LIM} ;
- c) Unlike the declining trend since 2009-10, the standardised catch rate (number of fish per operation day) of legal-sized Spanish mackerel, using logbook data from Sunset fishing operations, increased in 2019-20 (a statistically significant increase);
- d) Age-frequency data now available from 2019-20, shows estimates of recruitment have returned to around the average;
- e) Recent fishing pressure is not exceeding F_{MSY} (the harvest rate for Maximum Sustainable Yield (MSY) from the stock). This means overfishing is not occurring.

RAG considerations

- a) **1989 exploratory model:** From previous assessments, it was noted that results were dependent on the estimated annual harvests prior to 1989. This pre-1989 harvest data was estimated from a mix of historical fisher and Queensland fish board reports, plus a level of assumed Illegal, Unregulated and Unreported Taiwanese gillnet harvests. FFRAG suggested that the project team investigate the exclusion the pre-1989 harvest data, to test if the model could function with just the modern data set (1989 to present).

The project team performed this work and advised that the 1989 model runs were not able to produce consistent and meaningful results without some prior information being set in the model. The analyses highlighted a need to define bounds on the pre-1989 harvest rates, and results were influenced to whether the pre-1989 age length data were included.

The RAG agreed that 1989 model was a good approach in principle but has limited value at this time and requires further development. The project team advised that further development work was required on the model settings prior to 1989 (these are known as the 'prior' terms).

It was advised that when model aspects and settings are clearer, the RAG might expect to see more consistent comparisons between the 1989 and 1940 models. Only then and after FFRAG review, should this alternate model be included in the range of results used to set a median RBC.

- b) **‘Paper’ fish:** The project team reminded the RAG of the initial examination carried out in 2019 into the effect of possible over reporting of Sunset catch, ahead of the 2007 industry buyout. The 2019 stock assessment tested certain high points in the harvest data series. It was reported that adjusting the high points down had little effect on the outputs of the model biomass trends (see 2019 FFRAG power point report).
- c) **Hyper-stability in catch rates:** The project team advised that historical catch rates are not stable, but varies overtime with an evident pattern. This suggests that hyper-stability may not be an overpowering factor in the available data, and that increases in fishing power are considered each year. Nevertheless, noting that the fishery mostly targets the Bramble Cay spawning aggregation, the RAG agreed that further investigation is still warranted into this issue;
- d) **Retrospective analyses:** The project team noted RAG advice that performing retrospective analyses, whereby the model works backwards through time in a stepwise manner to test how the model performs, will be a powerful tool for examining how well the model performs. The team advised that this has not yet been actioned but would attempt to include this analysis in the final report;
- e) **Environmental factors:** The RAG noted advice from the project team that environmental factors have not been incorporated into the assessment for FFRAG 8. The RAG agreed that this work remained a high priority to understand the factors for consideration in RBC settings.

3.2 Spanish mackerel RBC for 2021-22

Selecting an appropriate RBC calculation method

To guide advice on an RBC for the 2021-22 fishing season, noting there is no agreed harvest strategy in place for the Torres Strait Finfish Fishery, the FFRAG considered a range of RBC calculations. These are described in **Table 2** and outlined below.

In forming their RBC advice, the FFRAG:

- a) considered five different constant (non hockey-stick) harvest rates applied to the six results from the 1940-model. Each level of harvest rate related to building the stock to different target reference points (F_{MSY} through to F_{60});
- b) agreed to forecast the stock biomass to the 2021-22 fishing season based on an assumed level of harvest in 2020-21 (55 t = 39 t sunset, 4 t TIB harvest (based on the mean of the past three TIB fishing seasons), 10 t subsistence, 2 t recreational and 0 t for charter catches) and assuming average recruitment occurring. Therefore the RAG discounted approaches based on the 2019-20 estimate of biomass (Table 2, Approaches 7, 8, 9, 10 and 11);

- c) agreed to assume average, rather than depressed recruitment in future fish population risk-projections. Unlike the findings from last stock assessment, the most recent recruitment deviations for each of the model runs were all positive (**Attachment C**). The RAG therefore agreed there was insufficient basis to assume below average recruitment in the future projections. Therefore the RAG discounted all approaches that assumed reduced recruitment (Table 2, Column 5);
- d) reviewed fish population projections to evaluate risk to the stock. Consistent with the 2019 approach used by the RAG, it was agreed to consider how many years in a model run and simulation the stock would drop below the limit reference point (B_{20} or 20% of the unfished spawning biomass level in 1940) during a 12 year-time period (three times the age of full sexual maturity)⁴. The RAG agreed, in line with the *Commonwealth Harvest Strategy Policy*, that if more than 10% of model runs (based on over 1000 simulations), dropped the stock below B_{LIM} that this would represent unacceptable risk to the stock. Therefore the RAG discounted approaches which represented unacceptable risk to the stock (Table 2, Approach 1 Constant F_{MSY} and Approach 2, Constant F_{40});
- e) considered industry member advice at the meeting and the principles recommended by industry for developing a harvest strategy for the fishery to be conservative by '*hastening slowly*' and by '*banking*' fish if the biomass is increasing. A summary of the guiding principles is in **Attachment D** (as tabled at FFRAG 5). Therefore the RAG discounted Approach 3 (Constant F_{48}) with an RBC calculation of 112 t as this represented too great of an increase in RBC over the 2019-20, 71 t RBC level. Likewise, the RAG discounted Approach 5 (constant F_{60}) with an RBC calculation of 75 t as it offered little increase from the current season 71 t RBC noting that the assessment outcomes did suggest an increase in RBC was warranted based on improvements in CPUE and modelled recruitment;
- f) noting that 75 t RBC (constant F_{60}) was considered too low, and 112 t RBC (Constant F_{48}) was considered too high the RAG requested the project team to present a compromise approach of an RBC based on the mean point between F_{48} and F_{60} . This approach (Table 2, Approach 6) would represent an RBC of 94 t;
- g) reviewed fish population projections for 105 t and 94 t harvests to evaluate the likelihood of the stock building to B_{48} over the 12 year projected time period (three times the average age of sexual maturity) projection graphs considered are at **Attachment E**;
- h) The RAG considered B_{48} or B_{50} to be a sensible interim target reference point, noting that B_{48} is the default proxy for B_{MEY} when no economic data are available (under the *Commonwealth Harvest Strategy Policy*). B_{MEY} measures the biomass of fish to yield the sustainable maximum-economic-yield (MEY) from the stock. B_{MEY} also relates to the long-term aspirational target reference point of B_{60} recommended by industry under the harvest strategy work completed to date (see **Attachment D**).
- i) The RAG noted that only one of the six 1940-model runs would be reaching the reference point of B_{48} (with a constant harvest of 105 tonnes) after 12 years. Therefore, the RAG discounted the approach labelled 4 (Constant F_{50}) as although the harvest

⁴ The RAG reviewed and agreed to the rationale of the 12-year timeframe being three times the full age of maturity i.e., based on age-length information by four years of age most fish are fully mature and contributing to the stock.

poses acceptable risk to the stock, this level of harvest will likely not build the stock to the interim B_{48} target reference point within 12 years. However, the constant harvest of 94 t did build the stock to B_{48} by 12 years.

RBC advice

In line with the agreed RBC calculation method described above of removing less appropriate RBC options (summarised in Table 2 below), **the RAG recommended** a 94 tonne RBC for Spanish mackerel for the 2021-22 season. The RAG agreed that this RBC:

- a) is based on the application of a constant harvest rate equivalent to the mean point between F_{48} and F_{60} to the estimated biomass in the 2020-21 fishing season;
- b) would build the stock on average to the interim target reference point (for F_{48}) within a reasonable timeframe of 12 years (three times the age of sexual maturity) and assuming average recruitment to be occurring (**Attachment E**);
- c) poses an acceptable low risk of the stock falling below the limit reference point (less than 10% of model runs and simulations dropping the stock below 20% of unfished spawning stock biomass in 1940); and
- d) reflects the preference of industry members to have a harvest strategy that is balanced and careful by '*hastening slowly*' by '*banking*' fish if the biomass is increasing.

Table 2. Summary of options presented to the FFRAG as outputs from the 1940 model runs in the 2020 Spanish mackerel stock assessment update. Yellow highlighted approaches were those considered by the RAG as potentially appropriate RBCs for recommendation.

No.	Name of RBC approach	Biomass year for the RBC calculation	% runs below S_{20} over 12 years and 6 analyses		Median
	1940-model		Assuming average recruitment	Assuming reduced recruitment	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
5	Constant F_{60}	2021-22	7%	9%	75
6	Mean of F_{48} and F_{60}	2021-22	8%	N/A	94
7	Constant F_{MSY}	2019-20	8%	12%	99
8	Constant F_{40}	2019-20	8%	12%	97
9	Constant F_{48}	2019-20	7%	9%	77
10	Constant F_{50}	2019-20	7%	9%	73
11	Constant F_{60}	2019-20	6%	8%	53

RAG consideration: Forecasting an RBC for the fishing season ahead

The FFRAG noted advice from the project team that a lag existed between when the data was available to support the model (30 June 2020), when the stock assessment was considered (November 2020) and when the RBC takes effect on the stock (2021-22 fishing season). AFMA advised that common practice in other AFMA managed fisheries to address this issue was to set an RBC based on what the stock was predicted to be a year in advance of when data was available, and to assume the full TAC was to be taken along with average recruitment occurring in the intervening year. It was noted that this was the general approach but RAGs would deviate from it if evidence existed to do so.

The project team advised that outputs from the stock assessment model had been prepared as an option that would assume that the 2019-20 fishing season had proceeded with average recruitment (based on the stock recruitment curve), removing natural mortality and removing predicted fishing mortality (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). Based on this additional year of information the model can produce a forecast for the level of biomass and RBC for 2021-22.

The RAG noted project team advice that, as Spanish mackerel recruits need two years of growth before they enter the fishery, the assumed recruitment within the forecast period will have very little effect on the constant F RBC outputs.

Estimating non-commercial catches

The Finfish RAG reviewed the available information to support estimates of non-commercial catches available to the PZJA in setting a Total Allowable Catch from the RBC. The RAG noted advice from Dr O'Neill and the Chairperson that the QDAF recreational fishing for 2019-20 had

concluded however, the survey did not sample the Torres Strait to form a meaningful estimate of recreational catches for the region.

The RAG noted that 10,000 kg of catch estimated for subsistence catch by Traditional inhabitants, at 7.3 kg average weight per fish (based on the most recent biological sampling), would represent 1400 fish from all communities. This roughly translates to an average take of a few hundred fish from each Torres Strait community per year. Applying the same average weight, the previously assumed two tonne catch⁵ for recreational fishing represented around 280 fish.

Industry members and the TSRA member considered that both the subsistence and recreational estimates were a likely underestimate for the coming season.

- The TSRA member advised that, based on consultation on the Waphill trainee project, fishers in eastern communities are reportedly catching good numbers of Spanish mackerel for subsistence. The TSRA member has been advised by fishers that Spanish mackerel is not being sold due to the current lack of infrastructure.
- Industry members advised that along with having periods of good catches, many eskies of frozen Spanish mackerel are regularly shipped south to friends and family and are also used as barter/trade in communities. By way of example, industry members advised that within one community over the last three weeks, around eight boats have been fishing twice daily and landing 5-7 Spanish mackerel each fishing session per boat.
- Industry members were of the view 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.
- Industry members advised that along with the rollout of fisheries infrastructure in the near future there is a likelihood that with more fishers commercially targeting mackerel, more catch will be retained also for subsistence.

The RAG discussed the potential for recent observations to cause bias in the perception of seasonal trends, noting earlier advice from industry that there had been limited fishing most of the year due to poor weather. An industry member also commented that Spanish mackerel was not a preferred subsistence species with communities preferring species like Siganids (rabbitfishes) instead. However, on balance, the RAG accepted member advice that the previous estimates were likely an underestimate and, in line with the objectives of the Treaty, traditional fishing needed to be protected and have priority over harvesting for commercial purposes.

The RAG recommended increasing non-commercial catch estimates for Spanish mackerel for calculating TACs for the 2021-22 season (that is reducing the RBC by the total estimate to derive the TAC). Increases were recommended from 10 tonnes for subsistence to 15 tonnes and from 2 tonnes for recreational to 5 tonnes. Consistent with previous years, the RAG agreed that charter fishing catches were likely to be minimal and accepted AFMA advice that Australia and PNG were unlikely to enter into catch sharing arrangement under the Treaty in 2021-22 fishing season. Both were subsequently left unchanged for the 2021-22 fishing season.

⁵ The Spanish mackerel stock assessment team advised that the model used the 2013 point estimate of 2 t for recreational sector harvest with error bars ranging from 2-4 t (the model alternates between 2, 3 or 4 tonnes).

Agenda item 3.3 Coral trout recommended biological catch

The RAG recommended maintaining the coral trout TAC at 135 t for the 2021-22 season noting:

- a) catches remain low in the fishery (catches for the 2019-20 fishing season were 32.34 tonnes);
- b) the preliminary stock assessment undertaken in 2019 indicated that the stock biomass is likely to be high (the preliminary stock assessment estimated the biomass to be around 80 percent of estimate virgin biomass (B_0), with all of the model estimates of spawning biomass being above B_{65});
- c) although there is the potential for catches with further fisheries infrastructure development under TSRA funded programs, industry members did not forecast significant increases by 2021-22 fishing season; and
- d) it was not a priority at this time to estimate catches taken outside the fishery. However, the RAG recommended that AFMA under work next year to support RAG consideration of likely catches ahead of the following fishing season.

The RAG re-iterated that the data priority for the fishery remained as, improving the accuracy of catch and effort data (for example reporting catches by species rather than a basket of the four trout species) and biological sampling.

Noting that the fishery has remained under-utilised for some time, the TSRA member sought RAG advice on what information is needed to support a more accurate/reliable stock assessment which could then be used to adjust the TAC. The RAG noted that the research priorities to address gaps in the preliminary stock assessment were identified by the RAG in 2019. The priorities being to undertake further habitat mapping work, analyse the mid-90s CSIRO dive survey data, improve catch and effort data from TIB fishers and collect fishery independent data, such as an underwater survey and/or biological sampling.

The RAG noted previous advice that there a significant advantage to undertaking a fishery independent dive survey of abundance prior to any significant fishing pressure being applied. Such a survey would act as a baseline to measure the potential productivity of the fishery.

RAG consideration – likely industry development

An industry member advised that there will likely be increased interest in coral trout fishing with further infrastructure development in Torres Strait as more community freezers commence operations. It was reported that the Erub I Freezer (Darnley Deep Seafood) was back in operation with good demand for both fillet and whole trout being shipped to Cairns and then exported to China. An industry member from Mer advised that fishers were fishing trout and processing through a small scale private freezing operation to supply mainland buyers for good profit.

It was further noted that the *Seaswift* freight company was investigating installing recirculating live tanks to their Torres Strait cargo vessels. This would allow live trout and reef-fish to be sent to Cairns and other ports from Torres Strait. If cost-effective, this could support industry growth into the live trade market.

The RAG noted advice from TSRA Finfish Quota Management Committee members present at the RAG that there was little interest from Queensland east coast operators leasing access to the Torres Strait Reef Line Fishery. This was noted as likely being due to the cheap lease price on the east coast line fishery, operators there focusing on live trout trips and the readily

available quota in that fishery. With low Torres Strait Spanish mackerel quota in 2020-21 it was noted that there was some increased interest in leasing trout by Sunset licence holders that mainly target mackerel. It was noted that the healthy level of the trout stock and large available TAC would represent an opportunity for the new *Zenedth Kes* fishing company to lease trout and grow the company should there be interest in leasing or fishing within the TIB sector.

The RAG reiterated its support for the Torres Strait Fish Receiver System and the work AFMA was doing in communities to encourage fishers to report trout catches down to species level rather than as a basket. It was noted that the species-split issue posed a challenge for management and science. Further, it was noted that as trout grow to the larger sizes they turn into males, meaning they contribute less to the spawning biomass, which represents another challenge for management as the fishery develops.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 -15 October 2021
SPANISH MACKEREL STOCK ASSESSMENT Update on additional objectives of the Torres Strait Finfish Fishery Spanish Mackerel Stock Assessment Project	Agenda Item 3.2 For DISCUSSION

RECOMMENDATIONS

1. That the RAG **NOTE** and **DISCUSS** an update from Dr Michael O'Neil 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 Recommended Biological Catch (RBC) results from the current custom stock model versus Stock Synthesis software; and
 - b) Streamline the Spanish mackerel stock assessment system (completed by year 3 of the project).

KEY ISSUES

2. In addition to main project objective to undertake an annual stock assessment, the new project *Torres Strait Finfish Fishery Spanish mackerel stock assessment* (project number 200815) has an additional two objectives. These are to:
 - a) Compare and evaluate spawning biomass ratio and Recommended Biological Catch (RBC) results from the current custom stock model versus Stock Synthesis (SS) software; and
 - b) Streamline the Spanish mackerel stock assessment system (completed by year 3 of the project).
3. Objective 2(a) above, was added to the project in response to a request from the Torres Strait Scientific Advisory Committee (TSSAC) to explore the relative benefits of developing the existing bespoke stock assessment model, including a streamlined report component, versus moving to an open source stock assessment model which may also provide easier stock assessment updates similar to the streamline processed outlined in this proposal (TSSAC consideration of pre-proposals on 8 April 2021). Objective 2(b) above, was proposed by the project team.
4. Year one of the project will commence work to assess using a packaged stock assessment software, instead of the current model. For this, a comparison will be made to the SS software (Methot and Wetzel, 2013). Department of Agriculture and Fisheries (DAF), Queensland Government, stock assessment staff have completed training in this software. This software is being used for east coast Spanish mackerel and other finfish fisheries in Queensland.
5. Both models will calculate numbers of Spanish mackerel by year and age group 1940–present. The age-structured models account for annual processes of fish births, growth,

reproduction, and mortality. The model's operation is in two phases: (i) model fitting to data to estimate the parameters, and (ii) simulation of parameters to evaluate confidence intervals on predictions, reference points and forecasts.

6. The results will be evaluated by FFRAAG, to guide transition to SS if appropriate, and streamline the stock assessment. The initial SS comparison will use project year 1 data, and run on a single base case dataset; to compare with the current custom model.
7. Year two of the project will initiate stock assessment streamlining. Computer code will be established to rapidly compile all data and analyses to dynamically publish results, tables and figures in a single report that can be shared and updated rapidly. The work will develop new semi-automated stock assessment and reporting system developed by DAF. The system will enable routine updates of existing stock assessments to support harvest strategies and stock status assessments.
8. The Principal Investigator advised the TSSAC that, "the normal stock assessment timeline can take 2–3 months or more per year. A settled streamlined or semi-streamlined system will reduce this time. Potentially the system can be managed by one person, ideally under DAF and AFMA-FFRAAG direction, reducing stock assessment salary costs to \leq \$20K per year (my estimate after project streamlining)".

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting No.9 14-15th October 2021
STOCK ASSESMENT Estimates of Spanish Mackerel and Coral Trout Catch Taken Outside the Fishery	Agenda Item 3.3 For ADVICE & DISCUSSION

RECOMMENDATIONS

That the Resource Assessment Group (RAG):

- a. **NOTE** previous RAG advice on estimated catch outside of the fishery.
- b. **DISCUSS and PROVIDE ADVICE** on any recommended changes to these estimates in light of new data or knowledge.

KEY ISSUES

1. Consistent with Australian Government policy (detailed in the *Commonwealth Fisheries Harvest Strategy Policy and Guidelines 2007*), all sources of mortality (catch) must be taken into account when setting a TAC. This means the TAC generally equates to the Recommended Biological Catch (RBC) (previously referred to as 'total kill' by the FWG) for the species minus expected catches to be taken outside of the fishery.
2. Estimates of other sources of mortality were used to revise the Spanish mackerel notional TAC for 2017-18, 2018-19, 2019-20, 2021/21, and 2021/22 seasons.
3. FRRAG 8 (4-5 Nov 2020) updated the estimate of non-commercial catches of Spanish mackerel (**Table 1**) to be applied to the TAC for the 2021/22 season.

Increases were recommended from 10 tonnes to 15 tonnes for subsistence fishing, and from 2 tonnes to 5 tonnes for recreational fishing. Consistent with previous years, the RAG agreed that charter fishing catches were likely to be minimal and accepted AFMA advice that Australia and PNG were unlikely to enter into catch sharing arrangement under the Treaty in 2021-22 fishing season. Both were subsequently left unchanged for the 2021-22 fishing season. The FFWG supported this approach (meeting on 25 November 2020).

4. The RAG are invited to discuss whether updates to these estimates of non-commercial Spanish mackerel 'catch outside the fishery' require amending.
5. It was noted at FRRAG 8 (4-5 Nov 2020) that in relation to coral trout that *"it was not a priority at this time to estimate catches taken outside the fishery. However, the RAG recommended that AFMA undertake work next year to support RAG consideration of likely catches ahead of the following fishing season."*

As recommended by the FFRAG at meeting 8, the RAG is asked to provide advice on estimates of coral trout catches outside the fishery. This advice will be used to support the RBC of coral trout for the 2022/2023 season.

Table 1. 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 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 tonnes was appropriate. At FFRAG meeting 8, the RAG agreed to recommend the estimate be increased to 2 tonnes 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 stat-wide recreational fishing survey, there were only 7 catch records from 2 people on 4 fishing days in Region B (Torres Strait). There was 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 from 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.

Background

2017

6. At the Finfish RAG 1 meeting on 9-10 November 2017 the following advice was provided on catches taken outside of the commercial fishery:
 - Recreational sector catches are likely to be minimal based on available evidence from the QDAF surveys.
 - Charter sector catches are likely to be minimal based on available evidence provided from QDAF catch data. The RAG noted that there is no evidence to suggest the number of charter boat operations/licences is increasing.
 - RAG recommended the estimate of subsistence take of Spanish mackerel used for TAC setting be increased from 5.155 tonnes to 10 tonnes based on the following points:
 - Data underlying the estimate was ageing and was available from only three islands
 - The number of TIB (commercial) sector fishing endorsements has increased since the Busilacchi study.

- Effort creep may have been occurring from the 1990s CSIRO studies to the Busilacchi study and may still be occurring.
- Torres Strait population has likely decreased since the Busilacchi study.
- RAG considered that there was no requirement to provide a recommended subsistence take deduction from the coral trout TAC given the amount of available information and that an assessment would likely be conducted on the species in 2018.
- RAG did not recommend any work on improving the estimates of mortality at this time though some options were considered.

2019

The FRAG at meeting 4 (13-14 March 2019) provided advice on best estimates for catches taken outside of the commercial fishery and supported the use of the values shown in **Table 2**.

Table 2. Outdated summary 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	10	Based on data from <i>Busilacchi 2013</i> this includes total of catch estimates for Mer, Masig and Erub Islands. The 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. 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. NOTING that anecdotal information presented at the FRAG by TIB industry members infers this number generally may have gone down.
Recreational	2	RAG advised that based on the available evidence from QDAF recreational survey results recreational catches are likely to be minimal. Changed now - based on QDAF survey (2013) which included TS.
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. RAG has advised based on the available evidence from QDAF logbook data from charter catches are likely to be minimal.
PNG catch sharing	0	PNG-NFA declined to enter into catch sharing arrangements under the Treaty for 2018-19 fishing season.

2020

The FRAG at meeting 8 (4-5 Nov 2020) provided advice, and updated the estimates of catches outside the fishery as follows:

“The Finfish RAG reviewed the available information to support estimates of non-commercial catches available to the PZJA in setting a Total Allowable Catch from the RBC. The RAG noted advice from Dr O’Neill and the Chairperson that the QDAF recreational fishing for 2019-

20 had concluded however, the survey did not sample the Torres Strait to form a meaningful estimate of recreational catches for the region.

The RAG noted that 10,000 kg of catch estimated for subsistence catch by Traditional inhabitants, at 7.3 kg average weight per fish (based on the most recent biological sampling), would represent 1400 fish from all communities. This roughly translates to an average take of a few hundred fish from each Torres Strait community per year. Applying the same average weight, the previously assumed two tonne catch¹ for recreational fishing represented around 280 fish.

Industry members and the TSRA member considered that both the subsistence and recreational estimates were a likely underestimate for the coming season.

- The TSRA member advised that, based on consultation on the Waphill trainee project, fishers in eastern communities are reportedly catching good numbers of Spanish mackerel for subsistence. The TSRA member has been advised by fishers that Spanish mackerel is not being sold due to the current lack of infrastructure.
- Industry members advised that along with having periods of good catches, many eskies of frozen Spanish mackerel are regularly shipped south to friends and family and are also used as barter/trade in communities. By way of example, industry members advised that within one community over the last three weeks, around eight boats have been fishing twice daily and landing 5-7 Spanish mackerel each fishing session per boat.
- Industry members were of the view 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.
- Industry members advised that along with the rollout of fisheries infrastructure in the near future there is a likelihood that with more fishers commercially targeting mackerel, more catch will be retained also for subsistence.

The RAG discussed the potential for recent observations to cause bias in the perception of seasonal trends, noting earlier advice from industry that there had been limited fishing most of the year due to poor weather. An industry member also commented that Spanish mackerel was not a preferred subsistence species with communities preferring species like Siganids (rabbitfishes) instead. However, on balance, the RAG accepted member advice that the previous estimates were likely an underestimate and, in line with the objectives of the Treaty, traditional fishing needed to be protected and have priority over harvesting for commercial purposes.

The RAG recommended increasing non-commercial catch estimates for Spanish mackerel for calculating TACs for the 2021-22 season (that is reducing the RBC by the total estimate to derive the TAC). Increases were recommended from 10 tonnes for subsistence to 15 tonnes and from 2 tonnes for recreational to 5 tonnes. Consistent with previous years, the RAG agreed that charter fishing catches were likely to be minimal and accepted AFMA advice that Australia and PNG were unlikely to enter into catch sharing arrangement under the Treaty in 2021-22 fishing season. Both were subsequently left unchanged for the 2021-22 fishing season.”

¹ The Spanish mackerel stock assessment team advised that the model used the 2013 point estimate of 2 t for recreational sector harvest with error bars ranging from 2-4 t (the model alternates between 2, 3 or 4 tonnes).

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 -15 October 2021
Management Spanish Mackerel & Grey Mackerel Size Limits	Agenda Item 4.1 For DISCUSSION and to PROVIDE ADVICE

RECOMMENDATIONS

1. That the RAG:

- a) **NOTE** wildlife trade operation (WTO) 'condition 7' as outlined in the '*Assessment of the Torres Strait Finfish Fishery December 2020*¹'. This export approval condition states that "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."
- b) **DISCUSS** and **PROVIDE ADVICE** on the appropriateness of the current minimum size limit for Spanish Mackerel, taking into consideration the following;
 - a. Objectives of the *Torres Strait Fisheries Act 1984*
 - b. Scientific/Biological factors (risk to the stock)
 - c. Economic factors
 - d. Catch data
 - e. Practical/Industry factors

Based on the review of the relevant facts, the RAG are to provide advice on the merits of either increasing, or maintaining the current minimum size limit for Spanish mackerel.

- c) **DISCUSS** and **PROVIDE ADVICE** on the appropriateness of the current minimum size limit for grey mackerel, taking into consideration the following;
 - a. Objectives' of the *Torres Strait Fisheries Act 1984*
 - b. Scientific/Biological factors (risk to the stock)
 - c. Economic factors
 - d. Catch data
 - e. Practical/Industry factors

Based on the review of the relevant facts, the RAG are to provide advice on the merits of either increasing, or maintaining the current minimum size limit for grey mackerel.

KEY ISSUES

2. In October 2020 the Australian Fisheries Management Authority applied for export approval for the Torres Strait Finfish Fishery (TSFF) under the EPBC Act. The application was assessed and the fishery was declared an approved wildlife trade operation under Part 13A of the EPBC Act until 1 November 2023.
3. This approval was based on the '*Assessment of the Torres Strait Finfish Fishery December 2020*', which was undertaken by The Department of Agriculture, Water and the Environment.

This assessment contained 9 approval conditions to ensure ecological risks continue to be managed.

4. 'Condition 7' of the WTO approval requires the PZJA to review the appropriateness of the Spanish mackerel minimum size limit (MSL) in the Torres Strait Finfish Fishery. The current minimum size limit for Spanish mackerel in the TSFF is 750mm total length (TL).
5. The rationale for the current minimum size limit of Spanish mackerel, which was agreed to by the PZJA in 2003 is summarised below:

"In early 2001, Torres Strait mackerel and line fishers recommended to the Finfish Working Group that the minimum legal size for Spanish mackerel be increased from 450 mm to 750 mm (total length). The commercial fishery in Torres Strait targets specimens greater than 750 mm and increase in minimum size would also bring the Torres Strait in line with the Queensland east coast and the Gulf fisheries. The recreational fishing size limit in the Torres Strait is also 750mm." - **Torres Strait Protected Zone Joint Authority Meeting No. 15, 12-13 June 2003**

6. The FFRAG is asked to discuss this MSL of Spanish mackerel, taking into consideration the **risk to the stock**. Indicators of potential risk to the stock are factors such as:
 - Established 'size-at-maturity' data for the species.
 - Proportion of size-cohorts caught within the fishery.
 - Post-release survival rates.
 - MSL in neighbouring jurisdictions.
7. The review is to be guided by the objectives of the *Torres Strait Fisheries Act 1984*, which are:
 - a) to acknowledge and protect the traditional way of life and livelihood of traditional inhabitants, including their rights in relation to traditional fishing;
 - b) to protect and preserve the marine environment and indigenous fauna and flora in and in the vicinity of the Protected Zone;
 - c) to adopt conservation measures necessary for the conservation of a species in such a way as to minimise any restrictive effects of the measures on traditional fishing;
 - d) to administer the provisions of Part 5 of the Torres Strait Treaty (relating to commercial fisheries) so as not to prejudice the achievement of the purposes of Part 4 of the Torres Strait Treaty in regard to traditional fishing;
 - e) to manage commercial fisheries for optimum utilisation;
 - f) to share the allowable catch of relevant Protected Zone commercial fisheries with Papua New Guinea in accordance with the Torres Strait Treaty;
 - g) to have regard, in developing and implementing licensing policy, to the desirability of promoting economic development in the Torres Strait area and employment opportunities for traditional inhabitants.
8. Upon review of the relevant considerations, the FFRAG are asked to provide advice to the PZJA on the appropriateness of the MSL. The RAG is to recommend to either retain, or amend the MSL of Spanish mackerel.
9. If the current minimum size limit of Spanish mackerel is deemed to be not appropriate, then RAG advice is sought on what it should be amended to.
10. Preliminary advice from the sunset sector suggests that catch rates of Spanish mackerel in

the size-cohort between the current minimum size limit of 750mm, and the established size-at-maturity length of 900mm is low.

Some fishers are known to avoid 'nursery areas' in southern Torres Strait which contain smaller fish (750-900mm), as they are not desirable to buyers.

Bramble Kay and northern Torres Strait in general is known to have bigger fish.

Smaller fish are said to often be present in the early season (June-July), but throughout the majority of the season not many are caught.

Some fishers are known to start fishing in August in order to avoid catching the smaller size class of fish.

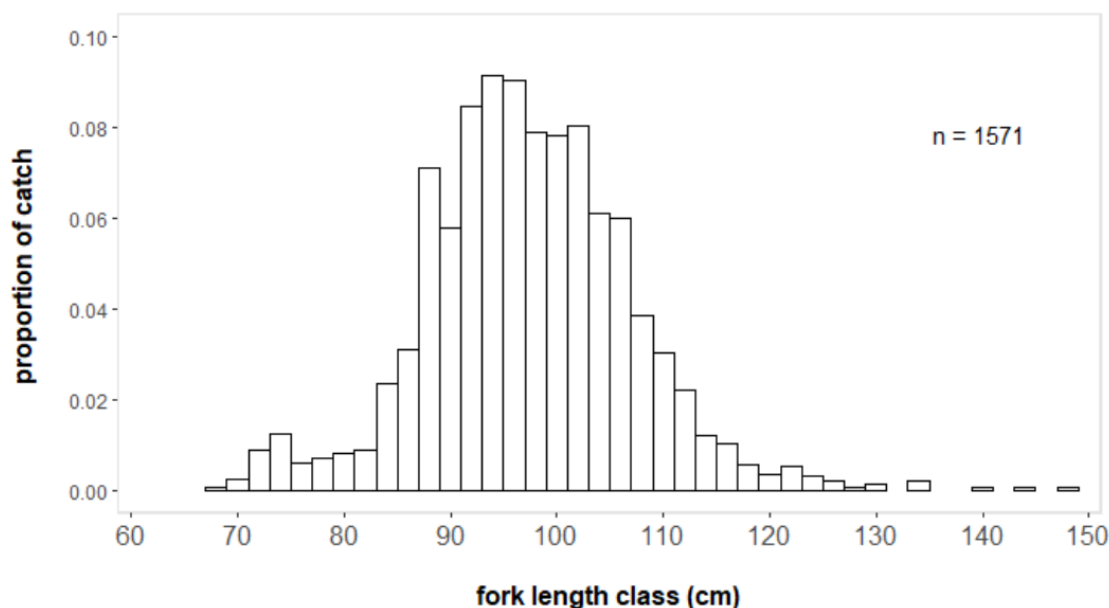
11. The current minimum size limit of grey mackerel in the TSFF is 500mm. The FFRAG are invited to discuss the appropriateness of this size limit, **given consideration to the same factors in reviewing the MSL of Spanish mackerel**. If the current minimum size limit is deemed to be not appropriate, then RAG advice is sought on what it should be amended to.
12. Upon review of the relevant considerations, the FFRAG are asked to provide advice to the PZJA on the appropriateness of the MSL of grey mackerel. The RAG is to recommend to either retain, or amend the MSL.
13. If the current minimum size limit of grey mackerel is deemed to be not appropriate, then RAG advice is sought on what it should be amended to.
14. If size limits are to be changed, amendments will be need to be made to the *Torres Strait Fisheries Management Instrument No. 14*. Minimum size limits for both Spanish and grey mackerel are contained within *Schedule 1* of this instrument.
15. PZJA approval is required before AFMA can make amendments to this instrument.

BACKGROUND

Spanish mackerel

- Established length-at-maturity data for Spanish mackerel sampled from Mornington Island and the Torres Strait, found that the minimum fork length (FL) of mature female fish is 800mm (McPherson, G.R. 1993).
- 800mm FL equates to approx. 900mm total length (TL). (Begg, G., et al. 2006)
- Western Australia has set the minimum size limit within their jurisdiction at 900mm TL.
- Northern Territory has not set a minimum size limit for the species.
- Recent monitoring data for Torres Strait Spanish mackerel fishery show that the proportion of catch under the 800mm FL size at maturity is low. Refer to figure 7 from Langstreth J.C. and O'Neill M.F., 2020 below, which found that in 2019-20, 3.7% of fish caught (combined TIB & TVH) were below this 800mm FL size.
- Langstreth J.C. and O'Neill M.F., 2020 also noted that "length structures sampled in 2019-20 are very similar to those reported from on-board surveys conducted in 2000-2002 and 2005 (Begg et al. 2006; O'Neill and Tobin, 2016)."

Figure 7. Length structure of the commercial Torres Strait Spanish mackerel catch in 2019-20. TIB and TVH sub-sectors combined. Number of individual primary boats = 5. N-value (n=1571) is number of fish represented.



Below is an extract from the Torres Strait Protected Zone Joint Authority Meeting No. 15, 12-13 June 2003, which summarises the reasoning behind the current minimum size limit in the Torres Strait Finfish Fishery:

“Increase in mackerel Size Limits - (FOR DECISION)”

In early 2001, Torres Strait mackerel and line fishers recommended to the Finfish Working Group that the minimum legal size for Spanish mackerel be increased from 450 mm to 750 mm (total length). The commercial fishery in Torres Strait targets specimens greater than 750 mm and increase in minimum size would also bring the Torres Strait in line with the Queensland east coast and the Gulf fisheries. The recreational fishing size limit in the Torres Strait is also 750 mms.”

The PZJA approved the increase in size limit out-of-session based on this recommendation.

- Below is an extract from the *Assessment of the Queensland East Coast Spanish Mackerel Fishery 2004*, which summarises the reasoning in maintaining a minimum size limit of 750mm within the QLD east coast fishery:

“Sexual maturity in females usually occurs at 90 cm Total Length (TL), a size larger than the current Minimum Legal Size (MLS) of 75 cm TL, which applies to all sectors of the ECSMF. DPI&F recognises that this MLS does not afford the standard protection to the Spanish mackerel stocks of ensuring fish are not targeted before reaching sexual maturity, as is the case in general fisheries management practice and as exemplified by the DPI&F statement “Size limits are based on biological research into each species’ reproductive cycles. Minimum size limits allow fish to spawn at least once and thereby contribute to the growth of that species population before capture” (Source: DPI&F website). DPI&F argues that it is reasonable to retain the current MLS because:

- Current catch only has a small component of fish smaller than the size of first maturity (~4.9% and 15% of commercial and recreational sectors, respectively);

- Released Spanish mackerel have low survival rates due to stress of capture and serious physical damage caused by hooks;
- There are human occupational safety concerns in releasing large active fish (e.g. at or below the size range of first maturity);
- Yield-per-recruit (YPR) calculations indicate that the optimum size for harvesting Spanish mackerel is actually below the current MLS at 70 cm TL2 ;
- Fishermen are very efficient in targeting schools according to their size; and
- While there is commercial incentive for fishermen to target fish larger (85-90 cm TL) than the MLS, it would be inefficient and environmentally ineffective to not allow fishers to land fish between 75-90 cm."

Grey mackerel

- Grey mackerel attain sexual maturity between 651 and 700mm FL for females (Cameron, D. and Begg, G.A. 2002);
- 651 - 700mm FL equates to approx. 752mm - 806mm (TL) respectively (Cameron, D. and Begg, G.A. 2002).
- Western Australia has set the minimum size limit within their jurisdiction at 750mm TL.
- Queensland has set the minimum size limit within their jurisdiction at 600mm TL.
- Northern Territory has not set a minimum size limit for the species.

Agenda item 5.5 - key issue 4, at the Torres Strait Finfish Working Group meeting from 12-13 July 2016, addressed the grey mackerel size limit:

4. *Dr O'Neill advised that the minimum size limit of 50cm for grey mackerel was well below the size at maturity and should be set nearer to 75cm, which is the minimum size limit for Spanish mackerel. Dr O'Neill also noted that the minimum size limit for grey mackerel in the QLD east coast fishery was 60cm, but even this is not adequate considering the biological parameters of this species (i.e. previous research established that the size at sexual maturity for grey mackerel to be between 65-75cm fork length (FL) for females and 55cm (FL) or greater for males.*

Below is an extract from The Torres Strait Finfish Working Group meeting record from 12-13 July 2016. The WG noted the following in regards to appropriateness of the grey mackerel size limit.

5.5. Finfish legislative instrument – consideration of measures

The FWG noted the proposed remaking of the Torres Strait Spanish Mackerel Fishery legislative Instrument.

In relation to the 50cm minimum size limit for grey mackerel (*Scomberomorus semifasciatus*) the FWG noted:

- that the minimum size limit for grey mackerel was well below the size at maturity and below the size limit for the ECF;
- a more appropriate size limit for grey mackerel would be 75cm;
- grey mackerel are not a common catch in the Torres Strait fishery and there are no logbook records of this species being caught in the Torres Strait; and
- that any changes on the limit for grey mackerel should be deferred as the priority is to have the instrument remade at the earliest opportunity.

References

Assessment of the Torres Strait Finfish Fishery December 2020, Commonwealth of Australia 2020

McPherson, G.R. 1993. *Reproductive biology of the Narrow Barred Spanish mackerel (Scomberomorus commerson Lacepede, 1800) in Queensland waters*. Asian Fisheries Science 6: 169-82.

Begg, G., A., Chen, C. C.-M., O'Neill, M. F., and Rose, D. B. 2006. *Stock assessment of the Torres Strait Spanish mackerel fishery*. CRC Reef Research Centre Technical Report No. 66, CRC Reef Research Centre, Townsville

Langstreth J.C. and O'Neill M.F., 2020. *Enhancing biological data inputs to Torres Strait Spanish mackerel stock assessment*. Torres Strait AFMA Project Number: RR2019/0832. Department of Agriculture and Fisheries, Queensland Government.

Assessment of the Queensland East Coast Spanish Mackerel Fishery 2004, Commonwealth of Australia 2004

Cameron, D. and Begg, G.A. 2002, *Fisheries biology and interaction in the northern Australian small mackerel fishery. Final report to the Fisheries Research and Development Corporation (Projects 92/114 and 92/144.02)*, Fisheries Research Development Corporation, Canberra.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14-15 October 2021
MANAGEMENT East Coast Finfish Harvest Strategy	Agenda Item 4.2 For NOTING


RECOMMENDATIONS

1. That the Finfish RAG **NOTE** the presentation by Mr Ash Lawson (Manager of the East Coast Finfish Fishery) on the Harvest Strategy for the Reef Line Fishery to be provided at the meeting.

KEY ISSUES

2. Mr Ash Lawson, Manager of the Reef line Fishery, will be presenting to the RAG on the development and implementation of the Reef line fishery harvest strategy 2020-2025 which is provided as attachment 4.2a.
3. The RAG is due to further discuss the development of a harvest strategy for the Torres Strait Finfish Fishery at its 10th meeting on 18 November. Given the similarities in species the presentation by Fisheries Queensland may provide insight on developing finfish harvest strategies including lessons learnt along the way that might be valuable for the TSFF.
4. It is a requirement of the Wildlife Trade Operation (WTO) approval for the Fishery that a harvest strategy is developed by 30 June 2023¹.

¹ Condition 8 of the WTO for the TSFF: by 30 June 2023 the Torres Strait Protected Zone Joint Authority must develop a harvest strategy for the Torres Strait Finfish Fishery.



Reef line fishery harvest strategy: 2020–2025



Business unit owner	Management and Reform
Endorsed by	Deputy Director-General (Fisheries and Forestry) in accordance with delegated powers under Part 2, Division 1 (Harvest Strategies) of the <i>Fisheries Act 1994</i>
Approved by	Minister responsible for fisheries in accordance with section 16 of the <i>Fisheries Act 1994</i>

Revision history

Version no.	Approval date	Comments
1.0	October 2019	Draft harvest strategy for consultation
2.0	April 2020	Approval of final harvest strategy

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What the harvest strategy is trying to achieve

This harvest strategy has been developed to manage all coral reef fin fish species of Queensland, as part of the reef line fishery. All coral reef fin fish stocks are considered sustainable (noting that many species are undefined), with the risk of fishing on sustainability considered low due to the existing management framework and marine park zoning. It is a multi-species fishery; however, coral trout (*Plectropomus* spp.) are the principal target species that drives fishing effort, and they are often caught without high harvest of other (non-target) species.

The aim of this harvest strategy is to manage fishing mortality through setting sustainable catch limits at a level that allows the stock to achieve defined biomass targets. If biomass estimates are available for a species, decision rules are designed to set catch limits at levels appropriate for achieving and maintaining spawning biomass at 60%, and maintaining catch shares amongst commercial, recreational, charter and traditional fishing sectors. If biomass estimates are not available for a species, precautionary catch triggers have been designed to allow for controlled expansion of fishing, optimising economic yield while monitoring changes in catch and effort within historic catch levels.

Fishery overview

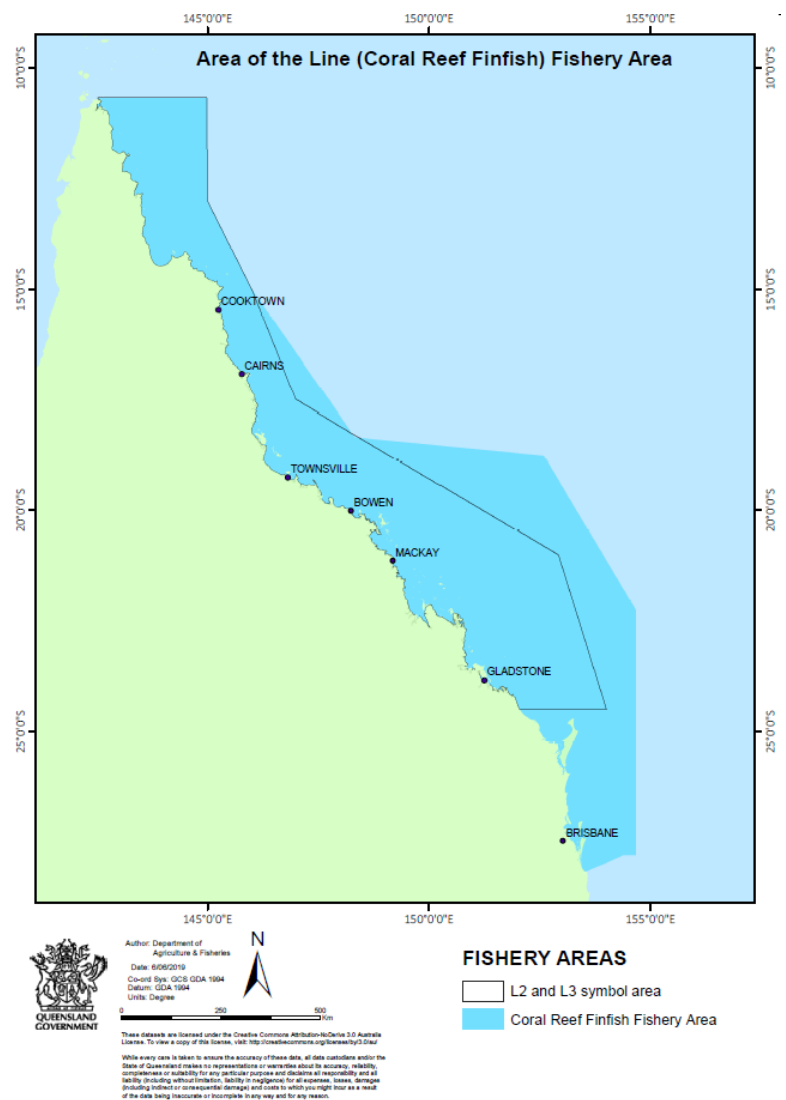
The reef line fishery is a line-only fishery targeting a range of bottom-dwelling reef fish. The commercial fishery operates predominantly within the Great Barrier Reef Marine Park, with a small amount of catch and effort reported from outside this area. Operators target high-value coral trout for live export, as well red throat emperor and a wide range of coral reef fin fish species sold domestically.

Commercial fishing operations generally consist of a number of smaller tender boats (dories) and a larger primary fishing vessel. However, there is a degree of variability within the fishery, which encompasses smaller operations undertaking single day trips through to larger vessels with multiple dories operating over a two-week period.

Recreational fishers access the fishery via private recreational vessels or as paying customers on offshore charter operations (both single and multi-day charters).

Recreational fishers target a wide range of coral reef fin fish species, with significant social interest in coral trout, emperor and tropical snapper species (which feature prominently in the statewide recreational fishing survey).

In addition to the recreational and commercial fishing sectors, the reef line fishery also includes traditional catch. Catch and effort in the Indigenous fishing sector remains the least understood of all sectors. However, it is assumed that this sector has comparatively low levels of effort, with fishing activities aligning closely with the recreational fishing sector.



Fish stocks covered by the harvest strategy

Coral trout is the primary species group targeted. There are a number of species of coral trout regularly caught in the fishery, including common coral trout (*Plectropomus leopardus*), barcheek coral trout (*P. maculatus*) and blue-spotted coral trout (*P. laevis*), with the common coral trout making up the majority of commercial harvest. A genetic study of coral trout on the Great Barrier Reef found no spatial separation of stocks.

Red throat emperor (*Lethrinus miniatus*) is Queensland's second most important reef fish by commercial catch weight, and is also a popular target fish for recreational fishers. Research on the stock structure of red throat emperor concluded that there was no evidence for distinct genetic stocks on the Great Barrier Reef. Table 1 outlines the fish stocks covered by this harvest strategy.

Table 1: Summary of fish stocks covered by this harvest strategy

Feature	Details
Primary target species	<p>Coral trout inclusive of:</p> <ul style="list-style-type: none"> • common coral trout (<i>P. leopardus</i>) • barred-cheek coral trout (<i>P. maculatus</i>) • Chinese footballer (<i>P. laevis</i>) • highfin coral trout (<i>P. oligacanthus</i>) • passionfruit trout (<i>P. areolatus</i>) • coronation trout (<i>Variola louti</i>)
Secondary species	<p>Red throat emperor (<i>L. miniatus</i>)</p> <p>Other species:</p> <ul style="list-style-type: none"> • red emperor (<i>L. sebae</i>) • stripey snapper (<i>L. carponatus</i>) • saddletail snapper (<i>L. malabaricus</i>) • crimson snapper (<i>L. erythropterus</i>) • goldband snapper (<i>P. multidentis</i> and <i>P. typus</i>) • spangled emperor (<i>L. nebulosus</i>)
Species biology ≈ : approximately equal to ~ : approximately	<p>Coral trout species</p> <p>Longevity:</p> <ul style="list-style-type: none"> • <i>P. leopardus</i> – 17 years, ≈650 mm fork length • <i>P. maculatus</i> – 13 years, 650 mm fork length • <i>P. laevis</i> – 16 years, ~1150 mm fork length <p>All species are protogynous hermaphrodites (individuals are born female and later become male)</p> <p>Age at maturity and sex change vary:</p> <ul style="list-style-type: none"> • <i>P. leopardus</i> – female ~280 mm fork length, male ~500 mm fork length (~4 years of age) • <i>P. maculatus</i> – female ~300 mm fork length, male ~ 440 mm fork length • <i>P. laevis</i> – female ~450 mm fork length, male ~870 mm fork length <p>Red throat emperor</p> <ul style="list-style-type: none"> • Longevity: 20 years, 650 mm total length • Age at 50% maturity: females 1.2 years, 280 mm fork length, 310 mm total length

Management units

Defining the fishery to which a harvest strategy will apply is a critical step in determining its scope. The management units for this harvest strategy are defined by the Fisheries (Commercial Fisheries) Regulation 2019.

Stocks:

- coral trout, including all seven species
- red throat emperor
- all other coral reef species (as defined by the Fisheries (General) Regulations 2019)

Fishing under the reef line fishery is permitted within the L1, L2, L3 and L8 fishery areas.

Summary of management information

A summary of the management arrangements for the reef line fishery are set out Table 2. Fishers should consult the relevant fisheries legislation for the latest and detailed fishery rules.

Table 2: Summary of management arrangements for the reef line fishery

Feature	Details
Commercial access	Primary commercial fishing licence with one of the following fishery symbols: <ul style="list-style-type: none"> • L1 – line fishing south of 24°30'S • L2 and L3 – line fishing north of 24°30'S in the Great Barrier Reef Marine Park • L8 – multi-hook deep-line in waters greater than 200 m • quota/access symbols – RQ
Relevant fisheries legislation	<ul style="list-style-type: none"> • <i>Fisheries Act 1994</i> • Fisheries (General) Regulation 2019 • Fisheries (Commercial Fisheries) Regulation 2019 • Fisheries Declaration 2019 • Fisheries Quota Declaration 2019
Other relevant legislation	<ul style="list-style-type: none"> • <i>Great Barrier Reef Marine Park Act 1975</i> • Great Barrier Reef Marine Park Regulations 2019 • <i>Environment Protection and Biodiversity Conservation Act 1999</i> • <i>Marine Parks Act 2004</i>
Working group	Reef line fishery working group (terms of reference and meeting communiques are available at fisheries.qld.gov.au)
Gear	The following apparatus are permitted for use: <ul style="list-style-type: none"> • hook and line apparatus • recreational fishers may use hook and line, rods and reels, and spearfishing gear (excluding hookah/scuba)
Main management methods	Spawning closures, minimum and maximum size limits, no-take species, gear restrictions Commercial only: Limited access through commercial fishing boat licences, species-specific individual transferable quotas (ITQ) for coral trout and red throat emperor, combined/basket ITQ for other species, vessel and tender restrictions Recreational only: In-possession and size limits, and a total possession limit of 20
Fishing year	Quota season: 1 July – 30 June

Feature	Details
Stock status	Status of Australian fish stocks reports (visit fish.gov.au): <ul style="list-style-type: none"> • coral trout listed as 'sustainable' (2018) • red throat emperor listed as 'sustainable' (2018) • all other species are listed as 'undefined' (2018)
Accreditation under the Environment Protection and Biodiversity Conservation Act 1999	Part 13: Accredited (expires 6 March 2020) Part 13A: Accredited (expires 6 March 2020) Visit environment.gov.au

Fishery objectives

Fishery objectives set out the direction and aspirations to achieve in the long term. The primary objective for the reef line fishery is to:

- maintain all species in the reef line fishery at, or returned to, a target spawning biomass level that aims to maximise economic yield (MEY) for the fishery, while
 - ensuring no unacceptable risk from fishing to species in the other species quota group
 - maintaining sectoral allocations for all coral reef fin fish species
 - minimising and mitigating high ecological risks arising from fishing-related activities
 - maximising profitability for the commercial and charter sector
 - monitoring the social and economic benefits of the fishery to the community.

Catch shares

This harvest strategy aims to maintain the existing catch shares between sectors. The resource allocation arrangements (as at 2018) are set out in Table 3 (overleaf) to ensure that catch shares among sectors are maintained in response to changes in the total allowable catch (TAC). Catch shares for secondary and byproduct species will be established once a species is assessed as requiring a stock assessment to inform setting a TAC.

These indicative resource allocation arrangements may be updated if new information becomes available from the 2019 statewide recreational fishing survey that indicates the defined sectoral proportions are no longer consistent with effective management of the fishery. An update of the resource-sharing arrangements would be undertaken in this instance to ensure that catch shares are based on the most recent and reliable information for all sectors. After 2021, only approved resource reallocations would adjust the catch shares within this harvest strategy.

The traditional fishing rights of Aboriginal peoples and Torres Strait Islanders are protected under native title legislation and relate to harvest for domestic, communal and non-commercial purposes. Accordingly, traditional and customary fishing is not a defined allocation.

Aboriginal peoples and Torres Strait Islanders desire more economic opportunities through fishing, particularly in their own sea country. In line with the *Aboriginal and Torres Strait Islander commercial fishing development policy*, up to 5 tonnes will be set aside to provide access through an Indigenous fishing permit, issued in accordance with section 54 of the Fisheries (General) Regulation 2019, to provide opportunities for communities to take part in fishing-related business.

Table 3: Resource allocation arrangements for the reef line fishery

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

* 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).

Managing performance of the fishery

Biomass-based performance indicators and reference points for target species

Key indicators measure the health of the fishery. The indicators relate to the objectives and use reference points to establish acceptable performance (Table 4 overleaf). The indicators measure the relative amount of fish biomass of key stock(s) against target and other reference points. The default biomass reference points identified in this harvest strategy are as follows:

- A target reference point (*B_{targ}*) of 60% of the unexploited spawning biomass (for key target species) is the relative biomass level the harvest strategy aims to achieve. This is also considered a proxy measure of *B_{mey}* (biomass at maximum economic yield) for the purposes of this harvest strategy.
- A limit reference point (*B_{lim}*) of 20% of the unexploited spawning biomass is the level that the harvest strategy aims to avoid. If the stock is assessed to be below *B_{lim}*, the risk to the stock is unacceptably high and the stock is defined as 'depleted'.

For key stocks, performance indicators and sustainable harvests for all sectors will be estimated from a stock assessment. The aim is to measure the capability of the stock to attain the target biomass level (*B_{targ}* 60%), and at which point the harvest strategy will be considered as meeting its fishery objectives.

The decision rules for setting a sustainable harvest are based on a 'hockey stick' approach (see Figure 1 overleaf)—the TAC is set based on a linear relationship between *B_{lim}* where the level of fishing mortality (*F*) is equal to zero, and *B_{targ}* where the exploitation rate and TAC is set at the level to achieve maximise economic yield).

The decision rules takes into account the current biomass level of the stock for determining the TAC to achieve *B_{targ}*. The recommended TAC is calculated by applying the rate of fishing mortality to achieve *B_{targ}* to the current spawning biomass level. As a result, the recommended TAC represents the total catch from all sectors (including discards) that can be harvested in the next two years, to move the current biomass level towards the target level.

If the spawning biomass falls below the limit reference point (*B_{lim}* 20%), there will be no more targeted fishing of the stock until a rebuilding strategy is developed to increase the spawning biomass above the limit within one generation (a generation is defined as the average age of full maturity for the fish species). The rebuilding timeframe of one generation takes into account the productivity and life span of the fish species.

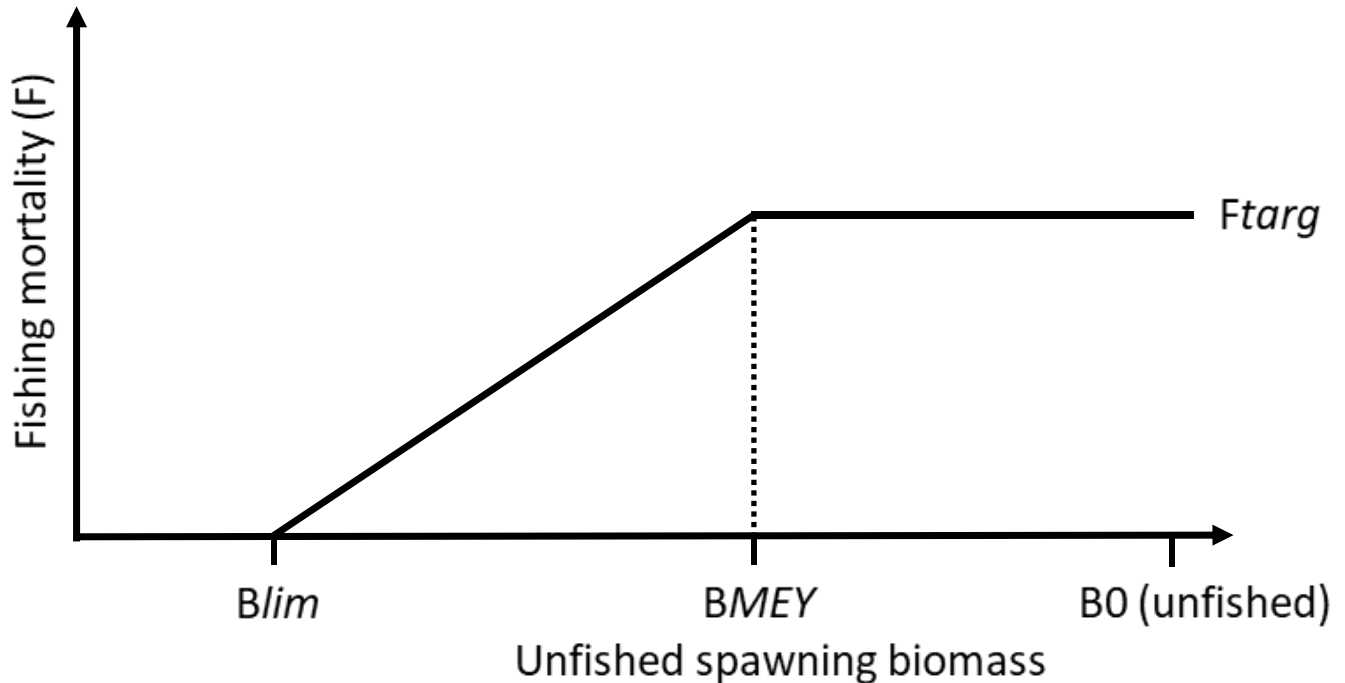


Figure 1: The 'hockey stick' rule—*B_{lim}* is the limit reference point, *B_{MEY}* is the biomass at maximise economic yield, *B₀* is the unfished biomass, *F* is fishing mortality and *F_{targ}* is the level of fishing mortality for *B_{MEY}*

To meet the objectives of the fishery, the harvest strategy will also constrain all sectors within their allocated catch share.

Should a new estimate of recreational harvest or catch from charter fishing logbooks indicate that a sector has increased their catch share outside of the allocated proportion for any TAC species, an adjustment will be made to constrain harvest within this catch share. Adjustments to recreational fishing limits may be undertaken if large changes are made to the TAC for a species.

Performance indicators and reference points for secondary and byproduct species

If the primary performance indicator (biomass) is not available for secondary target species (e.g. those in the 'other species' quota grouping), trigger reference points will manage levels of fishing mortality:

- 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 historical average levels (from the defined reference years).

An annual catch level of 20 tonnes per species has been determined as the point at which increasing harvests may present an increased risk to the sustainability of any given species. Given this, a catch trigger is used to detect species that may be subjected to increased targeting. The trigger aims to detect shifts in fishing effort by comparing annual harvests against the average catch level from the reference period of 2011–2015. This reference period represents a stable period of commercial operation—including weather events such as cyclones, fishing effort and number of licences—and has been evaluated using retrospective analysis.

Table 4: Performance indicators and reference points for the reef line fishery

Species	Performance indicator	Type of reference point	Reference level
Coral trout	Biomass	Target (<i>B_{targ}</i>)	60% spawning biomass
Coral trout	Biomass	Limit reference point (<i>B_{lim}</i>)	20% spawning biomass
Coral trout	Change in commercial harvest	Maximum change per year	200 tonnes
All species	Maximum level of fishing mortality by all sectors	Target reference point	F60
All species	Change in recreational in possession limit	Maximum change	±2 fish
Red throat emperor and other species (when available)	Biomass	Target (<i>B_{targ}</i>)	60% spawning biomass
Red throat emperor and other species (when available)	Biomass	Limit reference point (<i>B_{lim}</i>)	20% spawning biomass
Red throat emperor and other species	Logbook catch	Average catch 201–2015 Reference period	1.5 x reference period
Red throat emperor and other species	Logbook catch	Total allowable commercial catch	2 x reference period

Management of target species

Commercial decision rules for target species

The decision rules provide guidance to set the total allowable commercial catch (TACC) based on estimates of biomass available. The decision rules for coral trout use the outputs of the stock assessment and aim to achieve a target biomass (*B_{targ}*) of 60% (see Appendix A: Decision rules for coral trout). To minimise large changes to the TACC in any given year, there is a maximum change buffer of 200 tonnes. If the projected TACC change is greater than 200 tonnes (e.g. a 263 tonne decrease), this would result in a maximum 200 tonne reduction in the next season followed by the remainder amount of 63 tonnes the following season. The TACC is set biannually in year 1, year 3 and year 5 of the harvest strategy.

-
- 1.1 If the biomass is at or above *B_{targ}*, set the TACC at a level that maintains biomass at *B_{targ}*.
 - 1.2 If biomass is below *B_{targ}* and above *B_{lim}*, the TACC should be set as inferred by the 'hockey stick' approach (fishing mortality is reduced to the rate that allows the biomass to increase effectively back to *B_{targ}*).
 - 1.3 If biomass is below *B_{lim}*, there will be no further targeted fishing for that species, and a rebuilding strategy will be developed to increase the stock biomass to above *B_{lim}* within one generation.
 - 1.4 If any new information becomes available indicating that the assessment and TACC-setting arrangements are not consistent with the sustainable management of the fishery, decision rules must be reviewed and, if appropriate, the reference points or timeframes should be adjusted.

Notwithstanding that:

- 1.5 The rate of fishing mortality should not exceed that required to achieve *B_{targ}* (i.e. F₆₀).
 - 1.6 The TAC should not exceed the level of fishing mortality required to maintain a stock at maximum sustainable yield.
 - 1.7 The new TACC must not change by more than 200 tonnes in any given year unless the spawning biomass is below 20%.
-

Decision rules for secondary and byproduct species

The following decision rules are designed to ensure that fishing does not result in unacceptable levels of fishing pressure on secondary and byproduct species without biomass estimates. The harvest strategy also includes rules to allow TAC adjustment to red throat emperor if an updated biomass estimate becomes available (see Appendix B: Decision rules for secondary species).

-
- 2.1 If the commercial annual harvest of any species is less than 1.5 times the average reference period catch (2011–2015) or the annual harvest is less than 20 tonnes, no management action is required.
 - 2.2 If the commercial annual harvest of any species is greater than 1.5 times the average reference period catch (2011–2015) and the annual harvest is more than 20 tonnes, a stock assessment is required to inform the appropriate catch levels for this species.
 - 2.3 If the annual harvest of any species is greater than 2 times the average reference period catch (2011–2015) and the annual catch is more than 20 tonnes, an interim competitive TACC will be set at 2 times the reference period catch level and a stock assessment will be undertaken.

Break-out rules

- 2.4 If a stock assessment becomes available for a secondary target species that indicates a reduction in fishing mortality is required to achieve *B_{targ}* (60%) or *B_{lim}* (20%) reference points, management action will be undertaken to rebuild the stock (i.e. set the TAC for red throat emperor).
 - 2.5 If any new information becomes available indicating that the assessment and TACC-setting arrangements are not consistent with the sustainable management of the fishery, the harvest control rules must be reviewed and, if appropriate, the reference points must be adjusted.
-

Decision rules for recreational and charter sector management

To ensure the recreational fishing sector is not increasing their catch share at the expense of the commercial sector, the harvest strategy has been designed to include decision rules for maintaining catch shares between sectors. These decision rules only apply once a TACC is in place and catch shares have been formalised. Should a new estimate of recreational harvest or catch from charter fishing logbooks indicate that the recreational sector has increased their catch share outside of the formalised proportion for any TAC species, adjustments will be made to constrain them within this share. Adjustments to the recreational fishing limits may also be undertaken if large changes are made to the TAC for a species.

-
- 3.1 If a recreational harvest estimate for coral trout is no more than 5%, or for all other coral reef fin fish species no more than 10%, above the allocated recreational catch proportion, no management action is required.
 - 3.2 If a recreational harvest estimate exceeds the catch share by greater than 5% for coral trout or 10% for all other coral reef fin fish species, the recreational in-possession limit will be decreased to return catch to allocated proportions.
 - 3.3 If a stock assessment recommends an increase in the TACC to a level that would increase the commercial catch share for coral trout by 5%, and for all other coral reef fin fish species by 10% or more, the recreational in-possession limit will be increased to return catch shares to allocated proportions if necessary.

Notwithstanding that:

- 3.4 A recreational in-possession limit must not be increased or decreased by more than two fish in any given year, and if the TACC is equal to zero the species will be no take for all sectors.

Review triggers

A review will be undertaken to understand whether further assessment or management is needed if:

- 3.5 the recreational harvest estimate for a species is greater than 50 tonnes and has increased by greater than 30% from the previous estimate
or
 - 3.6 the retained charter catch for a species is greater than 20 tonnes and has increased by greater than 30% from the previous calendar year.
-

Minimising ecological risks

The foundation of sustainable fisheries management is managing the impact of fishing activities on non-target species and the broader marine ecosystem. Ecological risk assessments identify and measure the ecological risks of fishing activity and identify issues that must be further managed under harvest strategies. The below decision rules are in place to minimise and mitigate high ecological risks arising from fishing-related activities.

-
- 4.1 If an ecological risk assessment identifies fishing impacts that are considered to generate an undesirable level of risk to any secondary or byproduct species populations (i.e. high risk), a review is triggered to investigate the reason for the increased risk. Appropriate management action should be taken to reduce the risk to an acceptable level.
-

A whole-of-fishery level 1 ecological risk assessment for the reef line fishery was completed in 2019 (visit era.daf.qld.gov.au) and identified two ecological components/sub-components at higher risk—target and byproduct species (other species category) and protected teleosts (species of conservation interest only). These components have been progressed to a species-specific level 2 ecological risk assessment, which is due for completion in 2020. The *Ecological risk assessment guideline* is available at fisheries.qld.gov.au.

Future risk assessments will be undertaken periodically to reassess any current issues or new issues that may arise. Risk assessments can be undertaken more frequently if there are significant changes identified in fishery operations, management activities or controls that are likely to result in a change to previously assessed risk levels.

Monitoring social and economic performance

The *Queensland Sustainable Fisheries Strategy: 2017–2027* outlines the target to set sustainable catch limits based on achieving maximum economic benefits of the resource, which corresponds to around 60% of unfished biomass. This is to support the most economically efficient use of the resource, improve the fishing experience for all sectors (e.g. recreational fishing satisfaction) and promote a resilient system that can bounce back from other adverse environmental conditions (e.g. floods, cyclones and bleaching). The harvest strategy rules have been set up to maintain the stock to this target biomass level.

The objectives listed in Table 5 support the social and economic performance of this fishery. The management options outlined are intended to provide some guidance on the options that could reasonably be considered if fishery trends are of concern.

Table 5: Social and economic indicators for the reef line fishery

Objective	Performance indicators	Management options
Maximising profitability for the commercial and charter sector	Potential indicators to monitor include: <ul style="list-style-type: none"> • catch per unit effort (average per day) • costs, earnings and net financial and economic profit • quota sale and lease price 	Consider regulatory and non-regulatory options Adjust management as needed Options include minimum quota holding and latent effort review
Monitoring the broader social and economic benefits of the fishery to the community	Potential indicators to monitor include: <ul style="list-style-type: none"> • fisher satisfaction (with their fishing experience—commercial and recreational) • percentage of quota/licences that are owned (rather than leased) • income generated (crew plus profit—gross value added) • proportion of catch sold locally • fish prices • number of platforms / number of active licenses / total capacity 	Consider regulatory and non-regulatory options Adjust management as needed

Monitoring and assessment

The catch and effort data required to inform harvesting of coral reef fin fish species is obtained through commercial logbook returns. For the reef line fishery logbook, visit business.qld.gov.au.

As the reef line fishery is a quota-managed fishery, real-time reporting and catch disposal records are also required to provide an accurate record of catch. All boats in the fishery are required to have a vessel tracking unit installed and operational on all primary and tender vessels to verify fishing effort reported in commercial fishing logbooks.

Commercial catch rates are standardised to account for a range of potential influencing variables. The current catch rate standardisation considers fishing years, regions and months, as well as the main effects of fishing effort of individual vessels. The standardised commercial catch rates are based on the performance over the quota year.

The data collected via boat ramp surveys and the statewide recreational fishing survey helps provide important information on recreational fishing. Charter operators also record catch information in logbooks, which are included as recreational harvest.

Fisheries Queensland has committed to collecting biological information on seven key coral reef fin fish species to address the emerging knowledge requirements:

- common coral trout (from 1 July 2019)
- red throat emperor (from 1 July 2019)
- crimson snapper (2017)
- saddletail snapper (2017)
- stripey snapper (2017)
- red emperor (2017)
- spangled emperor (2017).

Biological information collected includes length, age and sex of fish being retained. Biological sampling of coral reef fin fish is separated into distinct regions along Queensland's east coast to account for any substantial variations in the population characteristics of the species over the whole region.

The coral trout stock assessment uses an age-structured model with a yearly time step based on financial years. Data on the abundance of coral trout within green zones is estimated using data from the Australian Institute of Marine Science Underwater Visual Surveys. The stock model (or core model) has been developed for management advice and setting the TAC in line with the decision rules. It is expected that the same assessment model and assumptions are used in future assessments under the harvest strategy, unless new information becomes available to suggest a change is required.

Information and research priorities

Key information and research priorities have been identified in Table 6 to help meet the objectives of this harvest strategy. These will be updated as required.

Table 6: Information and research priorities for the reef line fishery

Project description	Explanation of need	Priority
Red throat emperor stock assessment	An update to the 2006 red throat emperor stock assessment is required to inform an appropriate TAC for the fishery.	High
Coral trout and red throat emperor monitoring	Length and age data is needed to improve the stock assessments. Previous assessments included recommendations to include length, sex and age information.	High

Schedule of performance assessment and review

Schedule of assessment

The fishery's performance will be reviewed against this harvest strategy annually. This review will include convening the reef line working group in February/March to provide operational advice on the fishery's performance and any matters that may need to be addressed. In addition to estimates of spawning biomass, performance will be measured through ecological risk assessments and catch and effort data. If a biomass estimate becomes available prior to the scheduled timeframe that indicates the TAC should be adjusted to meet the objectives of the fishery, the TAC for that year should be reviewed.

Table 7: Anticipated performance schedule for the reef line fishery

	Year 1 (2020)	Year 2 (2021)	Year 3 (2022)	Year 4 (2023)	Year 5 (2024)
Monitoring and assessment activity	Coral trout stock assessment Catch and effort monitoring	Red throat emperor stock assessment Catch and effort monitoring	Coral trout stock assessment Catch and effort monitoring	Catch and effort monitoring	Coral trout and red throat emperor stock assessments Catch and effort monitoring
Management action	Review management and adjust TACs if required	Monitor catch levels and adjust TACs if required	Review management and adjust TACs if required	Review catch and effort data	Review harvest strategy, assessment and TACC decision Monitor catch levels

The above schedule outlines the expected timeframes that assessment information will be available to inform management action. There may be instances where an assessment needs to be available prior to the scheduled date or is delayed. Any change to the schedule should be considered by the working group and a decision made by the chief executive based on the below conditions:

- If during the period between scheduled stock assessments the chief executive is concerned that a performance indicator (e.g. stock status, length frequency distributions, standardised commercial catch rates, total harvest, age distributions etc.) suggests that the stock is not performing in a way that will achieve the target biomass level, the chief executive may decide that a stock assessment will be undertaken before the scheduled timeframe.
- If the chief executive is satisfied that; (1) indicators for the stock suggests that it is achieving, or rebuilding to, target biomass levels, and that there is a low ecological risk to the stock under the current management arrangement (i.e. TAC levels); (2) or if resourcing requirements prohibit the ability for an assessment to be delivered in the scheduled timeframe, the chief executive may decide that a scheduled stock assessment will be delayed.

Schedule of review

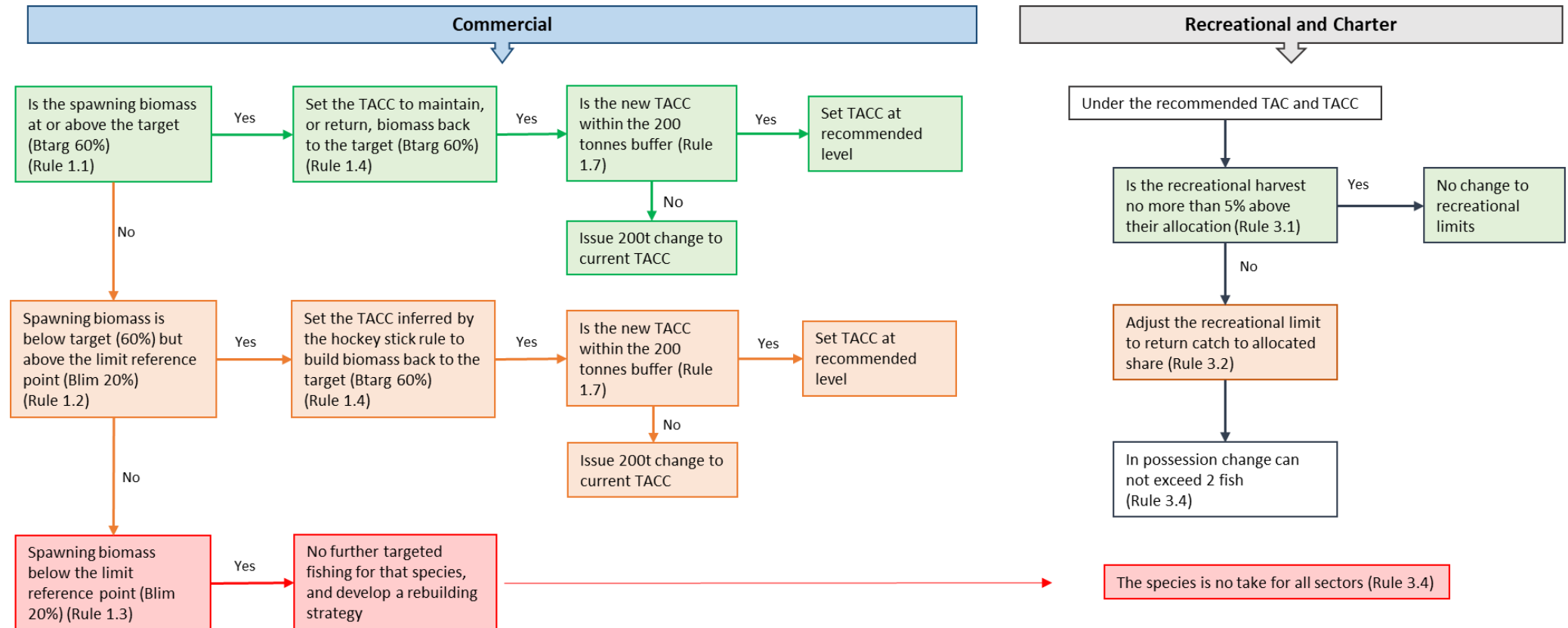
This harvest strategy will remain in place for a period of five years, after which time it will need to be fully reviewed in accordance with the *Fisheries Act 1994*.

While harvest strategies provide certainty and transparency in terms of management decisions in response to fishery information, there also needs to be flexibility to allow new information or changing circumstances to be considered. Consequently, the harvest strategy may be subject to further review and amendment as appropriate within the five-year period if the following circumstances arise:

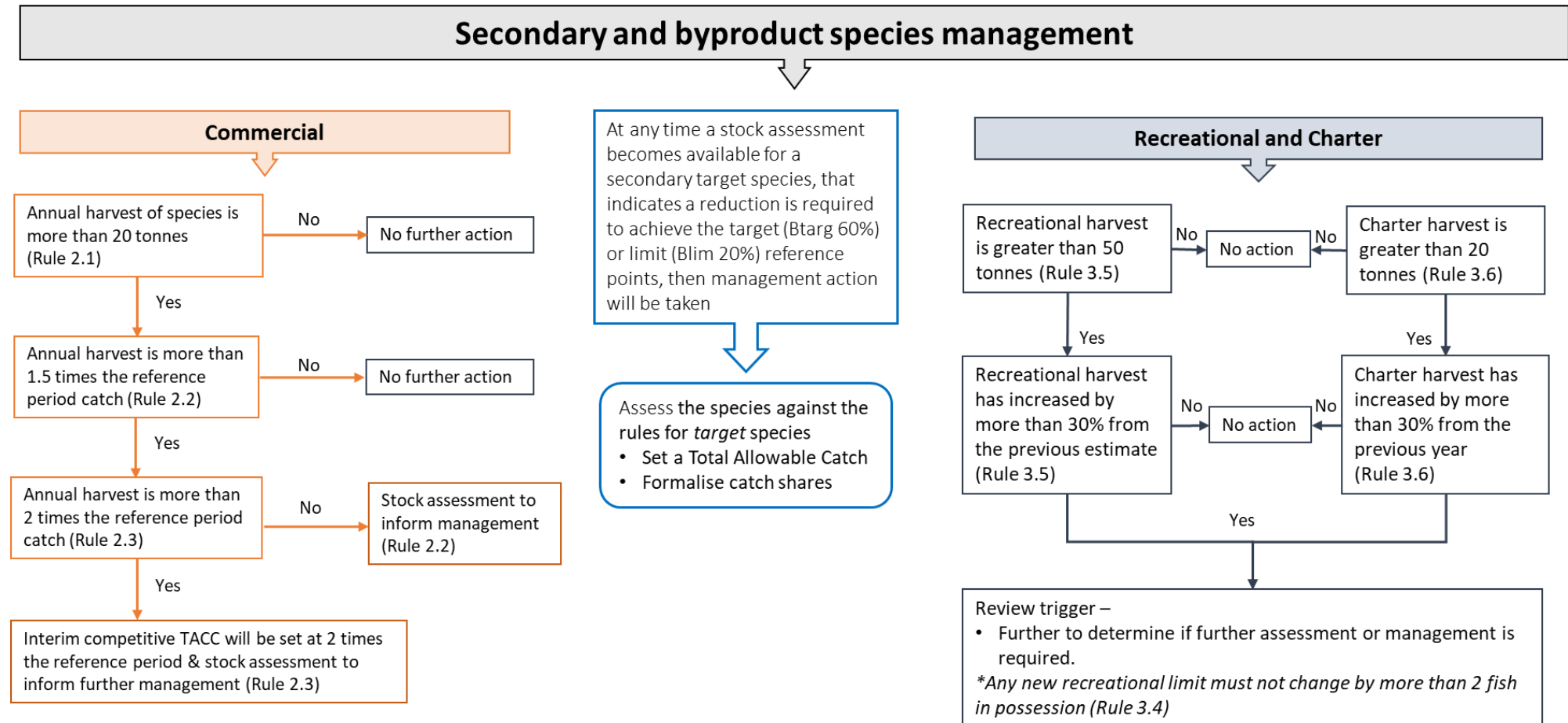
- there is new information that substantially changes the status of a fishery, leading to improved estimates of indicators relative to reference points
 - drivers external to management of the fishery increase the risk to fish stock/s
 - a new recreational harvest estimate becomes available that suggests the defined sector catch shares may have been set incorrectly or may be unrepresentative
- or
- it is clear the harvest strategy is not working effectively and the intent of the *Queensland harvest strategy policy* is not being met.

For more information on the processes for amending harvest strategies, refer to the *Queensland harvest strategy policy* available at publications.qld.gov.au.

Appendix A: Decision rules for coral trout



Appendix B: Decision rules for secondary species



TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting No.9 14-15th October 2021
MANAGEMENT Western Line Closure	Agenda Item 4.3 For NOTING

RECOMMENDATIONS

That the Resource Assessment Group (RAG):

- a. **NOTE** an 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.

KEY ISSUES

1. At the Torres Strait Finfish Fishery Working Group meeting on 25 November 2020, the Working Group supported AFMA's intention to undertake further targeted consultation with Gudamalulgal communities, in partnership with nominated industry members of the RAG (Tenny Elisala, Cr Rock Stephen and John Tabo) to broadly develop the conditions for removing the closure in the 'top hat' area.
2. These consultations were planned as a result of RAG advice tabled at FFRAG meeting 8 (4-5 November 2020), agreed to by the Finfish Working Group 25 November 2020.
3. Having regard for the RAG advice, the purpose of undertaking further targeted consultation with Gudamalulgal communities is to:
 - a) further understand the nature and extent of likely fishing effort in the short-term and longer-term industry aspirations and potential impacts on traditional fishing;
 - b) outline the risks with targeting jewfish – a species vulnerable to depletion; and
 - c) discuss with fishers the different options for management approaches for developing the fishery including:
 - opening with data collection and monitoring obligations and a review schedule for assessing whether the opening should continue
 - undertaking a resource survey before opening (noting funding would need to be sourced for this research); and
 - taking an adaptive management approach whereby fishing is allowed in part of the fishery as a means to examine likely impacts and the nature of fishing (noting this option is likely least viable given the small area under consideration)
4. The Working Group on 25 November 2020 recommended that potential biosecurity concerns associated with invasive fish species be considered; supporting the Traditional inhabitant members recommendation to delay community visits until early 2021 to enable more preparation time (AFMA had been working towards including the Western Line Closure matter in meetings scheduled with Gudamalulgal communities for the first week of December 2020).

In early 2021 AFMA could not progress this item due to the limited availability of stakeholders and 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 successful opening.

5. As of 30th September 2021, there was a draft plan to engage in community consultations in April/May 2022. A planning meeting between AFMA and industry members is scheduled to take place in October 2021.
6. The removal of the 'top hat' area of the western line closure requires an amendment to the existing *Torres Strait Fisheries (Finfish) Management Instrument 2020*. Specifically 'Prohibition 15' in the instrument, which legislates the closure, and defines its geographic area, will need to be updated to reflect the newly defined closure area. Such an amendment will require approval by the PZJA.
7. The geographic area of the 'top hat' area will need to be defined.
8. The draft plan of action moving forward is as follows:

October 2021	AFMA and nominated industry members meet to plan and discuss targeted community consultations. Planning will be supported by industry members, using knowledge gained from the beche-de-mer Harvest Strategy and eastern community advice.
October 2021	FFRAG 9 to note and discuss update on planned community consultations
November 2021	Finfish Working Group to note update on planned community consultations
Mar/Apr 2022	Targeted community consultations to be conducted.
Apr/May 2022	AFMA to report the outcomes of community consultations back the RAG and Working Group (OOS)
TBD 2022	PZJA Meeting. Subject to outcomes of community consultations and further RAG and WG advice, the PZJA are to consider approving the amendment of the western line closure.
TBD 2022	Subject to PZJA approval, AFMA to amend the <i>Torres Strait Fisheries (Finfish) Management Instrument 2020</i> to reflect newly defined western line closure.

BACKGROUND

2012

1. The removal of the western closure of the reef-line sector has been a long standing item which has been supported in-principle by the Finfish Working Group.
2. At the FFWG meeting (20 March 2012), TSRA indicated that there was community interest in removing the western closure.

2016

3. At its July 2016 meeting the FFWG noted members had varying views on whether or not sufficient consultation on removing the closure had occurred. A key development since initial consultation on this issue has been the Native Title Determination on the Regional

Sea Claim, and it was noted that notification to the relevant Registered Native Title Bodies Corporate groups would be undertaken prior to the PZJA making a decision.

2017

4. At its March 2017 meeting the FFWG noted progress since the last FFWG meeting to remove the western line closure (as detailed in the agenda paper, work is ongoing to compile outcomes of previous consultation processes). An industry member advised that if the area of the western closure was to be reopened consideration should first be given to:
 - a. how much fishing the area could support noting that the fishing grounds are different from those in the east and concern that the area may not be able to support the number of licences in the fishery; and
 - b. the potential for alternative livelihoods or business opportunities for traditional owners such as ecotourism.
5. Other industry members were generally supportive of this proposal and advised that further community consultation should occur before the western area of the fishery was reopened, to gauge community aspirations on future usage.
6. Noting there are no existing agreements in place to guide resource sharing between sectors (fishing, tourism etc.) the FFWG agreed for following action:
 - a. AFMA, TSRA and Malu Lamar to meet out-of-session to consider an appropriate process to canvass community aspirations and considerations for removing the western line closure.
7. AFMA convened a meeting with Malu Lamar and TSRA on 5 April 2017. The following was agreed:
 - Removal of the western line closure is to be contingent on further community consultation with the western communities and consideration of any sustainability risks. The aim of the consultation will be to determine how communities may/or may not like the resources to be managed to benefit both commercial and tourism industries;
 - TSRA will lead this consultation process (undertaking meetings / report findings etc). TSRA will undertake consultation opportunistically combining with other meetings (e.g. AFMA fish receiver meetings, top western projects);
 - AFMA will seek scientific advice (through the future Finfish RAG) on the possible impacts of removing the closure on stocks, noting advice that the fishing grounds/habitat may be different in the west compared to the eastern area. There is concern that the reefs are shallower and possibly more susceptible to localised depletion.
8. AFMA sought preliminary technical advice from the Finfish RAG (FFRAG 1 9-10 Nov 2017) on what inter-session work will likely be required to assess the likely stock impacts from removing the western line closure. The FRAG had limited amount of time available and FRAG requested a further opportunity to consider the matter. The FRAG did however provide the following preliminary observations:
 - Management is not proposing to increase the TACs for coral trout. In line with this it was suggested that removing the closure might spread the current commercial fishing effort to a broader area.

- RAG noted previous considerations about coral trout catch rates and considered that economic impacts would likely come into effect (hook-shy fish leading to a drop in local catch rates) before ecological impacts might occur.
- Some consideration was given to how the western habitats may be shallower than eastern habitats but data would be required to assess this.
- More fishing operations and freezers may open in the western Torres Strait in line with the outcomes of the current TSRA infrastructure project meaning there may be a total increase in fishing effort with more fishers entering the sector.

2019

9. At their FFRAG 4 meeting (13-14 March 2019) the RAG provided the following advice to support PZJA consideration on releasing a proposal to remove the closure for public comments:

The RAG noted advice from industry members that water turbidity means that fishers in Gudumalagal (top western) communities have fewer months of the year to target finfish compared to eastern, central and south-western Torres Strait communities. The RAG considered that western Torres Strait may be comprised of shallower reef habitats which may have lower carrying capacity than other areas of Torres Strait. Further Traditional Inhabitant boat sector licensed fishers will likely enter the fishery from Western Communities should the closure be removed. The RAG noted that catch data will be collected from operations in these waters through the mandatory Fish Receiver System which will allow monitoring of these extra harvests with analysis through future stock assessments.

The RAG provided the following advice on likely stock impacts from removing the Western Line Closure:

- a) Stocks impacts would likely be negligible, noting removal of the spatial closure would simply increase the total fishable area of the Fishery while all other management arrangements including recommended TACs for coral trout are to remain unchanged; and
- b) The boundary of the Western Line Closure is not likely to correspond to any natural stock boundary. Therefore there is no requirement for separate stock management arrangements within the Protected Zone for finfish species.

10. At its meeting in April 2019 the PZJA agreed to undertake public consultation on the removal of a closure to commercial fishing for finfish (not Spanish mackerel) west of Longitude 142°32'E.
11. Consultation outcomes were considered by the FFRAG (27-28 November 2019), FFWG (29 November 2019) and TRLRAG (10-11 December 2019). Advice from each advisory committee is provided in the **Attachment 4.3a**.
12. A key issue raised during public consultation and then considered by the various PZJA advisory committees was the potential impact on tropical rock lobster from increased fishing pressure on coral trout. The waters north of Turnagin Island are not part of the main TRL fishing grounds.

13. Other issues considered by the FFWG and FFRAG relevant to removing the northern part of the closure include:
 - a. How increased fishing pressure on finfish stocks might negatively impact the availability of fish for local kai-kai subsistence fishing through localised depletion and/or reduce catch rates (FFWG and FFRAG). The FFRAG suggested that management measures such as spatial closures could be introduced to minimise the impacts of commercial fishing on traditional fishing (beyond maintaining a high biomass); and
 - b. A lack of understanding on the extent of fishing likely to occur if the closure was removed (FFRAG). The FFRAG advised that there is a clear need to consider what the increase in reef-line fishing effort in the western Torres Strait might look like in the long term; i.e. how will fishing mortality on the stock change, how many TIB dinghies might fish, how many TIB primary-tender operations might access the fishery and considering what such scenarios may mean in terms of risk to the stock.
14. Noting the advice from Traditional Inhabitant members of the FFWG to open the closure north of Turnagain Island (meeting 29 November 2019) (or Numar Reef as recommended by participants as the recent Fisheries Summit convened by TSRA), AFMA sought further advice from FFRAG (meeting 8) on:
 - a. Likely risks to stocks noting fishing would likely target different finfish species, such as barramundi, salmon and jewfish and at this time, AFMA does not have a good understanding on the likely extent of fishing expected;
 - b. possible options for assessing and monitoring those risks; and
 - c. possible options for mitigating those risks in the short to medium term until more information is available to quantify key risks.

2020

15. As requested by the Finfish Working Group at their 29 November 2019 meeting, the RAG were asked to provide further advice at FFRAG meeting 8 (4-5th November 2020) on the following risks and considerations with lifting the northern part of the closure:
 - a. *General uncertainty on the nature and extent of fishing expected once the closure is removed.* Industry members advised that around 6 operators per community in Gudumalagal (Boigu, Dauan, Saibai) were interested and able to fish in the finfish fishery. Species of interest are Barramundi, jewfish, garfish, 'zarum' and coral trout
 - b. *Impacts on traditional fishing:* The RAG noted that commercial fishing in and around the relatively small near shore habitats may impact traditional fishing catch rates and sought advice from industry members on the likely interaction between the two sectors (commercial and traditional). Industry member advice was that the impact could be managed as it would likely be a relatively small number of fishers working commercially per community.
 - c. *IUU incentives:* It was noted that the opening may have impacts on incentives for Illegal, Unregulated and Unreported fishing, with jewfish swim bladder being a particularly valuable commodity. Dr O'Neill advised that, on the Queensland East Coast, jewfish have proven to be a challenging species to manage with substantial

management actions in place to regulate both commercial and recreational fishing for the vulnerable species.

- d. *Potential targeting of less productive species*: Dr O'Neill advised that, due to netting impacts, another inshore species - King Threadfin Salmon - were also in a vulnerable position at present due to overfishing.
 - e. *Shared stocks with PNG*: Noting the proximity of Gudumalulgal communities to identified key PNG spawning habitat for Barramundi and likely connectivity between the stocks, the RAG noted that AFMA will need to work closely with the PNG National Fisheries Authority on proposed changes. The PZJA will also need to consider obligations under the Treaty alongside any proposed changes to Australian management arrangements for Barramundi. The RAG noted that under the Torres Strait Treaty commercial fishing for Barramundi is limited to only Australian Traditional Inhabitants and only in the Torres Strait within a defined area surrounding six islands within the 'top-hat' of the Protected Zone. Under the Treaty PNG retain the right to fish Barramundi in the waters surrounding these communities within the top-hat.
 - f. *Gillnetting in PNG*: The RAG noted AFMA advice previously tabled in the FFWG by PNG NFA, that fishers in PNG Western Province have had issues with their catch rates using gillnets to target Barramundi and jewfish. As a result PNG NFA have investigated whether fishers can effectively move to line fishing with lures.
 - g. *Community freezer*: An industry member advised that the infrastructure review had suggested a small portable freezer would best be suited to support these communities in the short term during the opening. It was advised that this could be a low risk, cost-effective investment as it could be relocated should the infrastructure not have sufficient usage.
 - h. *Fishery independent survey*: RAG science members advised that a fishery independent stock survey would be the ideal science to understand the finfish stocks in this area noting though that this is an expensive option.
16. The FFRAG supported the suggestion that a targeted round of consultation occurs in Gudumalulgal to discuss the following three options with communities to support opening the reef-line fishery in this area:

Option	Detail
1: Opening with data collection and monitoring	<p>Noting that it would likely only be a few fishers from each community active in the short term, the fishery could be opened with an agreed obligation from these fishers to contribute to monitoring. Monitoring will help form an understanding of what the fishery might look like (who is fishing where, what species, fishing effort) with annual review. The RAG suggested the following options for monitoring to be discussed with communities:</p> <ul style="list-style-type: none"> ▪ CDRs (fish receiver system) status quo arrangement ▪ Daily Fishing Logbooks ▪ Onboard scientific observers (catch comp, bycatch, discards, TEPs, invasive fish species) ▪ Port sampling for biological sampling / verification (potential indicator for future decision rules).

2: Survey before opening	Fishery Independent Survey before opening to inform what the fishery stock is (standing stock biomass), noting that it is good to assess natural mortality while the stocks are relatively unfished.
3: Adaptive management	Run an adaptive management approach which could allow fishing in a part of the fishery. AFMA/RAG are able to then consider the results/risks and apply the learnings to the rest of the fishery (smaller scale experiment first, low level fishing ahead of heavier fishing).

17. AFMA advised that they would engage top-western community members through upcoming community consultations. AFMA advised they could give information for communities to consider and seek their views on:

- aspirations for the fishery – community expectations on what the fishery will look like (number of operators, location, targeted species);
- likely impacts on subsistence fishing;
- likely high risks associated with targeting jewfish;
- data needs – monitoring that would be possible against indicators to support how the fishery is responding to fishing; and
- the need to review the opening after one year to check whether enough data has been captured to feel safe and continue the opening.

AFMA noted the request from industry Tenny Elisala and the offer from industry members Cr. Rocky Stephen and John Tabo to support the Top-Western consultation with lessons learned from the beche-de-mer Harvest Strategy and eastern community advice.

18. The Working Group at their meeting on 25th Nov 2020 noted previous Working Group advice and advice from FFRAG, Tropical Rock Lobster (TRL) RAG discussion, and previous outcomes of public consultation on the proposal to remove the Western Line Closure. The Working Group noted further advice from the FFRAG (meeting 8) on removing the closure in the northern 'top hat' area of the Torres Strait Protected Zone only, for example north of Turnagain Island or Numar Reef. Members noted that that the 'top hat' area does not overlap with significant TRL fishing grounds. Interactions with the TRL Fishery was a key concern raised during public consultations.
19. Noting advice from the FFRAG (as detailed in the agenda item paper), the Working Group supported AFMA's intention to undertake further targeted consultation with Gudamalulgal communities, in partnership with nominated industry members of the RAG (Tenny Elisala, Cr Rock Stephen and John Tabo) to broadly develop the conditions for removing the closure in the 'top hat' area.
20. The Working Group recommended that potential biosecurity concerns associated with invasive fish species be considered; supporting the Traditional Inhabitant members recommendation to delay community visits until early 2021 to enable more preparation time (AFMA had been working towards including the Western Line Closure matter in meetings scheduled with Gudamalulgal communities for the first week of December 2020). Traditional Inhabitant members noted that communities want to open the area but they haven't yet had the information to think through the risks and options for managing those risks. In their view therefore, it was important to not rush and be well prepared, and to share and gather the right information.

ATTACHMENT 4.3a

Summary of PZJA advisory committee consideration and advice on public consultation outcomes on removing the Western line Closure.

FFRAG Meeting 6, 27-28 November 2019, Agenda item 4.1 Western line closure review. Meeting record extract.

1. FFRAG noted the general outcomes of public consultation on the proposal to remove the 'Western Line Closure' and then considered specific concerns raised by communities. FFRAG advice against each of these concerns is detailed in **Table 4** below.
2. The RAG noted advice from Traditional Inhabitant Industry Members that:
 - many communities were not aware of the closure and for others it has been a long-standing issue to have the closure removed; and
 - while some communities raised concerns with the removal of the Western Line Closure, others are very eager to have it removed as a means to provide an important and much needed economic opportunity.
3. As general advice, the FFRAG noted that the key to understanding the true impacts (or risks to the stock) from removing the closure would be to understand the extent of fishing likely to occur if the closure was removed. The RAG advised that there is a clear need to consider what the increase in reef-line fishing effort in the western Torres Strait might look like in the long term; i.e. how will fishing mortality on the stock change, how many TIB dinghies might fish, how many TIB primary-tender operations might access the fishery and considering what such scenarios may mean in terms of risk to the stock.

Table 4. FFRAG advice regarding concerns raised during public comment on the Western Line Closure review.

The potential for increased fishing pressure on coral trout to negatively affect the abundance (availability) of Tropical Rock Lobster (TRL, kaiaar) stocks. Some stakeholders have observed and believe there is a positive relationship between coral trout and TRL abundance (more coral trout = more TRL). It was noted that a different view was held by some who believed coral trout compete with or eat TRL. As a result if coral trout numbers in an area are reduced, TRL numbers will increase.	
FFRAG advice	Given the complexity of trophic interactions (many and varied, for example, direct and indirect impacts on (i) competition for food, (ii) habitat and (iii) predatory-prey interactions), it is extremely difficult to predict and assess potential impacts that fishing one species may have on another. There are studies (to be circulated to FFRAG members) from the Great Barrier Reef and other areas also suggest there are ecological relationships between coral trout and other fish groups including herbivorous fish. Herbivorous fish in turn impact habitats (algae levels) which in turn can impact the abundance on animals that rely on certain habitats (e.g. high algae levels can impact the settlement of shellfish/molluscs which can then be a food source for other animals).

	<p>To quantify these interactions and then assess possible fishing impacts there are at least two options:</p> <ul style="list-style-type: none"> • Long-term depletion experiments (remove coral trout and monitor TRL numbers). Around 5-10 years of experimentation and observation would be required but may still yield uncertain results; • Ecosystem modelling. An ecosystem model could be used to provide general guidance on possible impacts i.e. hypothesis testing. This information would be generalised. <p>The RAG also noted the suggestion that if inner western communities had opposition to removing the closure due to risks to the TRL stocks the closure might be lifted for Gudumalulgal communities only, noting that Top-Western Communities are very supportive of lifting the closure to pursue economic opportunities.</p>
If the Closure is removed, what impact would it have on the TAC (up or down?)	
FFRAG advice	<p>Coral trout within the Torres Strait is currently assumed to form a single stock. Accordingly, the TAC represents a Total Allowable Catch for the stock irrespective of whether or not the Western Line Closure is in place or not. Removal of the Western Line Closure would not warrant a change to the TAC for the purposes of managing risks to the level of the stock.</p>
Fishing effort may be redistributed across the Fishery. Aside from possible increases in effort in new areas, effort may increase in the eastern part of the Fishery as more fishers take an interest in the Fishery.	
FFRAG advice	<p>As detailed above, the RAG advised that the risk from fishing at the stock level, irrespective of where those catches are taken, is not expected to change if the TAC remains the same or continues to be set on the assumption of a single stock. The RAG did consider that there is risk of localised depletion for reef-associated species such as coral trout. Coral trout have been found to have high site fidelity (meaning they don't move far as adults) and monitoring would be required to understand fine scale fishing effort in areas of the fishery over time if understanding localised depletion was a management priority. Science members noted that Vessel Monitoring Systems (VMS) might be a powerful fisheries management tool to help understand this issue.</p>
Increased commercial fishing pressure on finfish stocks in the area of Western Line Closure will negatively impact the availability of fish for local kai-kai.	
FFRAG advice	<p>The RAG noted advice from scientific members that different users of fish stocks (e.g. TIB commercial, sunset, traditional kai-kai fishing) generally have different fishing power. Operators with higher fishing power are generally known to take fish from an area first. It is plausible therefore that if the closure is lifted commercial operators (assuming they are more efficient) may affect kai-kai fishing catch rates overtime. It was suggested that management measures could be introduced to minimise the impacts of commercial fishing on traditional fishing (beyond mainlining a high biomass) if that was a management priority (eg spatial closures).</p>

4. The FFRAG considered that, aside from the status quo with the closure in place, a number of scientific options could potentially be considered to aid understanding the impacts of lifting the closure including:
 - a. Ecological research while the closure remains in place with the outcomes from research to inform a decision on opening/maintaining closure.
 - RAG noted the above advice that ecological research is challenging, and that research into understanding the impacts occurring takes a long time and will be challenging to yield a meaningful result and to understand risks to the stock.
 - b. Ecological research with the closure lifted (research occurring alongside commercial fishing operations could inform maintaining the open area of the fishery)
 - RAG noted similar advice as per point 1 above.
 - c. Closure could be lifted with no research occurring, fishery-dependent data only could be collected for analysis.
 - RAG noted that understanding the risk to the stock would be very challenging as fishery dependent data alone (i.e. logbooks and fish receiver system data) may not be powerful enough.
 - While effort (number of boats entering the fishery) and catch can be monitored, the risks to TRL from trout harvests and the impacts on catch rates for the subsistence users of the stock (from increased commercial take of trout) would not likely be able to be understood from these available data. This is in part due to the difficulties in identifying and measuring the interaction between species, especially noting the variation in TRL abundance year to year.
 - RAG noted mitigation of risk could be achieved by establishing relevant data needs and monitoring requirements to meet these needs. But a relevant management response would need to be developed should monitoring show risk to the stocks was changing; i.e. a policy would be required to describe what levels of catch, changes in effort/participation would cause management to respond.
 - d. An adaptive management approach, where a representative area of the fishery is opened with the response of the area (effort and catch rates) monitored over time.
 - The RAG noted that the benefits of this approach are that potential ecological impacts from this fishing will only apply to a limited area but noted general advice that discerning ecological impacts (e.g. TRL and coral trout interactions) from catch and effort data would be challenging.

FFWG meeting 29 November 2019. Agenda item 5 Western line closure. Meeting record extract

5. The FFWG noted the outcomes of public consultation on the potential removal of the Western Line Closure (the Closure) as detailed in agenda paper. The FFWG noted that there is varied support for the removal across communities within the area of the Western Line closure and that Eastern communities largely reserved commenting on the proposal (noting it was a matter for communities affected/within the closure).
6. Generally communities in the Gudamalagal (top-western) area support the removal of the closure while communities in the Kaiwalagalgal (inner-western) area of the closure do not support its removal due to concerns on the potential ecological and technical interactions with the Tropical Rock Lobster (TRL) Fishery and traditional fishing. Other concerns

raised more broadly were in relation to how potential changes in fishing effort (total levels and distribution) might impact risk of localised depletion, kai-kai (traditional/subsistence fishing) fishing catch rates and the TAC for the stock.

7. The FFWG noted advice from the FFRAG that:

- research on ecological interactions between coral trout and TRL (e.g. to understand the risk to the TRL stock from increased trout harvest) would be difficult and costly to perform successfully and that analysing fishery dependent catch data would also yield little understanding about the effect of increased trout harvests on TRL or kai-kai finfish catch rates over time;
- an adaptive management experiment could be performed by opening a selected area of the fishery and monitoring the response of TRL and trout over time however the likelihood of detecting an impact would be low;
- coral trout within the Torres Strait is currently assumed to form a single stock. Accordingly, the TAC represents a Total Allowable Catch for the stock irrespective of whether or not the Western Line Closure is in place or not. Removal of the Western Line Closure would not warrant a change to the TAC for the purposes of managing risks to the level of the stock;
- there is risk of localised depletion for reef-associated species such as coral trout. Coral trout have been found to have high site fidelity (meaning they don't move far as adults) and monitoring would be required to understand fine scale fishing effort in areas of the fishery over time if understanding localised depletion was a management priority;

8. The FFWG noted advice from the Traditional Inhabitant members and observers that Gudumalualgal communities respected the views held by inner-western communities and are only seeking access to finfish in waters north of Turnagin Island. Unlike inner-western communities who participate the TRL Fishery, Gudumalualgal communities have little employment opportunities, including fisheries (there is limited TRL fishing around Gudumalualgal communities). Within their waters, Gudumalualgal communities wish to fish for other-reef line species such as barramundi, salmon and jewfish, not coral trout.
9. Having regard for community views Traditional Inhabitant members and observers supported the removal of the part of the Western Line closure north of Turnagin Island.
10. The AFMA member also supported this approach noting both advice from communities and advice from the FFRAG. The AFMA member noted however that further advice on concerns raised during public consultation would be sought from the TRL Resource Assessment Group in December. This advice would be shared with the FFWG.
11. The TSRA suggested that the Western Line Closure Review could be progressed at the Torres Strait Fisheries Summit planned for April 2020, which would enable a discussion to be had by all stakeholders and attempt to reach some consensus from industry about maintaining or removing the closure.

TRL RAG meeting 27th, 10-11 December 2019. Agenda item 8. TRL interactions with coral trout. Meeting record extract.

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

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 -15 October 2021
RESEARCH Environmental drivers	Agenda Item 5.1 For DISCUSSION & ADVICE

RECOMMENDATIONS

1. That the RAG:

- a) **NOTE** a presentation provided 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).
- b) **NOTE** that this project was funded by the Torres Strait Scientific Advisory Committee (TSSAC) in the 2019-20 funding round.
- c) **DISCUSS** and **PROVIDE ADVICE** on the project outcomes and any further consideration required by the RAG including research and monitoring needs to support future stock assessments.

BACKGROUND

2. This study was identified as a key specific need for the Spanish mackerel fishery to better understand the factors underlying the declining CPUE trend for Spanish mackerel and the working hypothesis of the RAG that environmental drivers influence population trends (based on advice from industry about changes in water salinity and turbidity at Bramble Cay potentially linked to Fly River outflow or drought in PNG). This is an issue for the Torres Strait Spanish mackerel stock and is also reportedly impacting mackerel catch rates across northern Australia.
3. The main objectives of this project were to:
 - a) Characterise the TS Spanish Mackerel fishery, reviewing and updating the assessment with 2018-19 and 2019-20 seasons' data, presented at 2019 and 2020 Finfish Resource Assessment Group (RAG) meetings.
 - b) Review environmental associations with TS Spanish mackerel, e.g. by comparing environmental data such as temperature, rainfall, productivity etc, with catch patterns, recruitment anomalies, and trends in catchability, presented at the September and November 2019 RAG meetings.
 - c) Conduct an assessment of the fishery including new 2018-19 season catch and effort information acquired to 30 June 2019, presented at the September & November 2019 RAG meetings.
 - d) Conduct an assessment of the fishery including new 2019-20 season catch and effort information acquired to 30 June 2020, presented at the September & November 2020 RAG meetings for technical review, ahead of a final presentation and report to the Finfish Working Group.
 - e) Provide recommendations on research and monitoring needs to support future assessments.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14-15 October 2021
RESEARCH Project update – Spanish mackerel and coral trout biological sampling	Agenda Item 5.2 For NOTING

RECOMMENDATIONS

1. That the RAG **NOTE** the update provided via video conference at the meeting by Jo Langstreth and Andrew Trappett, Queensland Department of Agriculture and Fisheries (QDAF), on the biological sampling project.

BACKGROUND

1. Age data is an important input into the Spanish mackerel stock assessment, helping to understand: changes in abundance, the impact of fishing and fishing selectivity, as well as recruitment variability. In line with recommendations from the FFRAG, the collection of age and length data for Spanish mackerel resumed in the 2019-20 fishing season (most recent ageing data before this was from 2005).
2. QDAF, led by Jo Langstreth, was funded by AFMA and TSRA to undertake the sampling (AFMA Project number: 2019/0832, project title: *Enhancing biological data inputs to Torres Strait Spanish mackerel stock assessment*). An updated summary of the final results from the 2019/20 project is provided as Attachment 5.2a.
3. A subsequent project was funded to continue sampling in the 2020-21 fishing season. Under the project, for the first time, samples were collected from coral trout (AFMA project number: 190851, project title: *Torres Strait Finfish Fishery: Coral trout and Spanish mackerel biological sampling*).
4. The project was recently funded again for another three fishing seasons 2021-22, 2022-23, 2023-24 (contract formed 28 Aug 2021) (AFMA project number 2020/0814, project title: *Torres Strait Finfish Fishery Coral Trout and Biological Sampling 2021-2024*). On 14 September 2021, the project team wrote to Torres Strait Finfish Fishery stakeholders advising them of the continuation, objectives and intended outcomes of the project (see Attachment 5.2b).
5. Research has started for the current fishing season with Spanish mackerel samples already being collected and processed (length, sex and otoliths taken for ageing later in the season) at the Cairns based laboratories.
6. As part of the project, the project team has planned community visits for:
 - 18-19 Oct on Mer, 20-22 Oct on Erub
 - 29-30 Nov on Mer, 1-3 Dec on Erub
7. Jo Langstreth and Andrew Trappett will be attending the FFRAG meeting via video conference to provide a project update. Members are asked to consider the update and if relevant, provide any advice on any additional initiatives to ensure industry support and participation in the sampling.

Torres Strait Spanish mackerel sampling 2019–20 results

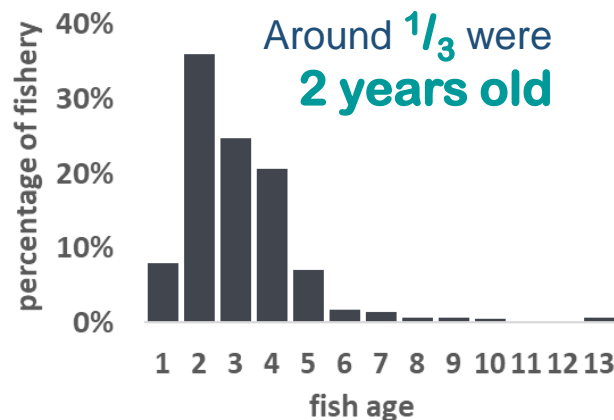
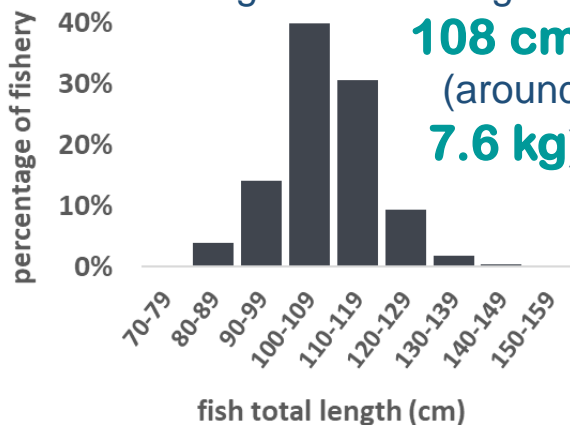
Commercial catch
sampled in **Erub**, **Masig**
and **Ugar** – and fishing
grounds, including
Bramble Cay



Mackerel are aged by counting
growth rings of ear bones
under a microscope –
just like growth rings of
a tree trunk!



Most fish caught were between
100 cm and **120 cm** total
length – an average of
108 cm
(around
7.6 kg)



Around $\frac{1}{3}$ were
2 years old

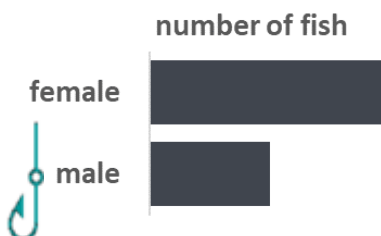
The oldest fish was
13 years old



The largest fish was a total
length of **158 cm**



Around
 $\frac{2}{3}$ were
female



Thanks to everyone who provided data to
help communities understand their fisheries.

We need more volunteers in 2020–21.

If you'd like to help, call:

- Fisheries Queensland
📞 **13 25 23**
- Australian Fisheries
Management Authority
📞 **1300 723 621**



Australian Government
Australian Fisheries
Management Authority



Queensland
Government

14 September 2021

Dear Torres Strait Finfish Fishery Stakeholder,

I am writing to advise of the successful funding for continuing the *Torres Strait Finfish Biological Sampling Program* through to June 2024.

This three-year project - *Torres Strait Finfish Fishery: Coral Trout and Spanish Mackerel Biological Sampling 2021-24* - is funded by Protected Zone Joint Authority (PZJA) management agencies (Australian Fisheries Management Authority (AFMA), Torres Strait Regional Authority (TSRA) and Fisheries Queensland) and is being led by Fisheries Queensland (Jo Langstreth and Andrew Trappett).

This continues the research conducted in both the 2019-20 and 2020-21 fishing seasons. The need for the research has been identified as a high priority by the PZJA Advisory Groups (Finfish Resource Assessment Group and Finfish Working Group) due to the uncertain stock status of Spanish mackerel and the concern about declining catch rates shown in recent stock assessments. There is also a need to collect information to support the Torres Strait coral trout stock assessment which was only conducted for the first time in 2019.

With your support, we will continue working with your community over the next three years to achieve the objectives of the research which are to:

1. Collect information from commercial catches on the **sex, lengths** and **ages** of Spanish mackerel and coral trout.
2. Collect information on the **catch composition** of coral trout (percentage split between the four main commercial species).
3. Analyse this information and securely provide the results to AFMA to support Spanish mackerel and coral trout stock assessments.
4. Report the findings back to the PZJA and communities.

To achieve the objectives the project team will continue to:

- Work with fishers and fish receiver businesses in your community to collect biological information from the Traditional Inhabitant Boat (TIB) sector for study. Across eastern communities we are seeking to:

- Collect **100-200 Spanish mackerel frames** per season.
- Collect **100-200 coral trout frames** per season.
- Measure every fish from **20-30 Spanish mackerel catches** per season.
- Measure every fish from **20-30 coral trout catches** per season.

- Visit Erub and Mer communities twice during the season to take any samples fishers and community members can keep frozen to support the project.
- Work with fish receiver businesses to keep frozen fish frames and ship these to the Cairns laboratories (Northern Fisheries Centre) at intervals through the pre-paid Seaswift account.
- Analyse the samples provided at the Cairns laboratories and report these data back to communities electronically and when visiting.

The Sunset sector will also continue to provide several hundred Spanish mackerel and coral trout frames per season (**200-300**) along with measuring 20-30 catches.

The information collected will be useful to:

- assist communities, scientists and managers to better understand the status of the Torres Strait Spanish mackerel and coral trout stocks,
- inform the scientific stock assessments for the Torres Strait Finfish Fishery that set appropriate catch levels for the fishery,
- maintain the profitability and long-term sustainability of the Spanish mackerel and coral trout fisheries in the Torres Strait which support local businesses, and
- empower communities with information to support making their own local management arrangements for their sea country and resources.

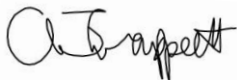
The next step will be for myself (Andrew Trappett) contacting Torres Strait Island Regional Council Councillor's and Island Native Title Prescribed Body Corporates to arrange dates that will work for communities to have the team visit. These visits are to conduct sampling and share results from the 2020-21 fishing season that was recently completed. I also will be contacting fishers and fish receivers asking them to continue retaining samples and filling out length sheets for collection by the project team during the first visit.

Further information on the project is available on the PZJA webpage here:

<https://www.pzja.gov.au/torres-strait-biological-sampling-program>. Please contact me (or one of the other project partners below) if you would like any additional information or if you would like to discuss any concerns or provide feedback.

I hope to see you soon and look forward to continuing to work with you.

Yours sincerely



Andrew Trappett
Fisheries Biologist, Fishery Monitoring
Fisheries Queensland
0488 021 694
andrew.trappett@daf.qld.gov.au

Additional contacts:

Project lead: Jo Langstreth (QDAF) 07 4241 1200 Joanne.Langstreth@daf.qld.gov.au;
 Project partner: Kayla Yamashita (AFMA) 07 4069 1990 or Kayoko.Yamashita@afma.gov.au
 Project partner: Quinten Hirakawa (TSRA) 07 4069 0700 or Quinten.Hirakawa@tsra.gov.au

Important Note on COVID-19: Project staff will not be visiting the Torres Strait while any COVID-19 travel restrictions are in place. Project staff will follow all Government guidelines and will discuss any visit with community leaders before planning any travel.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 -15 October 2021
RESEARCH Designing a close-kin mark-recapture study for Torres Strait Spanish mackerel	Agenda Item 5.3 For NOTING

RECOMMENDATIONS

1. That the RAG:

- a) **NOTE** the video presentation provided by Dr Ashley Williams on the status of the project *Designing a Close-Kin Mark-Recapture study for Torres Strait Spanish mackerel* (project number 200817).
- b) **NOTE** that this project was supported for funding by the Torres Strait Scientific Advisory Committee (TSSAC) at their 79th meeting held on 9-10 June 2021.

BACKGROUND

2. This study was funded to design a full-scale close-kin mark-recapture (CKMR) study to estimate the current level and trend in spawner biomass of Spanish mackerel in Torres Strait. The project will evaluate alternative sampling designs and their associated costs and resource requirements for their implementation in a full-scale CKMR monitoring program for Spanish mackerel.
3. The main objectives of this project are to:
 - a) Examine genetic population structure between the Torres Strait population of Spanish mackerel and surrounding populations on the Queensland east coast, Gulf of Carpentaria and the Gulf of Papua; and
 - b) Using information on population structure from objective (a), and rough abundance estimates from existing stock assessments, design a full-scale CKMR study to estimate the current level and trend in spawner biomass of Spanish mackerel in the Torres Strait, including an evaluation of alternative sampling designs and their associated costs and resource requirements for their implementation in a full-scale CKMR monitoring program for Spanish mackerel.
4. A copy of the full project proposal is provided at **Attachment 5.3a**.
5. The research was initially identified and discussed by FFRAG 5 (31 Oct – 1 Nov 2019) and FFRAG 6 (27-28 November 2019) as a need to develop an alternative index of abundance for Spanish mackerel other than the relative abundance provided from fishery dependent logbook catch rate data noting the relatively data-poor state of the fishery with few vessels providing data to build a signal of stock trends.
6. AFMA and the RAG technical members discussed out of session that progressing a close-kin mark-recapture study could be feasible and would likely address abundance and reliance on the stock assessment as well as address genetic connectivity and hyper-stability issues in the longer term.

7. FFRAG 7 (8 October 2020) recommended that a scoping study for CKMR could report on whether the method would work biologically the number of samples that would be required over time (based on the population model) and how the technique might provide other insights such as connectivity with adjacent stocks. This research was supported as essential, and ranked as number for in the priority for research funding in the 2020-21 TSSAC funding round.

Torres Strait Scientific Advisory Committee research application

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

X

Pre-proposal (Please complete Sections 1-4 inclusive)

Full Research Proposal (Please complete sections 1-8)

SECTION 1 - ADMINISTRATIVE SUMMARY

Project title:	Designing a close-kin mark-recapture study for Torres Strait Spanish mackerel		
Applicant (organisation or person):	CSIRO		
Contacts			
<u>Administrative</u>			
Title/Name:	Ms Bonnie Lau	Phone:	08 6436 8614
Position:	Finance Advisor	Email:	bonnie.lau@csiro.au
Organisation:	CSIRO Oceans & Atmosphere	Postal address:	CSIRO Marine Laboratories, GPO Box 1538, Hobart, TAS, 7001
<u>Principal Investigator (person)</u>			
Title/Name:	Dr Ashley Williams	Phone:	0456 188 321
Position:	Principal Research Scientist	Email:	ashley.williams@csiro.au
Organisation:	CSIRO Oceans & Atmosphere	Postal address:	CSIRO Marine Laboratories, GPO Box 1538, Hobart, TAS, 7001
<u>Co-investigator (s)</u>			
Title/Name:	Dr Mark Bravington	Phone:	03 6232 5222
Position:	Principal Research Scientist	Email:	mark.bravington@csiro.au
Organisation:	CSIRO Oceans & Atmosphere	Postal address:	CSIRO Marine Laboratories, GPO Box 1538, Hobart, TAS, 7001
<u>Co-investigator (s)</u>			
Title/Name:	Dr Pierre Feutry	Phone:	03 6232 5222
Position:	Senior Research Scientist	Email:	pierre.feutry@csiro.au
Organisation:	CSIRO Oceans & Atmosphere	Postal address:	CSIRO Marine Laboratories, GPO Box 1538, Hobart, TAS, 7001
<u>Co-investigator (s):</u>			
Title/Name:	Dr Shane Baylis	Phone:	03 6232 5222
Position:	Postdoctoral Fellow	Email:	shane.baylis@csiro.au

Organisation:	CSIRO Oceans & Atmosphere	Postal address:	CSIRO Marine Laboratories, GPO Box 1538, Hobart, TAS, 7001
<u>Co-investigator (s)</u>			
Title/Name:	Dr Rasanthi Gunasekera	Phone:	03 6232 5222
Position:	Senior Experimental Scientist	Email:	rasanthi.gunasekera@csiro.au
Organisation:	CSIRO Oceans & Atmosphere	Postal address:	CSIRO Marine Laboratories, GPO Box 1538, Hobart, TAS, 7001
<u>Co-investigator (s):</u>			
Title/Name:	Dr Ben Mayne	Phone:	08 6488 7270
Position:	Postdoctoral Fellow	Email:	benjamin.mayne@csiro.au
Organisation:	CSIRO Oceans & Atmosphere	Postal address:	Bldg 453 UWA, Fairway Crawley WA 6009 Australia
<u>Co-investigator (s):</u>			
Title/Name:	Dr Rik Buckworth	Phone:	0435 120 107
Position:	Principal Research Scientist	Email:	rik.buckworth@gmail.com
Organisation:	Sea Sense Australia Pty Ltd	Postal address:	PO Box 375 Mission Beach Qld 4852
<u>Co-investigator (s):</u>			
Title/Name:	Andrew Trappett	Phone:	0429 324 642
Position:	Fisheries Biologist	Email:	andrew.trappett@daf.qld.gov.au
Organisation:	Fisheries Queensland QDAF	Postal address:	Northern Fisheries Centre PO Box 5396, Cairns QLD 4870
Planned Start and End Date			
Start Date:	12/07/2021	End Date:	11/07/2022

SECTION 2 – PROJECT DESCRIPTION

PROJECT BUDGET: (Excluding GST)

With epigenetic ageing

Financial Year	AFMA	Applicant (in kind)	Applicant (cash)	Other
2021-22	\$92,342	\$10,000*	\$39,575	
Totals	\$92,342	\$10,000	\$39,575	\$141,917

Extension option:

Without epigenetic ageing

Financial Year	AFMA	Applicant (in kind)	Applicant (cash)	Other
2021-22	\$84,855	\$10,000*	\$36,366	
Totals	\$84,855	\$10,000	\$36,366	\$131,221

*Project time for co-investigators Buckworth and Trappett is an in-kind contribution to the project

SECTION 3 – PROJECT DESCRIPTION

Background and need (max 250 words) - *detail any important background relating to the project. Why it is important and being proposed (need). Any related projects or other information the TSSAC should know when considering it for funding.*

The Torres Strait Spanish mackerel stock was recently estimated to be at 23% of unfished spawning biomass (SB) (O'Neill et al. 2019), close to the limit reference point of 20%. Standardised fishery-dependent catch-per-unit-effort (CPUE) data are the only source of information to estimate SB for Spanish mackerel. However, the Torres Strait Finfish Resource Assessment Group (FFRAG) has identified a number of uncertainties in the standardised CPUE series, including potential hyperstability and the small number of vessels in the fishery that contribute useful CPUE data. Thus, the standardised CPUE series may be an unreliable index of relative SB, generating significant uncertainty in assessment outputs.

Close-kin mark-recapture (CKMR) is a new, but proven, technique that uses modern genetics to identify closely related pairs from samples of fish, enabling estimation of key population parameters, such as absolute SB and natural mortality, without needing CPUE (Bravington et al. 2016a). CKMR has been successfully applied since 2013 to another pelagic population (southern bluefin tuna), transforming its stock assessment and forming an ongoing key index (Bravington et al. 2016b, Hillary et al. 2020, Anon 2020, Davies et al. 2020), as well as to six Australian shark species (e.g. Hillary et al. 2018, Thomson et al. 2020). Successfully completed CKMR studies for fish stocks overseas include Rawding et al. (2013), and Ruzzante (2019).

A successful CKMR study for Torres Strait Spanish mackerel would provide much needed fishery-independent estimates of spawning biomass, natural mortality, age-specific fecundity, and connectivity. However, CKMR studies can fail altogether unless properly designed, e.g. in terms of sample size and composition and spatial coverage. This project will do the design work to ensure success of a subsequent full-scale study.

It is important to note that the current AFMA-funded biological sampling project is completely complementary with a full-scale CKMR study. That is, the implementation of a full-scale CKMR study would seek an expansion in the biological sampling project to include the sampling of muscle tissue. The data derived from the continued collection of length, otoliths and gonad samples from the biological sampling project would continue to be essential inputs into the CKMR population model and stock assessment, as it will remain important to have information on the age, length and sex composition of the catch.

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O'Neill M, Buckworth R, Trappett A 2019. Torres Strait Spanish mackerel: Stock assessment 2019. Stage 1 Project report Torres Strait AFMA Project Number: 2019/0831.

Rawding DJ, Sharpe CS, Blankenship SM 2014. Genetic-Based Estimates of Adult Chinook Salmon Spawner Abundance from Carcass Surveys and Juvenile Out-Migrant Traps, *Trans Am Fish Soc.* 143:1, 55-67

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Thomson R, Bravington M, Feutry P, Gunasekera R, Grewe P 2020. Close Kin Mark Recapture for School Shark in the SESSF. FRDC 2014/024, Final report to the FRDC.

Objectives / performance indicators (max 250 words) - *list the major objectives or planned outcomes of the project. These will form your project milestones:*

The main objectives of this study are to:

- i) Examine genetic population structure between the Torres Strait population of Spanish mackerel and surrounding populations on the Queensland east coast, Gulf of Carpentaria and the Gulf of Papua,
- ii) Implement a pilot sampling program to evaluate the potential for industry to collect tissue samples from Spanish mackerel with minimal cross-contamination, and
- iii) Using information on population structure from objective i), the results from the pilot sampling programs from objective ii), and rough abundance estimates from existing stock assessments, design a full-scale CKMR study to estimate the current level and trend in spawner biomass of Spanish mackerel in Torres Strait, including an evaluation of alternative sampling designs and their associated costs and resource requirements for their implementation in a full-scale CKMR monitoring program for Spanish mackerel.

Extension option:

A full-scale CKMR project will require the collection of thousands of tissue samples, with age estimates required for most samples. Currently, the AFMA-funded biological sampling project collects and processes approximately 200-300 otoliths per year. To increase this current otolith sampling and processing to provide the thousands of age estimates required for a CKMR project would be logistically difficult and very costly. Finding an alternative ageing method that is more cost effective and logistically feasible would be a priority for a CKMR study, noting that the precision in age estimates required for CKMR can be less than that required for the age estimates for the stock assessment. Recent advances in epigenetic ageing are demonstrating encouraging results, with relatively high precision of age estimates compared with otolith-derived estimates, including for other scombrid species. The collection and processing of otoliths from the AFMA-funded biological sampling project provides an excellent opportunity (because the otoliths have already been collected and aged, and tissue samples are available for many of them) to determine the precision of epigenetic ageing for Spanish mackerel (noting that the precision of epigenetics ageing varies between species, so processing tissue samples is required). Therefore, an additional objective of this project (with an additional cost to AFMA of \$8,100 – see costings above) is to:

- iv) Evaluate the utility of epigenetic ageing to provide accurate estimates of age for Spanish mackerel. This will involve a comparison of the relative cost vs precision in estimating age from otoliths or from epigenetics based on the sample sizes indicated from the CKMR design study.

Consultation and Engagement - Note consultation is required for both the pre- and full-proposal phases for TSSAC projects. This differs from AFMA Research Committee Proposal requirements.

Pre-proposal phase consultation

Briefly detail (this will form the skeleton of your community engagement strategy which must be developed as part of full proposal phase):

- the areas in the Torres Strait region where the proposed research activities may occur
- the Torres Strait community groups or individuals that you will engage/involve from these areas in the development of and or during the project if it reaches full proposal phase (refer to Step 2 of Attachment A - Procedural Framework for Researchers in the Torres Strait).
- how you plan to engage/involve key stakeholders (e.g. community notices, telephone, email, employment, interviews, meetings, workshops) in the project development. Note, any potential fee for service rates need to be factored into your research project budget.

This project is motivated based on the need expressed by stakeholders for this information to support improved monitoring and management of the Spanish mackerel fishery. The results of this project will be shared with stakeholders via formal channels such as the Torres Strait Finfish RAG and Working Group, and also in a non-technical summary to all stakeholders. Samples for this project will be sourced from the AFMA-funded biological sampling project in Torres Strait (eastern Islands) and the existing Queensland Fisheries Fishery Monitoring program. Some additional consultation with Torres Strait fisheries representatives and TSRA members will occur during meetings of the Torres Strait Finfish RAG and Working Group.

If there has been any initial consultation and engagement outline with whom and key outcomes (note consultation is **not** necessary at the EOI stage but has sometimes occurred through existing relationships).

No initial community consultation has occurred, although the concept of the project has been discussed at the two most recent Torres Strait Finfish RAG meetings (October and November 2020) where it received full support from RAG members.

Full proposal consultation and engagement

In accordance with the Procedural Framework for Researchers in the Torres Strait (Nakata 2018; Procedural Framework), the TSSAC full proposal requires two different aspects be completed.

1. Develop a stakeholder engagement strategy, including a plain-English community consultation package which should be used to undertake preliminary consultation with relevant stakeholders as part of your full proposal application. Follow instructions in Appendix 4 of the procedural framework ([Attachment A](#)).

2. Provide documentation and outcomes from the preliminary consultation and engagement conducted, including:

- The level of stakeholder support – particularly from Traditional Inhabitants for the proposed work (include a list of who was contacted and whether they support the project, or if not, why).
- Any perceived risks or stakeholder considerations with the project.
- How traditional knowledge might be considered or incorporated to enhance the project, its outcomes and benefits.

- Any activities suggested by Traditional inhabitants to improve the project, or bring it into alignment with community needs.
- How the research outcomes will benefit Traditional Inhabitants directly or indirectly, or why it is not relevant/applicable (i.e. projects in the prawn fishery).

Attach the stakeholder engagement strategy (which should have been updated as required following initial consultation) with your full proposal application.

This project is a lab-based desk top study and no specific community consultation is proposed. However, Traditional inhabitants from the eastern islands will be indirectly involved through their participation in providing samples to the AFMA-funded biological sampling project in Torres Strait which will be used in this project to evaluate connectivity among Spanish mackerel populations.

Traditional inhabitants will benefit directly from this project through a better understanding of how their resource is connected with populations in neighboring regions and from the development of a detailed design for the implementation of a full-scale CKMR study which can provide an unbiased estimate of absolute spawner abundance of Spanish mackerel in Torres Strait. A more robust estimate of spawner biomass provides more certainty in stock assessments which in turn will provide opportunities for economic development and employment for Traditional inhabitants, and maximise the Total Allowable Commercial Catch.

Methods (max 250 words) – Please detail the basic methods that will be used to undertake this project.

A minimum of 50 tissue samples will be collected from each of 4 main locations: Torres Strait, Gulf of Papua in PNG, Queensland east coast and Gulf of Carpentaria. Tissue samples will be sourced from the AFMA-funded Torres Strait Biological Sampling Program and the Fisheries Queensland Fishery Monitoring Program. Additional samples will be sourced from the Gulf of Papua with the assistance of the PNG National Fisheries Authority. Each tissue sample will be genotyped and single nucleotide polymorphisms (SNPs) used for population grouping analysis using the R package stockR (Foster 2018). SNPs provide greater resolution than other genetic approaches previously used for Spanish mackerel (i.e. allozyme genetics, mitochondrial DNA and microsatellite nuclear markers), and greatly improve the power to detect population structure by reducing significantly the risk of failing to identify barriers to gene flow due to a lack of adequate genetic resolution.

A pilot sampling program will engage commercial fishers to assist with collecting muscle tissue samples from Spanish mackerel. Fishers will be supplied with a specially designed genetic sampling tool (widget) and associated tips which minimises the risk of DNA contamination between fish samples. The fishers will be trained in using the widget, and tissue samples will be collected from a target of 1000 fish selected from the fish that are currently measured as part of the AFMA-funded biological sampling project. Tissue samples will be placed in pre-filled vials of RNAlater (preservative) and stored cool on the vessel (no need to be frozen) until it offloads. Tissue samples will be sent to CSIRO and a subsample (~50) from the first trip will be analysed to evaluate the level of contamination. Assuming the level of contamination is low, the sampling will continue until the end of the 2021 season. If the contamination is high, the sampling technique will be evaluated to determine if additional training or equipment is needed.

The degree of connectivity among populations estimated from objective i) will be used to develop a CKMR population model to statistically evaluate the number and distribution (in space, time, size, sex) of samples required to provide a reasonably precise (e.g. $CV < 0.2$) estimate of spawner biomass of Spanish mackerel in Torres Strait. Information from recent stock assessments (O'Neill et al. 2019) will be used to parameterise the CKMR population model and to provide a plausible starting range for abundance.

Preliminary analyses, using a range of simplifying assumptions that would be addressed in this CKMR design study, estimate the required sample size for a full-scale CKMR project would be in the order of 3-5000 tissue samples to obtain a CV of 0.2. However, it is not necessary to collect all these samples in a single year, as the strength of the CKMR approach is that samples collected over multiple years provide cumulative information. Therefore, the target sample size (e.g. 3-5000) could be collected over say 3-5 years, reducing the burden on sampling. Given the biological sampling project has collected length measurements from around 2500 fish

over the past two years, which could easily be sampled for muscle tissue, there are good avenues for accessing samples. It would then be a matter for further RAG advice as to whether a CKMR would be used to produce a single biomass estimate or continued beyond this initial period to become part of an ongoing monitoring method.

Prior to submitting this proposal, the project team discussed the potential for a joint proposal with a group of managers and scientists from other States and territories (NSW, QLD, NT and WA). While there was genuine interest in pursuing a broader northern Australia CKMR project across all jurisdictions, financial support for such a project was considered to require a longer period of consultation to secure. The group considered that FRDC could be a potential option for funding a broader project, and that a CKMR design study for Torres Strait would provide a good proof of concept in support of such a proposal.

Extension option:

The feasibility of epigenetic ageing for Spanish mackerel CKMR samples will be investigated as a potentially cheaper and easier alternative to otoliths, and a more accurate alternative to inferring age from length. A more cost-effective method for estimating age will be particularly valuable for the implementation of a full-scale CKMR project that will likely require age information from a large sample size.

It is very unlikely that a sufficient number of otoliths can be sampled and processed to provide age estimates for a full-scale CKMR project, given the substantial amount of field work required to collect otoliths and the cost and time involved in processing and ageing a large number (thousands) of otoliths. Developing an epigenetic approach to ageing during this CKMR design study will enable the implementation of a full-scale CKMR study to commence immediately on completion of the design study. If the epigenetic ageing approach was evaluated after the CKMR design study is completed, then there would be a delay of around 1 year prior to implementing a full-scale CKMR project, and it may be difficult to assemble the required project team to do the work in isolation. Furthermore, it is not possible to simply evaluate the feasibility of epigenetic ageing for Spanish mackerel without analysing tissue samples, given that there is significant variation in the precision of the method among species. Therefore, the approach proposed in this project is the most efficient for evaluating the feasibility of epigenetic ageing for Spanish mackerel.

References

Foster S 2018. stockR: Identifying stocks in genetic data. R package version 1.0.74

Planned outcomes and benefits (max 150 words) – this should include how the research will be used by management to benefit the fishery and other stakeholders:

This project will deliver new information on the contemporary population structure of Spanish mackerel in northern Australia, which is essential for the effective management of this species across multiple jurisdictions. Current management arrangements and stock assessments assume separate stocks of Spanish mackerel in Torres Strait, Gulf of Carpentaria, Queensland east coast and PNG. Results from this project will allow managers to re-evaluate these key assumptions and determine if current management arrangements are appropriate.

This project will also deliver a comprehensive design for a full-scale CKMR study for Spanish mackerel in Torres Strait. The design study will provide clear advice on the pros and cons of alternative sampling designs and the costs and resources required for their implementation in a full-scale CKMR monitoring program for deriving biomass estimates with various levels of precision for Torres Strait Spanish mackerel. The implementation of a full-scale CKMR study would provide an unbiased estimate of absolute spawning biomass of Spanish mackerel in Torres Strait and more certainty in stock assessments, which would provide managers with more confidence in setting recommended biological catches at appropriate levels.

Project extension (max 100 words) - *are there possible future research options that could result from this project?*

Extension is the main purpose of this project, i.e. to prepare the way for a future full-scale CKMR project by evaluating and costing alternative sampling designs. A full-scale project would involve collecting and genotyping many thousands of samples, so would require significantly more resources, but could be developed into an ongoing monitoring program for Spanish mackerel, providing an ongoing fisheries-independent index of spawning abundance for use in stock assessments and harvest strategies. Future research opportunities may also arise if further refinement of the population structure is desired to provide more precise resolution of population boundaries.

Risk Analysis - *be sure to consider risks specific to conducting research in the Torres Strait including community support or lack there-of.*

This project is relatively low risk as the project is primarily a lab-based desk top study and the project team has extensive experience in the application of methods for analysing population structure and CKMR design work.

Collecting the required number of samples for population structure is considered very low risk as sample collection from all locations will be facilitated by existing projects. However, difficulties may arise in sourcing samples from PNG, as there are currently no sampling programs in place. Additional efforts will be made to develop a reliable network with PNG NFA staff and local seafood buyers to maximise the opportunities for sample collection in PNG.

However, the risk to the project of not collecting samples from PNG is low. This is because there is currently no commercial fishing for Spanish mackerel in PNG (only low levels of subsistence fishing), which means that the CKMR model does not need information on fishing mortality from PNG. However, if commercial fishing was to commence in PNG, then samples from PNG would become more important.

Related Projects and Research Capacity (max 100 words) - *Are there any past or current projects relevant to this proposal funded through the TSSAC, TSRA, FRDC or other organisation? Outline the Investigators' experience in the proposed research and Torres Strait region.*

Samples for this project will be sourced from the AFMA-funded Torres Strait Biological Sampling Program (Project 2019/0832) and the Queensland DAF-funded Fishery Monitoring Program. Outputs from the AFMA-funded stock assessments (Project 2019/0831) will be used to will be used to design CKMR sample sizes. Previous FRDC-funded research (Project 1998/159) on the stock structure of Spanish mackerel across northern Australia will provide useful background information for evaluating contemporary population structure.

The assembled project team has extensive experience relevant to the proposed project. While the project team is large for a relatively small project, all listed project team members are essential for the delivery of this project. To reduce costs to the project, co-investigators Buckworth and Trappett will provide all their time as an in-kind contribution to the project, which has reduced the cost of the project relative to the pre-proposal. The cost for co-investigator Mayne will only be required if the extension option for the epigenetics work is agreed. All other co-investigators are costed at 5% FTE or less.

The relevant skills of the project team include:

Williams and Buckworth are scientific members of the FFRAG and have extensive experience in Spanish mackerel fisheries and research in the Torres Strait region. Feutry, Gunasekera and Bayliss have experience in collecting, processing and analysing genetics data for population structure, including specific experience for Spanish mackerel across the Indian Ocean. Bravington and Bayliss have established methods for kinship identification and CKMR design work. Trappett has established methods for collection of biological samples from the Torres Strait, and is coordinating the sampling for the biological sampling project from which samples for this project will be obtained. Mayne has developed epigenetic ageing approaches for estimating the age of fish.

SECTION 4 - Schedule of Payments

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

With epigenetic ageing

Milestones	Deliverable date (Please refer to instructions)	Schedule of AFMA payment(s) (excluding GST)
Initial payment on signing of contract	12-Jul-21	\$12,342
Preliminary analysis of population structure	1-Dec-21	\$25,000
Preliminary CKMR model developed & epigenetics ageing approach evaluated	1-May-22	\$25,000
Draft final report	10-Jun-22	\$30,000
TOTAL		\$92,342

Extension option: Without epigenetic ageing

Milestones	Deliverable date (Please refer to instructions)	Schedule of AFMA payment(s) (excluding GST)
Initial payment on signing of contract	12-Jul-21	\$9,855
Preliminary analysis of population structure	1-Dec-21	\$25,000
Preliminary CKMR model developed	1-May-22	\$25,000
Draft final report	10-Jun-22	\$25,000
TOTAL		\$84,855

SECTION 5 - Description of Milestones

Details on each milestone must provide sufficient information to justify the milestone cost and should match the performance indicators. The description field will describe the work to be completed for that milestone with the justification field elaborating further on the categories of cost - for example salary.

Milestone: Initial payment on signing **Date:** 01-Jul-21

With epigenetic ageing

Financial Year	Salaries	Travel	Operating	Capital	Total
2021-22	\$12,342	\$0	\$0	\$0	\$12,342

Extension option: Without epigenetic ageing

Financial Year	Salaries	Travel	Operating	Capital	Total
2021-22	\$9,855	\$0	\$0	\$0	\$9,855

Description:

Initial payment on signing of contract.

Justification:

Project team salary for initial project planning meetings to determine the sampling strategy for collecting tissue samples from PNG and to organise lab processing systems to enable genetic analyses.

Note: The project time for co-investigators Buckworth and Trappett is an in-kind contribution to the project, and no salary is sought

Milestone: Preliminary analysis of population structure **Date:** 01-Dec-21

With epigenetic ageing

Financial	Salaries	Travel	Operating	Capital	Total
2021-22	\$13,310	\$1,400	\$10,290	\$0	\$25,000

Extension option: Without epigenetic ageing

Financial Year	Salaries	Travel	Operating	Capital	Total
2021-22	\$14,010	\$1,400	\$9,590	\$0	\$25,000

Description:

A preliminary genetic analysis of population structure to determine the relatedness of Spanish mackerel populations from Torres Strait, Gulf of Carpentaria, and the Queensland east coast. Samples from PNG will be included in this analysis if available, otherwise included in the final analysis.

Fishers trained in use of widget for sampling muscle tissue from Spanish mackerel

Justification:

Project team salary to process tissue samples, extract DNA and analyse genetic data. Operating costs for lab supplies and costs for Diversity Arrays Technology (DART) to do the genotyping. Travel for a project team member to travel to Cairns to train fishers in the use of the widget.

Extension option: Operating costs for lab supplies to process the tissue samples for epigenetic ageing

Milestone: Preliminary CKMR model **Date:** 01-May-22

With epigenetic ageing

Financial Year	Salaries	Travel	Operating	Capital	Total
2021-22	\$23,600	\$1,400	\$0	\$0	\$25,000

Extension option: Without epigenetic ageing

Financial Year	Salaries	Travel	Operating	Capital	Total
2021-22	\$23,600	\$1,400	\$0	\$0	\$25,000

Description:

A preliminary CKMR population model is developed which will enable the evaluation of the number of expected parent-offspring pairs that can be expected under different sampling designs.

Extension option: An evaluation of the cost benefits of ageing Spanish mackerel using epigenetics versus using otoliths. Note that the precision of epigenetics ageing varies between species, so it is not possible to evaluate this via a desktop study, as processing tissue samples is required.

Justification:

Project staff salary to build population model that incorporates relevant biological and CKMR data. Project staff salary to evaluate plausible sampling regimes given specifics of fishing operations. Project staff travel to relevant TSFF RAG and/or TSFF WG meetings to present results

Extension option: Project staff salary to process the tissue samples for epigenetic ageing and analysis of ageing data from genetics and otoliths

Milestone: Draft final report**Date:** 10-Jun-22**With epigenetic ageing**

Financial Year	Salaries	Travel	Operating	Capital	Total
	\$30,000	\$0	\$0	\$0	\$30,000

Extension option: Without epigenetic ageing

Financial Year	Salaries	Travel	Operating	Capital	Total
	\$25,000	\$0	\$0	\$0	\$25,000

Description:

Submission of draft final report for review.

Justification:

Project staff salary to finalise all analyses and refinements to the CKMR population model.
Project staff salary to write and submit the draft final report.

Section 6 – Special Conditions

If relevant, this field will be used to assist in contract preparation for any special conditions. Examples of special conditions

may relate to marine spatial closures (including access) or any other clauses not specifically contained in the contract.

No special conditions identified

Section 7 - Data management

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

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

The following IP category applies to this application:

Code 1

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

Yes. Previous studies have provided data on the population structure of Spanish mackerel in northern Australia, but all have used older methods. This project will use cutting edge methods to provide more contemporary information on population structure of Spanish mackerel. This project will use existing information on the biology of Spanish mackerel to build a CKMR population model.

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

- information on data security or privacy issues and applying to the data
- Nominated data custodian

This project will not collect new data from Torres Strait or the fisheries that operate in Torres Strait. However, new information will be generated from the analysis of Spanish mackerel tissue samples collected from Torres Strait through other projects. These data include genotypes for the samples collected for evaluating population structure. These data will be entered and stored within secure CSIRO databases.

- Document how research data, traditional knowledge and intellectual property will be handled during your project, including but not limited to:
- Acknowledging where the data or information used in research comes from, so that any income made from selling a concept in the future will be adequately linked to a community's contribution/knowledge so they also receive financial or other benefit from "selling" a concept onward.
- How you will negotiate use and publish of traditional knowledge with communities. For example do traditional inhabitants allow public publication of information or only for project activities and reported on in internal reports? This will depend on data sensitivity and privacy (such as fishing grounds etc).
- Are there any other ethical considerations you have identified for this project which need to be managed?
- Are you committed to gaining ethics approval for this project from a suitable body such as a university or AIATSIS?

The data and information generated during the project will be stored in secure CSIRO databases. The data will be summarised and communicated back to stakeholders through the TS FFRAG and TS FFWG meetings. The data will also be summarised and reported in a final report to AFMA and scientific publications. Appropriate acknowledgements of contributors and funding sources will be made in any reporting and communications. The data and data summaries will not involve any traditional knowledge.

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 -15 October 2021
DEVELOPING AN APPROACH FOR MEASURING NON-COMMERCIAL FISHING	Agenda Item 5.4 For NOTING & ADVICE

RECOMMENDATIONS

1. That the Resource Assessment Group (RAG):

- a) **NOTE** the presentation provided by 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*.
- b) **NOTE** 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:
 - (i) 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).
 - (ii) Phase 2:
 - Develop App, database and data flow infrastructure
 - Community rollout – pilot (on some communities).
 - Community rollout – full-scale (to all communities).
- c) Having considered the above, **DISCUSS** and **PROVIDE ADVICE** to TSSAC on the project recommendations and any further actions relating to the development of a non-commercial catch data collection method for the region.

BACKGROUND

2. The TSSAC funds projects that are applicable across Torres Strait Fisheries. Two such projects that were funded in 2019-20 are the *Climate variability and change relevant to key fisheries resources in the Torres Strait – a scoping study*) and *Measuring non-commercial fishing (indigenous subsistence fishing and recreational fishing) in the Torres Strait in order to improve fisheries management and promote sustainable livelihoods*.
3. This scoping study was funded to quantify the subsistence and recreational (i.e. non-commercial) take of key commercial species and to gauge interest from Torres Strait communities in collecting information on the subsistence take of other non-commercial

species, to identify the most culturally significant and important species to communities (including contribution to health and livelihoods).

4. The research need was identified by the TSRA Finfish Fishery leasing quota committee. A committee at the time, comprising TSRA Board members and traditional inhabitant representatives from eastern island communities. Members identified the need to improve estimates of non-commercial catch of commercial species to inform stock assessment, the setting of sustainable catch levels and to determine the how much of the available catch needs to be reserved for traditional fishing.
5. The project found self-reporting using an app (or web-based approach indistinguishable from an app) was likely to be the best approach to monitoring non-commercial fishing, paired with a data validation method of conducting household surveys. The project undertook consultation with stakeholders on this monitoring approach which would need to continue should the project recommendation proceed. This would ensure communities are on board with this approach and identify risks and concerns that would need to be managed around it.
6. A summary of the TSSAC's agreed recommendations and actions regarding this project are provided in **Attachment 5.4a** and the full final project report is provided as **Attachment 5.4b**.
7. It will be relevant for the RAG to provide feedback to TSSAC on the outcomes and recommendations from this project as it relates to developing a catch data collection method for the region, and more specifically, improving understanding of the level of non-commercial catches of finfish species.

Summary of TSSAC 79 agreed recommendations and actions regarding the *Non-commercial fishing project*.

The TSSAC **AGREED** on the following recommendations and actions if this project moves forward:

- The project should be split into two phases, and the project scope released in the call for research should only include step 1 and 2 (“phase 1”) of the five-step process above. These two steps will cost out the rest of the project, at which time the relevant PZJA forums and TSSAC will consider the project for funding the remaining steps (pilot and full implementation). This is noting it is not possible for the project team to cost all five steps, until step 1 and 2 are complete, and it is difficult for a funding provider to support a project which has an undefined budget for parts of the work.
- That the focus of this project should remain with non-commercial catch of commercial species initially, however if communities wish to collect other information early on in the project, as their own initiative, this could be incorporated. This would be determined through step 1 and 2 of the project, using a co-design method with communities. In particular, communities should be consulted on whether they have any data they would like to collect (such as non-commercial species data) through this app for their purposes (not related to fisheries management as it isn’t the PZJAs mandate), which would add value to it beyond non-commercial catch of commercial species. They also need to guide the data storage and access process, including the types of people they would want to share the data with (like family groups, island groups or broader).
- Community expectations need to be managed around the full project going ahead, noting only the first two steps will be funded initially if the project goes ahead.
- All Torres Strait communities, and Northern Peninsula Area communities should be consulted as a part of any future project.
- The non-commercial catch monitoring project research scope should include a requirement to consider alternative tools to an app, that fulfil the same function (such as webforms) as the non-commercial take monitoring tool, to ensure value for money, including upkeep and maintenance costs.
- Ensure data biases are accounted for if the non-commercial catch monitoring project progresses, noting there will be some fishers reporting a lot and others not at all, skewing results. Statistically adjusting the data will account for this and needs to be considered in this project.
- Ensure project team work alongside AFMA if the non-commercial catch monitoring project progresses, to ensure the data is collected in a way that will allow the data to be pulled into the AFMA database (if AFMA was chosen to be used to store the data).
- Draft scope for the non-commercial catch data collection project to be developed for TSSAC 80 meeting in November, for scoping discussions.
- Data ownership and intellectual property for the non-commercial catch data collection project needs to be discussed and managed effectively based on community needs. This can be established during the consultation phase of the project.
- Non-commercial catch data collection project team to consider what environmental (or other) data that could be collected through the app, which would be useful for managing climate change or other factors relevant to managing commercial fisheries.

The TSSAC **NOTED**:

- That the first two steps may take longer than a year, given their complexity (including deciding what data to collect beyond commercial species, and where and how to house the data) and the level of consultation required. However undertaking the work as quickly as possible is a priority



Developing an approach for measuring non-commercial fishing in Torres Strait in order to improve fisheries management and promote sustainable livelihoods.

Project Number: 2019/0827

Kenny Bedford – Debe Mekik Le Consultancy

Tim Skewes – Tim Skewes Consulting

David Brewer – David Brewer Consulting

FINAL REPORT

February 2021



This report has been prepared by Debe Mekik Le Consultancy in collaboration with Tim Skewes Consulting and David Brewer Consulting for the Australian Fisheries Management Authority and the Torres Strait Regional Authority.



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Disclaimer

This report was prepared by Debe Mekik Le Consultancy Pty Ltd on behalf of the Torres Strait Regional Authority (TSRA). It has been prepared on the understanding that users exercise their own skill and care with respect to its use and interpretation. Any representation, statement, opinion or advice expressed or implied in this publication is made in good faith. Debe Mekik Le Consultancy Pty Ltd and the authors of this report are not liable to any person or entity taking or not taking action in respect of any representation, statement, opinion or advice referred to above.

Acknowledgements

Debe Mekik Le Consultancy and the project team recognises and acknowledges that our project Workshops were held (online) with participants located on the traditional lands of the Quandamooka, Gimuy, Kaurareg, Kulkalgal and Arakwal, Larrakia people. We each pay our cultural respects to these Traditional Owner groups, and to their Elders past and present for their spiritual relationship with the Land and Sea Country.

Debe Mekik Le Consultancy would like to thank and acknowledge Torres Strait Traditional Inhabitants and their communities including Prescribed Body Corporates (PBC's) and community fisheries associations for sharing their Traditional knowledge, supporting our consultation and providing guidance during key assessment aspects of the project

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Definitions and acronyms

Definitions

Arakwal	Traditional Owners of Byron Bay
Bus route survey	A survey where a monitor travels around a circuit incorporating several access sites according to a predetermined schedule of travel between sites and waiting times at sites. Designed for situations having a high number of access sites.
Catch	Marine species captured during fishing.
Census survey	A survey conducted on the full population.
Commercial catch	The catch from fishers that is used for commercial profit, mostly from wild fisheries.
Commercial fishing	Fishing activity that is undertaken with the goal of selling catch for commercial profit.
Creel survey	An in-person survey where a monitor interviews a fisher about their fishing experience and can also inspect the catch. Traditionally, the survey is conducted on-site at access points along the coastline.
Customary management	Decisions, policies and actions that influences the activities of Traditional Inhabitants on marine resources and habitats at the individual, clan, community or nation level.
Diary survey	Survey in which catch information is recorded by fishers in a diary—which is periodically reported via mail or via telephone interviews.
Equity	The quality of being fair or impartial between individuals or groups (social equity), for example w.r.t. social policy and public administration
Fishing logs	Fishers' recordings that characterise their catch and the associated circumstances and methods.
Gender equity	The concept of gender equity refers to fairness of treatment for women and men, according to their respective needs. This may include equal treatment or treatment that is different but which is considered equivalent in terms of rights, benefits, obligations and opportunities.
Gimuy people	Traditional Owners of Cairns area
Kaurareg	Traditional Owners of Thursday Island and surrounding districts
Kulkalgal	Traditional Owners of central island cluster of Torres Strait
Landing point survey	A fishing survey conducted at coastal landing sites to collect information that characterise the catch and the associated circumstances and methods
Larrakia	Traditional Owners of the Darwin region
Non-commercial fishing	Fishing for non-commercial purposes (e.g. sustenance, customary purposes, recreation). In the Torres Strait this includes Traditional fishing, recreational (non-indigenous) fishing, and the fishing charter sector fishing.
Off-site reporting	Fisher reporting fishing data after completion of the fishing trip(s), such as from their residence and often not same day as the fishing event; e.g., via telephone, diary log or computer.
Quandamooka people	Traditional Owners of Moreton Bay
Recreational fisher	Non-Indigenous person, 5 years old or older who went recreational fishing at least once in a 12-month period.*
Recreational fishing	The capture of fish, crustaceans or other aquatic taxa for non-commercial purposes* Note: for the purposes of this report, this does not include Traditional fishing.
Standard error (SE)	Estimate of how variable sample means are at estimating the true population mean (Technically, the SE of a statistic is the approximate standard deviation of a statistical sample population.

Self-reporting	Fisher reports fishing data largely independently, often using tools/proformas supplied by monitoring agency.
Stock assessment	Process for determining the status of key species by collating and assessing the best available information and matching it against clearly defined criteria.*
Sustainable catch	Number (weight) of fish in a stock that can be taken by fishing without reducing the stock biomass from year to year, assuming that environmental conditions remain the same.
TIB fisher	Traditional Inhabitant fishing commercially under a Traditional Inhabitant Boat, or TIB licence
TIB licence	Traditional Inhabitants in Torres Strait require themselves and their vessel to be licenced under a Traditional Inhabitant Boat, or TIB licence to fish commercially (for sale). TIB licences are endorsed for specific fisheries (e.g. Spanish mackerel, Reef line and Tropical rock lobster).
Traditional fishing	The Torres Strait Treaty describes Traditional fishing as “the taking, by Traditional Inhabitants for their own or their dependants’ consumption or for use in the course of other traditional activities, of the living natural resources of the sea, seabed, estuaries and coastal tidal areas, including Dugong and Turtle” (Torres Strait Treaty 1985)
Traditional Inhabitant	The Torres Strait Treaty defines a Traditional Inhabitant, in relation to the Australian jurisdiction, as “persons who (i) are Torres Strait Islanders who live in the Protected Zone or the adjacent coastal area of Australia, (ii) are citizens of Australia, and (iii) maintain traditional customary associations with areas or features in or in the vicinity of the Protected Zone in relation to their subsistence or livelihood or social, cultural or religious activities” (Torres Strait Treaty 1985).
Traditional Owner	People who can trace their descent back to an ancestor alive at the time of annexation by the relevant colonial power (Arthur 2004)
Torres Strait traditional fishery	Broadly, the participants, gear, habitats and species that are subject to Traditional fishing in the Torres Strait. In Torres Strait this includes up to ~200 species, including dugong and turtle (which are also treated separately as a sub-fishery with specific management arrangements) and also including some species that make up commercial fisheries (such as the Torres Strait Torres Strait Spanish Mackerel Fishery, the Torres Strait Finfish (Reef Line) Fishery (both sub-fisheries of the Torres Strait Finfish Fishery), and the Torres Strait Tropical Rock Lobster Fishery).

*from QDAF survey reports

Acronyms

AFMA	Australian Fisheries Management Authority
AW	Alinytjara Wilurara
CSIRO	Commonwealth Scientific and Industrial Research Organisation
FWCMP	Far West Coast Marine Park
EFMA	Erub Fisheries Management Association (Erub)
GBK	Gur A Baradharaw Kod (Peak PBC body for Torres Strait PBCs)
IPA	Indigenous Protected Area
KAIA	Kos and Abob Industry Association (Ugar)
LSMU	Land and Sea Management Unit
MCA	Multi-criteria assessment
MDWFA	Mer Dauer Waier Fisheries Association (Mer)
NRIFS	National recreational and Indigenous fishing survey
PBC	Prescribed Body Corporate
PAC	Project Advisory Committee
PI	Principal Investigator
PNG	Papua New Guinea
PZJA	Protected Zone Joint Authority
QDAF	Queensland Department of Agriculture and Fisheries
RNTBC	Registered Native Title Body Corporate
SARDI	South Australian Research and Development Institute
TEK	Traditional Ecological Knowledge
TIB	Traditional Inhabitant Boat
TRL	Tropical Rock Lobster
TSRA	Torres Strait Regional Authority
TSSAC	Torres Strait Scientific Advisory Committee
TVH	Transferable Vessel Holder (also known as Sunset licence holder)
YLM	Yalata Land Management

Executive summary

Key messages:

1. Information about the catch of non-commercial (Traditional and recreational) fishing in Torres Strait is important for sustainable management of current and future commercially important species in Torres Strait, but also for the sustainability of other species important to Torres Strait islander culture and health.
2. Non-commercial catch monitoring is strongly supported by Torres Strait Island community leaders and consultative representatives. General community support is uncertain, but indications are that it is positive and growing.
3. A successful monitoring program will need high levels of trust and a strong sense of ownership by local Torres Strait Islanders. In this regard, the main requirements are:
 - the value proposition – a shared understanding and agreement of the value of monitoring for management at all levels
 - transparency – implementation, analysis outputs and data use to be adequately communicated
 - simplicity – data collection and data stream to be conceptually straight forward
 - security – high data stream security and local control over data dissemination.
4. An assessment of several possible monitoring methods, based on stakeholder needs, feasibility and gender equality suggest that fisher self-reporting using a monitoring App may be the most effective method for collecting data on non-commercial catches by Traditional Inhabitants and recreational (non-Indigenous) fishers.
5. Complimentary household surveys should also be carried out, initially at least, to validate early-stage survey results and provide additional social data.
6. Importantly, this approach appears to be relatively gender equal - women are as likely to perceive the benefits and feel empowered to provide their catch data as men, and they have widespread access to smart phones and/or alternative data provision methods.
7. Implementation of all key phases of the monitoring program should be overseen by Traditional Inhabitants and include equitable representation for gender, region (e.g. island clusters) and other key groups.
8. Implement the monitoring program in a staged way (e.g. begin with pilot program at small number of communities and focus on basic catch data requirements to start with) which will help Traditional Inhabitants understand and become familiar with any new proposed process and minimise risks to ongoing use and uptake.

Access to marine resources by Indigenous Australians is not only important economically, but also culturally and spiritually. This is particularly so for the communities of Torres Strait, which have some of the highest consumption rates for marine species in the world. In order to sustainably manage marine species in Torres Strait, estimates of catches from all sectors of the fishery are needed. Processes for measuring the catches from commercial fishing are in place. However, the Traditional and recreational non-commercial fishery sectors currently have inadequate or no ongoing catch monitoring. Catch estimates for the non-commercial fisheries will allow more accurate estimates of the total harvest and hence, better informed management decisions that reduce the risk of over-exploitation and ensure the protection of Torres Strait Islander livelihoods. This report outlines an approach for a non-commercial fishery monitoring strategy in Torres Strait by reviewing past and

new and emerging approaches, canvassing stakeholder needs and assessing a range of potential approaches for possible implementation.

Objectives

The overarching goal of any future non-commercial catch monitoring strategy is to *Reduce the risk of declining marine populations by monitoring catch trends and including reliable estimates of non-commercial catches into population assessments*. The specific project objectives to help achieve this are:

1. Review of past and current non-commercial catch sector survey approaches in Torres Strait and more broadly
2. Review stakeholder needs for the collection and delivery of non-commercial catch sector information over the longer-term
3. Facilitate the establishment of a cost-effective Project Oversight Committee (PAC) to guide project delivery
4. Deliver an approach, or options, for collecting and delivering non-commercial catch sector data that is appropriate for management and stakeholder needs.

Review of past and current non-commercial catch sector survey approaches

Various approaches for monitoring Traditional and recreational catches have been applied in Torres Strait, although none on an ongoing basis. The outcomes and learnings from these approaches (successful and otherwise) and others elsewhere in Australia were reviewed as input into the design of an effective, ongoing data collection program.

Traditional fishing

We reviewed past approaches, outputs and learnings from previous Traditional fishery catch monitoring programs in Torres Strait, and in Australia more broadly. We found 14 studies that have been carried out in Torres Strait, dating from 1976 to 2018. Most of the monitoring programs were short-lived, and none currently operate. Six of the 14 studies were focussed on the catch of dugong and turtles. One study was focused on the Traditional Inhabitant commercial (TIB) fishery and their non-commercial (Traditional) component. The remaining seven studies focussed on the broader marine catch of the targeted communities.

The approaches that have been applied to monitoring the Traditional fishery catch in Torres Strait have primarily included creel surveys (observers recording the catch at landing points), fisher interviews, and catch logs. All studies involved an independent external researcher, usually scientists or PhD students, with the majority also involving dedicated trained monitors. Most studies were based on monitors carrying out creel surveys, and/or fisher or household interviews, with most yielding useable catch estimates. Self-reporting programs (e.g., using catch logs) had variable results, with some studies resulting in low returns by individual fishers or an unwillingness to participate.

Five Traditional fishing studies focused on other Australia Indigenous communities were also reviewed. Four of these were primarily based on fisher or household interviews, while two included catch logs. Only one study included a creel survey. The Indigenous survey associated with the National Recreational and Indigenous Fishing Survey (NIRFS) was the most extensive national survey and reported total numbers of 45 marine species or species groups.

The review classified the studies into four survey type (creel surveys—periodic and census; interviews; and self-reporting) and collated information on their strengths and weaknesses. We also

characterised their level of community involvement, which ranged from negligible to significant. However, none of the studies appeared to divulge significant control to local community stakeholders nor did there appear to be any significant community-based data interpretation or use.

Most studies concluded that engaging a wide range of local stakeholders was essential to implementing community-based monitoring. A good communication strategy was also seen as essential for fostering trust and building a shared understanding of the benefits and costs of the monitoring program and for providing ongoing feedback to the community about survey results, which can generate interest and foster participation and support. Project managers must also be ready to take feedback on board and act by adapting sampling approaches to suit local stakeholder wishes. Due to the highly variable nature of marine species landings, considerable sampling effort is required to get reasonably precise estimates of the catch for a community.

Recreational fishing

Recreational fishing, for the purposes of this review, is defined as non-commercial fishing by non-Indigenous fishers. This sector has been monitored by QDAF throughout Queensland and including Torres Strait. However, sample sizes are not considered adequate for an accurate representation of the catch of this sector in Torres Strait.

We found a wide range of approaches have been used in Australian recreational fishing surveys in the past and a range of new and emerging approaches and technologies also being applied. Most surveys targeted smaller local areas and mainly used intercept surveys which collected information in person, such as telephone, access point, roving creel, door-to-door or on-site fisher counts. Whereas broader-scale surveys (e.g., State-wide) used remote methods such as phone surveys, diary-based surveys or combinations of remote methods (Complemented surveys). The review defined each of the previous recreational fishing survey types and their approaches used and collates information on the strengths and weaknesses of each.

A common conclusion at the completion of previous monitoring projects was that any attempt to implement a non-commercial monitoring program will require strong cooperation and engagement of stakeholders at all levels, but particularly at the fisher and local community level. The review also notes that, despite a long history and multiple studies, monitoring the recreational catch is equally if not more challenging than monitoring the traditional catch.

Most attempts (and certainly the most successful ones) have used some type of complemented survey design; usually either a telephone-diary survey or a telephone-access point survey. However, the largest challenge was consistently estimating the full recreational fisher population to estimate total effort and extrapolate sample outputs.

Review of stakeholder needs

Designing a successful Traditional-fishery monitoring program in the Torres Strait requires addressing the needs and issues for all stakeholders. The failure to address a broad range of stakeholder needs will put the success of any future program at risk. We separated the needs into two overarching categories – ‘Data needs’ and ‘Program requirements, constraints and risks’ and assessed these for the following stakeholder groups:

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

In order to obtain detailed stakeholder needs information we completed a range of activities:

1. Pre-project consultation with Traditional Inhabitants
2. Review of past monitoring program assessments as a guide to help ensure that a comprehensive list of data needs, approaches and issues will be considered, and their learnings incorporated, during any monitoring program design
3. Summaries of statements from recent PZJA meetings where non-commercial fishing data has been discussed
4. Questionnaires (via e-mail), face-to-face, and/or remote consultation (phone, video call) with Traditional Inhabitants, fishery managers, current assessment and research scientists
5. Incorporation of learnings from previous and current Traditional fishery monitoring projects relevant to National stakeholders
6. Project team workshops
7. PAC feedback and comments during virtual meetings and review of draft reports.

Pre-project consultation with Traditional Inhabitants included responses from 13 of the targeted stakeholders (21%), with 11 being supportive (85%) of the proposed project, one against and one uncertain. Most of the community stakeholders recognised the importance and benefits of collecting data on the non-commercial fishery catch and two suggested their community would be interested in being involved in the pilot program. Two main concerns expressed were: 1) that (some) community members will think that information may be used to restrict their catch/access to the fishery; and 2) that recreational fishers may not be included in the monitoring.

Recent PZJA TSSAC, FFRAG and FFWG meeting records included statements that show strong support for a new data collection program for non-commercial fishing sectors, including guidance on key issues that will be important for program success.

Stakeholder needs from all sources were collated, summarised and assigned a priority from 1 to 3 to indicate their importance to achieving the objectives of the monitoring program for Torres Strait. The priority 1 and 2 program needs were categorised into design criteria used to assess a range of Traditional-fishery monitoring options.

(i) Data needs

Traditional Inhabitants identified five data needs:

- Annual catches of all fished species in the community
- Seasonal patterns in catches
- Location of catches (reef scale)
- Disaggregation of catch, effort, use by key demographic and other groups (e.g., women, children, TIB fishers)
- Household social and economic data

Fishery managers identified six data needs:

- Annual (accurate, comprehensive, and representative) estimates of the non-commercial catch of Tropical rock lobster (TRL), Spanish mackerel and coral trout (four species)
- Annual catch of all other species in the Traditional fishery (potentially ~200 species)
- Location of catches (logbook zones)
- Catch and catch use by Traditional Inhabitants (TIB fishers, women, children etc)
- Conversion ratios for fishery products through processing chains

- Economic information on the revenues and costs of fishing, and value chains.

Stock assessment scientists identified ten data needs:

- Annual (and seasonal) non-commercial catch (including discards) of commercially fished species such as Spanish mackerel, coral trout (4 species separately recorded), and TRL that are comprehensive, representative, and accurate
- Annual (and seasonal) catch (including discards) of non-commercial species that are comprehensive, representative, and accurate
- Fishing effort and gear type
- Marine species size/weight/age and sex information
- Location of catches (logbook zones)
- Fishers' observations on catch trends and fishery biology and ecology
- Data should be complimentary and comparable to other sectors of the fishery
- Abiotic parameter measurements (e.g., water temperature, turbidity, wind strength etc)
- Post-harvest value chains analyses, by species
- Provision of fish frames, otoliths, or tissue samples for aging, genetic or seafood contaminants studies.

National stakeholders identified three data needs:

- Improved data on Aboriginal and Torres Strait Islanders fisheries resource use
- Information of monitoring program implementation, utility and limitations
- To improve government policy.

Each of these needs are described in more detail and prioritised. The highest priority needs were then used in the design of a monitoring approach.

(ii) Program requirements, constraints, and risks

Traditional Inhabitants identified eight program requirements, constraints, and risks:

- Program is socially and culturally acceptable to Torres Strait Islander communities
- Monitoring program should be co-designed with communities
- Data management responsibility sits with communities or their representative leadership/bodies
- Data is held in a secure database
- Follow ethical principles, e.g., protection of identity of individual fishers
- Data provision needs to be technically easy and uncomplicated
- Provision of data by fishers should take up the least amount of time
- The monitoring program should include capacity building and/or employment opportunities for community members.

Fishery managers identified five program requirements, constraints, and risks:

- Program needs to include trust building based on shared aspirations, recognition of past experiences, transparency regarding how the data will be used and managed, legitimate local control, and information security
- Program needs to be affordable, and cost be proportional to data accuracy and precision (risk-catch-cost trade-offs)
- Approach needs to be logistically feasible, and relatively straight forward to implement

- Overall program must meet implementing agency OH&S guidelines
- The program should minimise environmental harm, including minimising greenhouse gas production.

Stock assessment scientists identified three program requirements, constraints, and risks:

- Data collection should be accompanied by comprehensive ethics agreements to ensure an ethical and culturally appropriate way to collect, securely store and use the Traditional fishery catch information
- Co-development of monitoring programs should occur with the community, perhaps as part of broader co-management strategies
- Communication material is sufficient to inform, educate and increase capacity (e.g., provision of training and species guide to minimise misidentification).

National stakeholders identified two program requirements, constraints, and risks:

- Program is socially and culturally acceptable to Torres Strait Islanders
- Formal agreements covering all aspects of the monitoring program must be developed and ratified.

Each of these program requirements, constraints, and risks are described in more detail and prioritised. The highest priority program requirements, constraints, and risks were then used in the design of a monitoring approach.

While the above needs and issues analysis was focused on the Traditional fishery, many of the same issues apply to recreational (non-Traditional Inhabitant) fisheries. In this sense, we have some confidence that the Traditional-fishery monitoring program assessment will also be suitable for monitoring recreational catches in Torres Strait. This has the major advantage of not having to develop and roll out separate programs for each of these two sectors.

Establishment of oversight committee

A Project Advisory Committee (PAC) was establishment to provide a cost-effective approach for guiding project delivery. The PAC was formulated with the following membership:

- Councillor Francis Pearson (Poruma Island Traditional Owner; TSIRC Councillor, Protected Zone Joint Authority (PZJA) consultative Traditional Inhabitant representative)
- Jon Tabo (Murray Island Traditional Owner; PZJA consultative Traditional Inhabitant representative)
- John Morris (Masig Island Traditional Owner; PBC Chair)
- Councillor Rocky Stephen (Ugar Island Traditional Owner; TSRA Member, STIRC Councillor, PZJA consultative Traditional Inhabitant representative)
- Frank Loban (James Cook University, Badu Island Traditional Owner, Zendath Kes Fisheries Interim Director)
- 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)
- TSRA Fishery Program representative

This membership provided expert assessment by two key stakeholder groups: Traditional Inhabitants and subject matter experts. Five Traditional Inhabitants represented different Torres

Strait communities and the two subject matter experts are national experts in Traditional fisheries, Traditional fisheries monitoring, Indigenous livelihoods and natural resource management.

The PAC was engaged through two (remote online) workshops, where the project methods and outputs were described, followed by feedback and group discussion. Feedback and additional information were also received through requests for comments on draft outcomes, by way of the draft written report.

The PAC deliberations resulted in several changes to project outcomes and made recommendations on the implementation of a specifically designed pilot program.

Assessment of monitoring approach options

Potential options for monitoring the non-commercial catch in Torres Strait were selected based on information from (i) the outcomes of a review of approaches; (ii) consultations with local stakeholders; (iii) the expert views of the PAC; and (iv) the project team assessments. The project team scored each of the options against the needs of key stakeholders in Torres Strait in a multi criteria analysis (MCA). This produced a score for each option and illustrates their strengths and weakness. This process resulted in a ranking of options and recommendations for a preferred candidate monitoring approach.

Six potential options were formulated to assess an acceptable non-commercial catch data monitoring strategy in Torres Strait. These reflect previously used monitoring strategies in Torres Strait, but also incorporate potentially suitable features from the range of monitoring methods. They were also moderated or refined to incorporate the needs of any future program based on stakeholder needs; then reviewed by the PAC.

Potential monitoring methods assessed by the MCA:

No.	Title	Description
1	Self-reporting via monitoring app	Reporting of daily catch and other information when fishing. Self-reporting (fisher level) via an App tool linked to a central secure database.
2	Self-reporting via catch datasheet	Daily reporting of catch and other information. Self-reporting (fisher level) using a catch data sheet which is then sent to a central location for entering into a secure database.
3	Self-reporting via periodic catch datasheet	Periodic reporting of catch (e.g., for previous month) and other information. Self-reporting (likely at household level) using catch data sheets is then sent to a central location for entering into a secure database.
4	Embedded observers via catch datasheets	Periodic reporting of catch (e.g., for previous month) and other information. Information collected by an embedded community-based observer collecting information from households.
5	Creel surveys by roving observers	Daily reporting of a temporal sample (e.g., quarterly for 5 days) for each community by independent observers based on roving (bus route) periodic sampling. Creel (landing point) survey of daily catch and other information.
6	Creel surveys by periodic roving observers	As above, but only done on every 2 to 5 years.

Fourteen high priority stakeholder needs were categorised into five high-level criteria groups: cost, benefit, feasibility, cultural considerations, and sustainability. Each of the criteria were then characterised with respect to their metric range, whether mandatory or not, and with criteria weighting estimates (based on proportion of priority 1 needs plus expert assessment). The criteria were then scored from 1 to 5, and reviewed by the PAC. Criteria group scores were calculated as the weighted average of the criteria scores in that group. The standard deviation in raw scores was also calculated to indicate the criteria's influence on the final option rankings.

The monitoring strategy option with the highest score from the MCA was *Self-reporting via a monitoring App*, followed by *Self-reporting via periodic data sheet* and *Self-reporting via daily data sheet*. Although a census of all fishing and catches is the aspirational goal, no matter which monitoring option is used, it is very unlikely that 100% coverage will be achieved. The assessment of (and accounting for) selection bias and measurement errors will be important to help improve the accuracy of catch estimates. Obtaining estimates of the catch using different methods will indicate possible biases in the different approaches, and allow for adjustment, correction, or initiate changes in the primary data collection method. For example, if self-reported catch information is used as the primary method to estimate catch, a periodic structured interview survey, may also be used to validate the fisher records and provide additional information (e.g., an estimate of socio-economic characteristics and summary catch data). To this end a parallel, complimented survey approach should be initiated early and broadly applied, with the possibility that it can be reduced or even eliminated once the primary data gathering strategy has been tested, modified and well established.

Based on these outputs, and the consideration of the project team and the PAC, we make a series of recommendations for implementing a non-commercial fishery monitoring program in Torres Strait. We focused on the Traditional fishery – it being the largest, the most diverse, and most important (from a food security and cultural point of view) of the non-commercial fisheries in the Torres Strait. This also came with the realisation that (i) the monitoring program for the Traditional fishery would likely be adaptable to the recreational fishery in Torres Strait, and, (ii) running two separate programs would be more difficult for a variety of reasons (cost, equity, data compatibility etc).

The development and implementation of a monitoring App will allow most fishers to directly provide daily catch data, and also provide useful information back to fishers and community members in almost real time. It should produce more data than other survey methods due to its ability to be used in real-time by most fishers. This data should also have relatively high accuracy of key parameters due to having accompanying photographic information of catches. This system should be linked electronically to a secure database that has transparent and robust security and permission protocols. Other benefits of using an App-based approach are discussed.

Note that the Traditional fishery catch also includes catch from TIB commercial operations that is not sold i.e. kept by fishers for home consumption, community sharing or barter. In this case, the catch of the TIB fishers will be recorded in two separate catch recording systems - the animals being sold commercially are being recorded in the FRS, and the rest being recorded in the new non-commercial catch sector monitoring program.

An important aspect in the design of the program will be data security and access. Data security, where an individuals' data is not disseminated without their written approval, will be paramount. Access to data and data summaries will need to be tightly controlled and negotiated. This is a critical aspect of the program that will need to be co-designed with Traditional Inhabitants early in the implementation phase.

Gender (and age) equity should be a primary consideration during the design and implementation of the monitoring program. Female fishers can be underrepresented in monitoring programs where there is a majority working-aged, male dominance of both commercial and intensive fishing effort. Women will often fish a different suit of species and use different methods than men (e.g., gleaning), therefore it is imperative to sample them proportionally to get a true presentation of the catch. In addition, the application of species specific, spatial and other management strategies can impact on women, and therefore, the unique social role of women's fishing disproportionately. Disaggregated data on fishing effort and catch will be required for equitable and socially beneficial management at all levels.

A range of other important considerations for the implementation of non-commercial fishery monitoring program are also discussed in detail, including consideration of AFMAs risk-cost-catch trade-off approach, consultation and engagement requirements between Traditional Inhabitants, managers, scientists and other key relationships. A summary implementation strategy is also presented along with a summary of the benefits of such a program and a series of key project recommendations.

1 Background

Fishing in Torres Strait is critically important to the regions cultural, social and economic fabric, and has been for millennia. The Traditional fishery (marine species fished by Traditional Inhabitants for consumption and/or cultural purposes) is important to Torres Strait Islander communities for food and physical health, and is also important socially, culturally and spiritually, with Torres Strait having among the highest seafood consumption rates in the world (TSRA, 2016; Harris et al., 1995; Busilacchi et al., 2013b). There are also Traditional Inhabitant commercial fisheries (the Traditional Inhabitant Boat, or TIB sector) and non-Traditional Inhabitant commercial fisheries for several species (the Transferrable Vessel Holder (TVH), or Sunset licence holder sector – known as 'Sunset sector'); the most important being for Tropical rock lobster (TRL), Spanish mackerel, coral trout and beche de mer. There is also a small non-Indigenous recreational and charter fishery sector that takes a range of species, as well as PNG commercial and Traditional fisheries.

In order to assess sustainable catch levels of fished species from Torres Strait waters (Figure 1-1) management agencies require reliable data on catches taken from all sectors of the fishery (noted above) to accurately estimate their impacts of marine populations (e.g. Torres Strait Finish RAG). More accurate estimates of fishing impacts will better inform management decisions, reduce the risk of over-exploitation and improve protection of Torres Strait Islander livelihoods.

While catch reporting mechanisms are in place for the TIB and Sunset sectors, the non-commercial fishery sectors (i.e. Traditional, recreational and charter fishing) have inadequate or no ongoing catch monitoring¹. The Traditional fishery sector has been monitored at times in the past, and the recreational fishery sector is monitored within the State-wide QDAF program. Charter fishing is the smallest of the sectors and has had no monitoring to date.

Various catch census and survey approaches for the Traditional and recreational fishery catches have been applied in Torres Strait and more broadly in Australia. The learnings from these approaches (successful and otherwise) are critical to the design of an effective, ongoing data collection program. Monitoring the Traditional fishery catch has not been an easy undertaking in the past (Henry and Lyle 2003). Although there have been several programs to estimate the Traditional fishery catches (Section 2), the most recent (successful) program was in 2005 (Busilacchi et al., 2008). This lack of recent information is most likely behind the assessment in the most recent Torres Strait *State of the Environment report card* which lists the Traditional fishery trend as “Uncertain” and confidence in the assessment only medium (TSRA, 2016).

Current assessments of the commercial fishery sectors (TRL, Spanish mackerel, coral trout and beche-de-mer) are based on fisher-recorded data and provide information on population status of the range of species involved, as well as sustainable catch levels. However, these assessments lack up-to-date information from the non-commercial fishery sectors. Instead, estimates from these sectors are used to try and manage the total catch from all sectors. These estimates are based on extrapolations from previous surveys and expert opinion within management fora (e.g., Resource

¹ Although Traditional fishing, as defined by the Torres Strait Treaty, includes dugong and turtle, consideration of future monitoring approaches in this report does not include these species. They are considered a sub-fishery of the Traditional fishery and have their own specific management arrangements, including monitoring, through the Dugong and Turtle Management Project (TSRA, 2016). However, learnings from established Dugong and Turtle monitoring programs will be considered during implementation of any future non-commercial fishery monitoring program.

Assessment Groups and Working Groups). A monitoring program for the non-commercial fishery sectors will strengthen fishery stock assessments and management for all commercial fishery sectors that have a non-commercial fishery sector component. Just as importantly it will provide communities with opportunities to use their own data sets for planning at the community level.

The lack of monitoring for species in the non-commercial fishery sectors means that if there are substantial changes in population sizes for species that are important to either (i) Traditional fishery catches and/or (ii) ecosystem functioning, they may go largely undetected. Such changes could impact Traditional Inhabitants' ability to catch marine species and/or create increasing change in the coastal marine ecosystems (Fulton et al., 2019). A monitoring program will identify these changes over time and their extent, and also be useful for tracking the size and composition of the non-commercial catch sector, and any changes that may be due to potential impacts of related fisheries, climate change and other external drivers (e.g., Delaney et al., 2017). This information will allow Traditional Inhabitants and other stakeholders to contribute to appropriate decisions about how to best manage their interactions with the culturally important species involved.

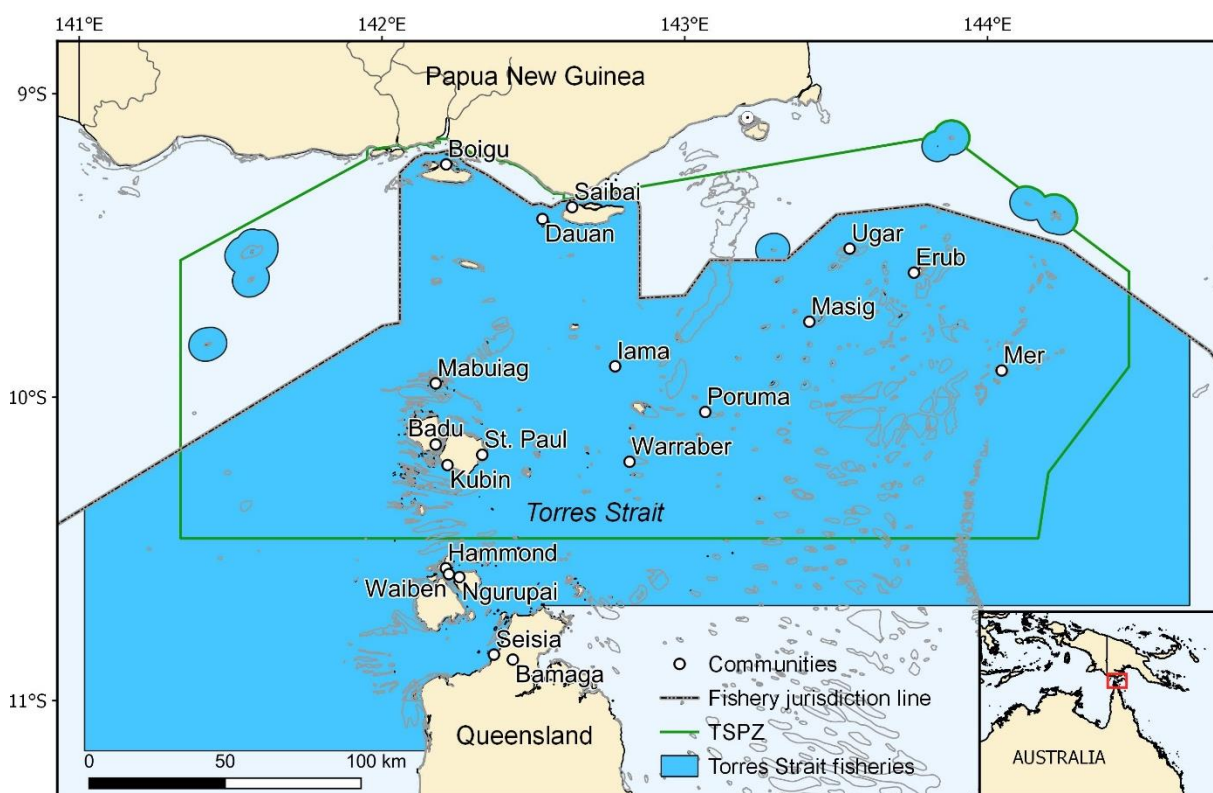


Figure 1-1. The Torres Strait Fishery area.

1.1 Project Objectives

The overarching goal of any future non-commercial catch sector monitoring strategy is to *Reduce the risk of declining marine populations by using reliable estimates of non-commercial catches*. If achieved, this will help to ensure that marine species will be available in adequate numbers to consistently fulfill the needs of Traditional fishing into the future. The specific project objectives to help achieve this are:

1. Review of past and current non-commercial catch sector survey approaches in Torres Strait and more broadly.
2. Review key stakeholder needs for the collection and delivery of non-commercial catch sector information over the longer-term.
3. Facilitate the establishment of a cost-effective oversight committee to guide project delivery
4. Deliver an approach, or options, for collecting and delivering non-commercial catch sector data that is appropriate for management and stakeholder needs.

1.2 Ethics considerations

We have implemented a range of ethics processes and considerations to ensure that consultation, information collection and project outputs both represent and protect the views of individuals. To this end, the project has been guided by a tailored Ethics Statement using the *GERAIS priorities for ethical assessment* (Appendix 1).

This statement was developed as part of a broader ethics approval process that includes seeking prior and informed consent for various levels of information handling and dissemination. Approval for ethics documentation was requested from the TSRA and project Advisory Committee. Traditional Knowledge (TK), in particular, was only used with the express permission of the Traditional Inhabitants.

1.3 Approach

We used the following broad approach (also see Figure 1-2):

- i. reviewing past and potential new approaches,
- ii. outlining the needs and issues of various stakeholder groups,
- iii. assessing a range of options, and
- iv. recommendation for the most appropriate approach for Torres Strait.

The project focused on the non-commercial catch from the Traditional and recreational sectors (excluding dugong and turtle), with an emphasis on the commercially important species, including TRL, Spanish mackerel, coral trout. However, we also investigate the opportunity for monitoring the large suite of other species of high customary value to Traditional Inhabitant communities.

A Project Advisory Committee (PAC) was also engaged (Section 3.3) to provide expert feedback on project ideas and results as well as other expert-based information to help guide the project to conclusion. Experts engaged included Torres Strait Traditional Inhabitants and experts on Traditional fishing practices and monitoring.

Detailed descriptions of the methods for each of the project components and their results are described in the sections following.

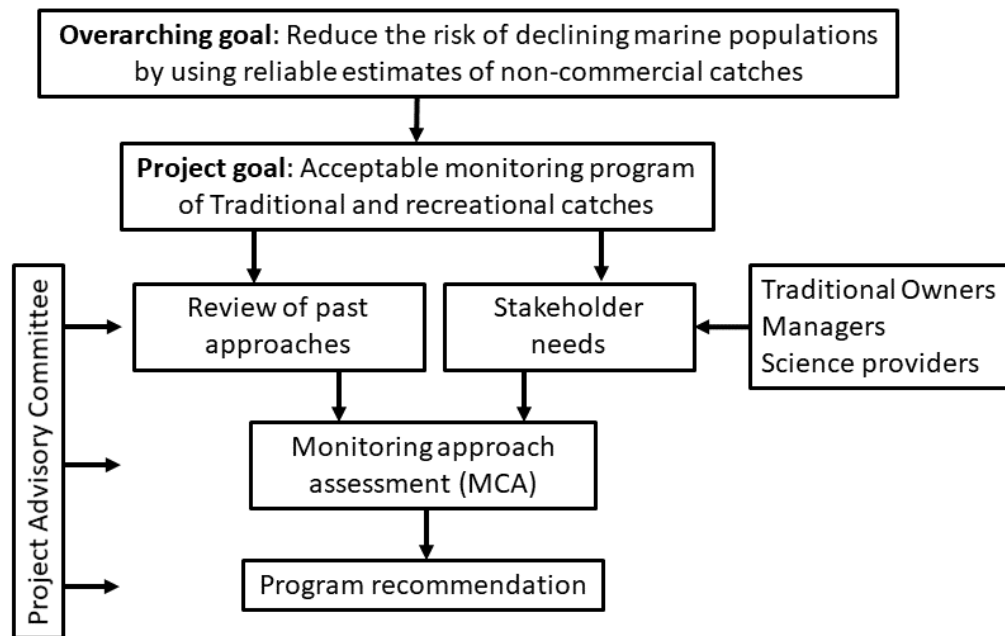


Figure 1-2. Conceptual overview of the project approach for assessing an acceptable non-commercial fishery monitoring program for the Torres Strait. MCA = Multi-Criteria Analyses.

2 Review of past non-commercial catch sector survey approaches

The objective of this component of the project is to review and characterise past approaches to monitoring the catch of non-commercial marine fishery resources relevant to Torres Strait. The non-commercial catch in Torres Strait consists of two main sectors—Traditional fishing by Traditional Inhabitants and recreational fishing by non-Traditional Inhabitants. PNG traditional fishers are included in the traditional fishing review. Charter fishing also occurs in Torres Strait, but effort is negligible and is not specifically included in the review. The outputs of this review will provide a baseline of information to support the design and evaluation of data collection approaches for a future non-commercial fishery catch monitoring program in Torres Strait.

2.1 Traditional fishing

Traditional fishing (Box 1) is an important component of the life for Indigenous communities in Torres Strait (TSRA, 2016; Harris *et al.*, 1995; Busilacchi *et al.*, 2013b) and coastal regions of Australia (Coleman *et al.*, 2003). Estimates of the size of the Traditional fishery catch are important for assessing the sustainability of the marine species caught (along with catches from the commercial and recreationally fished sectors), and to support community adaptation and resilience (Davies *et al.*, 1999; Butler *et al.*, 2013, Butler *et al.*, 2020). Most species in the Traditional fishery catch are, by definition, Traditional only, due to prohibition (e.g., dugong and turtle) or lack of a market/purpose. However, the Traditional fishery catch can also include some species caught in commercial fisheries (e.g., TRL, Spanish mackerel, coral trout) and invertebrate (e.g., Tropical rock lobster) species.

We reviewed past approaches, data and learnings from previous Traditional fishery catch monitoring programs in Torres Strait, and in Australia more broadly. This included review of published studies, reports and discussions (face-to-face or remote) with a range of stakeholders involved in previous monitoring programs. The review describes their key features, strengths and weaknesses and will inform an assessment of monitoring options for possible future use.

2.1.1 Torres Strait studies

We found 14 separate Traditional fishery catch monitoring studies that have been carried out in Torres Strait, dating from 1976 to 2018 (Table 2-2). Most of the monitoring programs in this review were short-lived, and none currently operate. Six of the 14 programs ran for one year, six for two or three years, and two for five years or more. The longest observer-based Traditional fishery catch monitoring program was the AFMA/CSIRO project that carried out 5 years of monitoring between 1994 and 2001 (Skewes *et al.*, 2004) – this could also be seen as an extension of the CSIRO Traditional fishing project that ran from 1991 to 1993 (Harris *et al.*, 1995; Dews *et al.*, 1993).

Six of the 14 studies were focussed on the catch of dugong and turtles (Table 2-2). These are species with high conservation and cultural value and have attracted significant interest (Kwan *et al.*, 2006; Grayson *et al.*, 2010; Marsh *et al.*, 2015). One study was focused on the Traditional Inhabitant commercial (TIB) fishery (and its Traditional component) (French *et al.*, 1914). The remaining seven studies generally included the broader marine catch of the focus communities, including species that are the basis of broader commercial fisheries – Spanish mackerel, coral trout and TRL (Table 2-2). Of these seven broadly focussed studies, two were focused on PNG communities and five in Australia. Only one of the broader fishery studies – Harris *et al.* (1995) – attempted to include all communities in the TSPZ (Table 2-1).

Of the 14 Torres Strait studies, Erub I was included in the monitoring the most frequently (7), followed by Mabuiag and Masig Is (6). The remainder of communities/islands have been monitored

four or five times apart from Hammond and Thursday Is, which have only been monitored once (for dugong and turtle) (Table 2-2).

Four of the 14 studies were carried out by independent researchers, three by university aligned PhD students, one by a university-based consultant, five by the CSIRO and one by AFMA. The amount of resources required to carry out the studies varied according to the number of communities included, and the demands of the monitoring approach (Table 2-2). They were funded by a variety of agencies, including the Torres Strait Research fund under the PZJA, Torres Strait CRC, CSIRO, the ARC, universities and several other conservation and philanthropic agencies.

Box 1: Definitions of Traditional fishing in Australian jurisdictions

Traditional fishing

There has been an ongoing dialogue about the terms and descriptions used for Indigenous community non-commercial fishing. Below are the definitions from the Torres Strait Treaty, and Queensland and Australian Commonwealth government agencies.

Torres Strait Treaty

The Torres Strait Treaty describes **Traditional fishing** as *‘the taking, by Traditional Inhabitants for their own or their dependants’ consumption or for use in the course of other traditional activities, of the living natural resources of the sea, seabed, estuaries and coastal tidal areas, including Dugong and Turtle’* (Australian Treaty Series 1985 No. 4)

Queensland Government (Department of Agriculture and Fisheries)

Under the Fisheries Act 1994, **Traditional fishing** applies in Queensland when:

- the taking, using, or keeping of the fisheries resources is for the purpose of satisfying a personal, domestic, or non-commercial communal need of Aboriginal or Torres Strait Islander people, and
- it is carried out in accordance with the Traditional laws and customs of native title holders or Traditional Owners of the area being fished, and
- those Aboriginal or Torres Strait Islander people, by their laws and customs, have a connection with the land or waters (Fisheries Act 1994; <https://www.daf.qld.gov.au/business-priorities/fisheries/traditional-fishing>)

Commonwealth Government (Department of Agriculture, Water, and the Environment)

The National Indigenous Fishing Technical Working Group defines **Customary fishing** as *‘fishing in accordance with relevant Indigenous laws and customs for the purpose of satisfying personal, domestic, or non-commercial communal needs’* (NNTT, 2004).

Torres Strait Ranger Program

An extensive ranger program has existed in Torres Strait since about 2009, and now there are 13 Ranger groups in 14 communities across the region (TSRA, 2016). They currently carry out a broad range of on-ground activities to help implement the TSRAs’ Land and Sea Management Units (LSMU) strategy, including natural resource management, cultural heritage site protection, implementation of dugong and turtle management plans and Traditional Ecological Knowledge (TEK) recording and management (TSRA, 2016).

Dugong and Turtle Management Project

The Dugong and Turtle Management Project supports the sustainable and culturally appropriate management of dugongs and marine turtles in Torres Strait. It includes the formulation and implementation of community-based Dugong and Turtle Management Plans, and the collection and storage of dugong and turtle catch data, as well as nesting, breeding and foraging activities across Torres Strait. This data is collected and used in line with community agreements, and, at this stage, communities have chosen not to release any outputs or information. We have, therefore, not included the dugong and turtle catch monitoring associated with this program in our review. However, it is likely that involvement of stakeholders from this program would be useful in any future design and implementation of a Traditional fishery monitoring project.

Traditional Ecological Knowledge (TEK) Project

In most Torres Strait communities (all except for 2), Torres Strait Islander Rangers and local Traditional Inhabitants collect and store a range of environmental and cultural information in a locally implemented TEK database that only the community can access under the management of the PBCs (TSRA, 2106). The TEK Project supports participating Torres Strait communities to “utilise a TEK database for the collection, protection and controlled sharing of cultural and natural resource information whilst ensuring adherence to cultural protocols” (TSRA, 2016). Similarly to the Dugong and Turtle Management Project (see above), a lack of published information means we are not able to include the TEK Project within this review. However, the involvement and learnings of implementors and other stakeholders from the TEK project would be critical in any implementation of a Traditional fishery monitoring project.

Objectives and approaches used

Most Traditional fishery catch monitoring studies had high-level objectives related to the sustainability of high conservation species (dugong and turtle) and improving understanding of the Traditional fishery in a broad sense. However, some studies made the connection between the project outputs to more specific management and adaptive management objectives at various scales (e.g., Grayson, 2011). Only one study had a specific objective related to a local community concern - investigating the interaction between the trawl fishery and the Traditional catch on Masig (Poiner and Harris, 1984).

The approaches that have been applied to monitoring Traditional catches in Torres Strait have primarily included creel (landing point, or bus route) surveys, fisher interviews, and fishing logs (either fisher or household based). Most studies involved dedicated monitors doing creel surveys or carrying out fisher or household interviews. Four studies involved fisher or household self-reporting. One used paper fisher logs of dugong and turtle catches and reported high return rates (Grayson, 2011). But others using electronic logs focused on TIB finfish fishers (French *et al.*, 2014), paper logs from households (Murphy *et al.*, 2019) and school-based reporting (Busilacchi 2008; Skewes *et al.*, 2004), with all reported low returns by individual fishers or unwillingness to participate.

All studies involved an independent external researcher; except for the AFMA school-based program which was managed by an AFMA officer. The level of involvement of local community members in project data collection ranged from negligible (e.g., Poiner and Harris, 1991), to being a significant portion of the project staff (e.g., Grayson, 2011). However, the majority did not include significant local involvement, such as regular activity by local monitors.

Catches were usually recorded down to the species level (e.g., Harris *et al.*, 1995, Figure 2-1). However, they were not always reported as separate Traditional and commercial (TIB) fishery catch for each species (although the methods outlined in the study reports indicate that the data was collected in a way that would allow this - Table 2-1) (Harris *et al.*, 1995; Busilacchi, 2008).

Table 2-1. Annual catch estimates (t/yr) for Traditional fishery catch monitoring studies that measured the whole catch (Australian studies only). (SM = Spanish mackerel; CT = Coral trout; TRL = Tropical rock lobster).

Traditional fishery Catch estimates (t/yr)	1984 – 1986 Masig (Poiner and Harris, 1991)	1991 – 1993 TSPZ (Harris <i>et al.</i> , 1995)	2005 – 2006 Erub, Masig and Mer (Busilacchi, 2008; Busilacchi <i>et al.</i> , 2012)	2014 Erub (French <i>et al.</i> , 2014)
Total catch	49.7	847.0	223 ^{6, 8}	5.7 ⁹
Commercial	15.9	184.8	46 ⁸	
Traditional	14.0 ¹	662.2	177	
SM – Total	20.1	14.2	9.2	0.9 ⁹
– Commercial	10.2	– ⁵	5.5 ⁷	
– Traditional	9.9	– ⁵	3.7	
CT – Total	3.0 ²	1.9	28.0	3.9 ⁹
– Commercial	1.4 ²	– ⁵	23.0 ⁷	
– Traditional	1.6 ²	– ⁵	5.0	
TRL – Total	6.2	131.8	– ⁸	0.6 ⁹
– Commercial	2.7 ³	121.2	– ⁸	
– Traditional	3.5 ⁴	10.6	– ⁸	

¹ An additional 20 t was traded, used for pig food or wasted.

² Coral trout included in “reef fish” category

³ Tails only

⁴ Heads only

⁵ Estimated commercial (TIB) catch was 14.1 t/yr – mostly “Spanish mackerel fillets and Coral trout”.

⁶ Catch estimates done separately for Traditional only and TIB.

⁷ Busilacchi, unpublished data

⁸ TRL TIB fishers were not included in the monitoring

⁹ Catch is for freezer and TIB fisher records combined (most marine species sold to freezer).

2.1.2 Australian case studies

We found five Traditional fishing studies focused on Indigenous communities in Australia (Table 2-3). Four of the five approaches were primarily based on fisher or household interviews, while two included multi-species catch logs (Saunders and Carne, 2010; Schnierer, 2011). Only one study included creel surveys, and even then, they were limited to collecting information on species size (Rogers *et al.*, 2014).

The Indigenous survey associated with the National Recreational and Indigenous Fishing Survey (Henry and Lyle, 2003; Coleman *et al.*, 2000; 2003) was the most extensive survey, and included 44 Indigenous communities across northern Australia (none in Torres Strait). It is still one of the few main sources of information used by fisheries management agencies to develop strategies addressing Indigenous fisheries (Steven *et al.*, 2020). The catch was reported as total numbers for 45 marine species or species groups, including mackerels (4,222/yr), coral trout (7,875/yr) and lobsters (14,224/yr).

Table 2-2. Summary of past Traditional fishery catch monitoring projects in Torres Strait.

No.	Date	Islands/ places sampled	Species monitored	Survey type	Resources required	Reference
1	1976 (Sept) - 1979 (Mar) (Nietschman)	Mabuiag, Badu and Kubin	Dugong	Independent observer; Creel (landing point) surveys and interviews; Census.	1 fte, external researcher (1) + operating	Nietschmann, 1984
2	1983 - 1986 (Johannes and McFarlane)	13 islands in TSPZ (all except Warraber)	Dugong	Independent observer; Interviews; Periodic sampling.	2 fte, external researchers (2) + operating	Johannes and McFarlane, 1991
3	1984 (Nov) - 1986 (Sept) (CSIRO)	Masig	All marine species (75 species)	Independent observer; Creel (landing point) surveys and interviews; Periodic sampling.	1 fte, external researcher (1) + ~\$50 k operating	Poiner and Harris, 1991
4	1987 (Johannes and McFarlane)	Boigu	All marine species	Independent observer; Individual fisher interviews.	1 fte, external researcher (1) + operating	Johannes and McFarlane, 1991
5	1991 (June) - 1993 (May) (CSIRO)	14 islands within the TSPZ	All marine species (208 species)	Independent observers; Creel (landing point) survey and interviews; Roving (bus route) community sampling.	2.5 fte external researcher + \$40K operating per year	Harris <i>et al.</i> , 1995; Dews <i>et al.</i> , 1993
6	1990 - 1999 (AFMA-Schools)	14 islands within the TSPZ	Dugong and turtles	Community self-reporting (school based); Catch calendars; Census.	0.25 fte AFMA Officer + operating per year	Skewes <i>et al.</i> , 2004
7	1994, 1996, 1998, 1999 and 2000/01 (AFMA/CSIRO)	14 islands within the TSPZ	Dugong and turtles (primarily)	Independent (local) observers (1 or 2); Creel (landing point) survey and interviews; Roving (bus route) community sampling.	2.5 fte, external researcher (0.5), local monitors (2) and + \$50K operating per year	Skewes <i>et al.</i> , 2004
8	1995 (Baines)	Daru Island (PNG)	All marine species	Independent observer; Creel (market) survey and interviews.	1 fte, external researcher (1) + operating	Baines, 1995

No.	Date	Islands/ places sampled	Species monitored	Survey type	Resources required	Reference
9	1998 (Jan) – 1999 (Oct) (JCU - Kwan)	Mabuiag	Dugong	Independent observer (embedded researcher); Creel (landing point) survey and targeted (fisher) interviews; Census.	1 fte, external researcher (1) + ~\$25k operating per year	Kwan, 2002; 2010; Kwan <i>et al.</i> , 2006
10	2005 (Apr) - 2006 (Nov) (JCU - Grayson)	Hammond Island and Thursday Islands	Dugong and turtles	Community (hunters) self-reporting supported by local observers; Catch log sheets and targeted (fisher) interviews; Census.	3.25 fte, external researcher (1), local monitors (2), TSRA liaison officer (0.25) + operating per year	Grayson, 2011; Grayson <i>et al.</i> , 2006; 2010
11	2005 (May) - 2006 (May) (JCU - Busilacchi)	Erub, Masig and Mer	All marine finfish species (62 species)	Independent observer (embedded researcher); Creel (landing point) survey and interviews; Periodic sampling.	1.5 fte, local monitors (0.5) and external researcher (1) + ~\$25k operating per year	Busilacchi, 2008; Busilacchi <i>et al.</i> , 2012; 2013a; 2013b
12	2012 (Sept) - 2013 (Oct) (CSIRO)	Torres Strait treaty villages and Daru (PNG)	All marine species	Independent (local and external) observers; Creel (landing point and market) surveys and interviews; Periodic sampling.	6 fte, external researcher (0.5), other external (0.5), local monitors (5) + operating	Busilacchi <i>et al.</i> , 2014
13	2014 (Jan - Oct) (Utas)	Erub	TIB catch (5 species categories)	Community (fisher, community freezer) self-reporting; Electronic log sheets on smartphone (fisher) and tablet (freezer); Census.	0.5 fte, external researcher (0.5) + operating (including App development, phones plus prepaid credits, travel for training etc)	French <i>et al.</i> , 2014
14	2018 (CSIRO)	Erub	All marine species	Community (household) reporting supported by an embedded local observer; Catch log sheets and interviews; Census.		Murphy <i>et al.</i> , 2019

Table 2-3. Summary of selected Traditional fishery catch monitoring projects in Australia.

No.	Date	Islands/ places sampled	Species monitored	Survey type	Resources required	Reference
1	1996 (Roberts)	Three communities in northern Queensland	All marine species	Independent (local and external) observers; Interviews (fishers); Census.	3.5 fte, external researcher (0.5), local monitors (3), + operating	Roberts <i>et al.</i> , 1996
2	2000 (June) - 2001 (Nov) (National Rec and Indigenous Fishing Survey – Comm/DAFF)	Northern Australia's coastal areas and catchments (Kimberley region of WA, throughout the NT and the west and east coasts of Qld north of Tully. (not Torres Strait)	All aquatic organisms in the "non-commercial" catch.	Independent (local and external) observers; Household interviews; Random stratified sample of communities and dwellings; Periodic (bimonthly) sampling; Previous 7 days catch recorded.	21 fte, Indigenous Fishing Survey Manager (1), State Managers (WA and Qld) (1), consultant staff (1), Field Supervisor (1), an Aboriginal Liaison officer (0.5), Office Manager (0.5), regional (local) interviewers/guides (16), Plus operating	Henry and Lyle, 2003; Coleman <i>et al.</i> , 2000; 2003
3	2008 (Feb) - 2008 (June) (NT DoR)	Groote Eylandt	Focus on sharks, rays, fish, crabs, green turtles and dugongs.	Community (Household) reporting supported by rangers; Catch log sheets reporting previous weeks catch; School based collection point; Census.	5 fte, external researchers (1), Anindilyakwa Sea Rangers (4) + operating	Saunders and Carne, 2010
4	2009–10, 2010–11 and 2011–12 (SARDI)	Yalata Indigenous Protected Area (IPA), Far West Coast Marine Park (FWCMP)	Mulloway, <i>Argyrosomus japonicus</i>	Independent (local and external) observers; Interviews and limited creel surveys (fishers) at landing sites; Census.	3 fte, external researchers (0.5) (SARDI), local monitors (Natural Resources Alinytjara Wilurara (AW) and Yalata Land Management (YLM) staff and volunteers) (2) + operating	Rogers <i>et al.</i> , 2014
5	2010 (FRDC - Schnierer)	Tweed River Catchment	Traditional catch	Independent (local and external) observers; Interviews (reporting on previous 12 months); Community reporting (cultural fishing logbook); Focus group interviews.	3 fte, external researcher (1), Indigenous community liaison officers (2) + operating	Schnierer, 2011

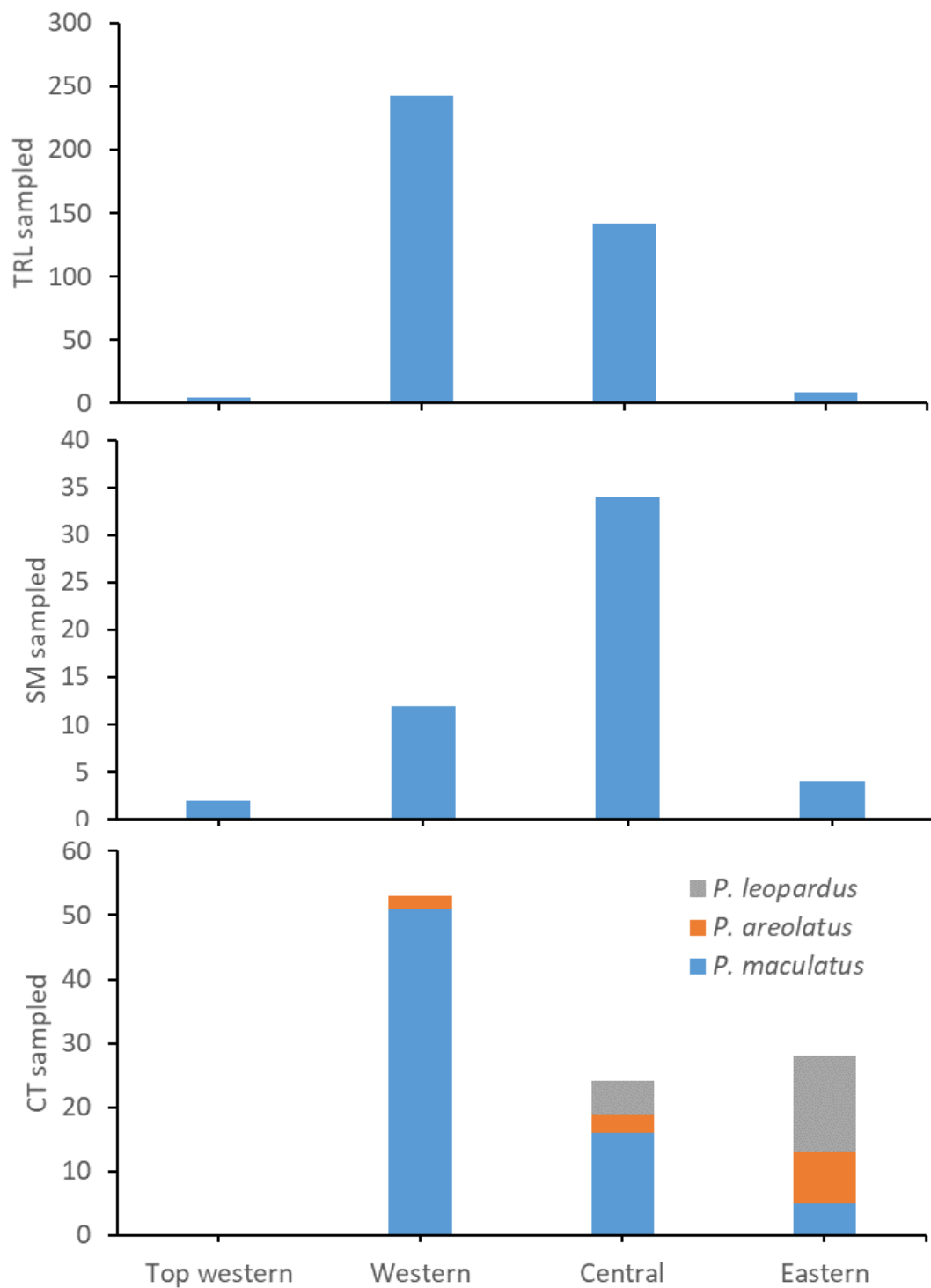


Figure 2-1. Number of individual animals sampled in 1991-93 for TRL (*Panulirus ornatus*) – TRL (top); Spanish mackerel (*Scomberomorus commerson*) - SM (middle); and coral trout (*Plectropomus* spp., 3 species) – CT (bottom) (Harris *et al.*, 1995). [Note that only 3 of 4 coral trout species are identified in this data set – *P. areolatus* also occurs in the catch (Williams *et al.*, 2008)]

Table 2-4. Summary of common Traditional fishery catch survey approaches used and their strengths and weaknesses.

Survey type	Strengths	Weaknesses
1. Creel surveys. Census survey.	Provides the most accurate species-specific catch data. Size and other biological data can also be collected.	Labour intensive and expensive. Can be difficult to implement if landing sites are dispersed.
2. Creel surveys. Periodic sampling (e.g., monthly or seasonally)	As above (but lower accuracy). Lower cost than census survey.	Low sample effort can result in uncertain catch estimates. Biases can occur due to unrepresentative sampling.
3. Fisher or household interviews.	Moderate costs. Can also provide valuable auxiliary data.	Depends on peoples' perceptions and memories. Can have a low participation rate.
4. Fisher/household self-reporting.	Can provide high quality data if fishers respond. New technologies can make this option easier.	Fishers may not participate or lose interest. Requires significant support by competent local observers. Paper returns can be very difficult to manage.

Creel surveys

Creel surveys are based on independent observers' recording of fishers' information, usually at the landing site. They are considered the benchmark for monitoring the Traditional catch, especially for multispecies fisheries, as they provide the most accurate species-specific catch estimates. Most studies in Torres Strait included creel surveys, usually in combination with fisher or household interviews (Table 2-2). Generally, it was acknowledged that using these two approaches at the same time was advantageous in that they provided a broader range of information on fishery catches, fishing techniques, fishing effort and trends; and allowed for some cross-validation of catch estimates (Harris *et al.*, 1995; Busilacchi, 2008; Grayson, 2011). Interviews also collected ancillary information and provided feedback to adapt the monitoring program (Harris *et al.*, 1995; Busilacchi, 2008). However, there are a range of disadvantages in using creel survey approaches, including high cost, accessibility, and potential for bias without a robust sample design (Table 2-4).

Interview surveys

Surveys based solely on Interviews (fisher or household) can be a low-cost way of estimating catches and obtaining information about fishing patterns and trends as it does not require monitoring of catches by external observers (e.g., creel surveys). They have also been applied in situations where creel surveys are not possible due to scale (Coleman *et al.*, 2003) or highly dispersed landing sites (Rogers *et al.*, 2014; Schnierer, 2011). However, interviews rely on the fishers recall of past catches and their perceptions of the current state of their fishery which contain significant biases (Griffiths *et al.*, 2014). These data can require careful treatment as recall and perceptions are open to various biases. Also, unless communities have a high level of confidence in the program, participation rates can be low (Murphy *et al.*, 2019) (Table 2-4).

Self-reporting

Studies that rely on fisher or household self-reporting can be a very efficient and cost-effective way to gather Traditional fishery data (Grayson, 2011; Saunders and Carne, 2010). However, they have had problems with low levels of fisher cooperation and data reliability (Skewes *et al.*, 2004; French *et al.*, 2014; Murphy *et al.*, 2019). Using individual fisher logs and a focus on a small number of dedicated fishers supported by well-trained local monitors can be successful (e.g., such as Grayson, 2011). However, the challenges to getting individual fisher logbook returns has been well illustrated in Torres Strait by the difficulty in monitoring TIB fishers catch at an individual level using vessel logbooks for fisheries such as the Torres Strait Beche-de-mer (sea cucumber) fishery (Plaganyi *et al.*, 2019) (Table 2-4).

2.1.3 Discussion

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

- i. a high degree of local community involvement at all stages of development;
- ii. engaging key local community people (representative influencers);
- iii. effective information flow to all local community members; and,
- iv. sufficient resources to maintain adequate sampling levels.

The level of involvement by local community members in monitoring programs has been summarised by Danielsen *et al.*, 2009 and a summary presented in Table 2-5. In projects we reviewed, the level of community involvement ranged from negligible, to being a significant portion of project staff (Table 2-2, Table 2-3) (Categories 1 to 3; Table 2-5). However, none of the studies appear to have devolved significant control to local stakeholders (e.g., program oversight, data control); nor did there appear to be any significant local data interpretation or use (Category 4; Table 2-5). We have no knowledge of any current (formal) autonomous marine catch monitoring at the community level existing in Torres Strait (Category 5; Table 2-5), although by its very nature this could be happening without external knowledge.

None of the projects appeared to address social equity issues regards their application, either by implementing strategies to ensure representation by women and or age groups, or in terms of investigating gender of age-based differences in resource values or catch fate.

Table 2-5. Categories of Traditional fishery monitoring in Indigenous communities based on levels of local involvement and control (modified after Danielsen *et al.*, 2009)

Category of monitoring	Primary data gathers	Primary users of data
1. Externally driven, professionally executed	Professional researchers	Researchers and external agencies
2. Externally driven with local data collectors	Professional researchers, local monitors	Researchers and external agencies (with some potential limited local adoption)
3. Collaborative monitoring with external data interpretation	Local monitors with professional researcher advice	Local people and professional researchers (with potential local adoption)
4. Collaborative monitoring with local data interpretation	Local administrators and monitors with professional researcher advice	Local people (and potential external agencies)
5. Autonomous local monitoring	Local administrators and monitors	Local people

Most studies had a high involvement by external scientists. Interestingly, some of the more comprehensive monitoring programs (at least for a limited number of communities) have been carried out by PhD students (Kwan, 2002; Busilacchi, 2008; Grayson 2011). One advantage of PhD students is that they usually have a strong incentive, drive and determination to carry out and complete high-effort surveys; often requiring long hours and arduous surveillance of landing sites, and willingness to be embedded within communities (Kwan, 2002; Busilacchi, 2008).

There is some evidence that Torres Strait Islanders may prefer an outsider to carry out Traditional fishery monitoring (Busilacchi, 2008). Although an outsider without sufficient community engagement will have problems with trust and cooperation (Murphy *et al.*, 2019). There is also broad support for collaborative arrangements and for the engagement of local islander monitors (Busilacchi, 2008, Grayson, 2011). The engagement and training of locally recruited fishery monitors has the additional benefit of providing capacity building and facilitating community awareness. However, they can be challenging to recruit and retain due to a variety of factors, including logistical (lack of funding, support, transport and training), social (community resistance, lack of confidence) and economic factors (competition for time, better employment opportunities) (Skewes *et al.*, 2004; Kwan, 2002; Busilacchi, 2008; Murphy *et al.*, 2019). There can also be challenges with maintaining data integrity (Skewes *et al.*, 2004; Grayson, 2011 p 149).

Most studies found that engaging a wide range of local stakeholders was essential to implementing community-based monitoring. In Torres Strait, this included community leaders (e.g., TSRA, TSIRC, PBC, fishers' associations), leading fishers, commercial operations (e.g., freezer operators, CDEP, My Pathway supervisors) and schools (Harris *et al.*, 1995; Busilacchi, 2008; Grayson, 2011; Murphy *et al.*, 2019). Just as importantly, the project manager must also be ready to take feedback on board and act by adapting sampling approaches to suit local stakeholder wishes (Murphy *et al.*, 2019).

An effective communication strategy is essential for fostering trust and building a shared understanding of the benefits and costs of the monitoring program (Grayson *et al.*, 2011; Murphy *et al.*, 2019). While the vast majority of community members recognise the importance of marine resources, and that monitoring these resources is important for maintaining fishery populations (Busilacchi, 2008; Grayson 2011), there is also some resistance to monitoring associated with the involvement of outside agencies in local issues, including the potential for a loss of control and/or access (Busilacchi, 2008; Murphy *et al.*, 2019). While communities have been shown to be generally welcoming and willing to cooperate with monitoring programs in the past, there is some anecdotal evidence that communities may be more questioning as they develop more control and autonomy over their affairs and require more detailed information about data uses and ownership of monitoring data (Murphy *et al.*, 2019).

Providing regular feedback to the community about survey results can generate a lot of interest and foster participation (Busilacchi, 2008). Information booklets that included species identifications and local language names can also create interest and engagement by community members (Murphy *et al.*, 2019). Local communities and fishers need rapid and regular feedback of detailed information about catches to maintain interest and enthusiasm (Grayson, 2011). Whereas management agencies may only need the data on longer timescales. However, the local need should be primary (Davies *et al.*, 1999). Decision making processes that use the data also needs to be clearly articulated to local community members (Grayson, 2011).

Due to the highly variable nature of marine species landings, considerable sampling effort is required to get reasonably precise estimates of the catch for a community. For dugong, at least 70 days of sampling per year would be required to get estimates of dugong catches with a Coefficient of

Variation of <20%, and 150 days of sampling for estimates with a Coefficient of Variation of <10% (Kwan, 2002; Grayson, 2011). However, dugong catches are extremely variable, and possibly a worse case sampling scenario (Kwan *et al.*, 2006). The objectives of the catch sampling are an important consideration in determining sampling effort and analytical power. For example, precise catch data at the island level requires a high sampling effort for that island, whereas estimating the catch for the entire Torres Strait does not need such precision at the island level (Skewes *et al.*, 2004; Grayson, 2011).

2.2 Recreational fishing

Recreational fishing (defined here as non-commercial fishing by non-Indigenous people) is a popular sport and social activity in Australia. The NRIFS (Henry and Lyle, 2003) estimated that 19.5% (3.36 million people) of the Australian population participated in recreational fishing in 2000/01. During this period, fishers undertook 23.2 million fishing events, caught 72 million finfish, and contributed \$1.8 billion to the economy (Griffiths *et al.*, 2010; Campbell & Murphy, 2005; Henry & Lyle, 2003).

Since then, recreational effort has continued to increase (QDAF, 2019). In Queensland, the popularity of recreational fishing has increased from 15% of residents in 2013 to nearly 19% in 2019 (to a total of almost 943,000 people) (QDAF, 2019). These increasing participation rates, together with an increasing population in coastal regions and the increasing sophistication of fishing technologies, highlights a growing need for reliable data to inform policy development and management. In particular, it can be combined with the data from other sectors (commercial and Traditional sectors) to provide more comprehensive estimates of catch and effort for fished populations to underpin robust stock assessments and for allocating resources among sectors.

There have been two recent reviews of recreational fishing monitoring approaches in Australia. In 2010 the FRDC published the report from a large project which reviewed past approaches and new technologies (Griffiths *et al.*, 2010). Then in 2014 the FRDC published the report from another large project to update the state of knowledge and information gaps across the recreational fisheries sectors (States, Territories and Commonwealth) in Australia (Griffiths *et al.*, 2014). This provided an improved understanding of data sets and their deficiencies and described a framework for a national recreational fishing data portal to make summarised recreational fishing survey data available. However, the study concluded that community-based projects could not typically be integrated with the broader jurisdiction-wide surveys as they either used different survey methods or did not produce estimates of total catch and effort for discrete regions (Griffiths *et al.*, 2014). This also highlighted the fragmented nature of recreational fishing data in Australia. An in-depth assessment of recreational fishing monitoring program approaches is described below.

In this study, we reviewed the published and 'grey' literature to identify methods that have or may potentially be used to collect catch and/or effort data from recreational fisheries in the Torres Strait. Electronic data searches were conducted using a range of search engines and the most pertinent studies have are described in the following review. Personal contact with researchers or survey companies was also made in order to access some information sources.

Due to the number of studies on recreational fishing surveys, we focused our search on the more recent literature, including the use of previous reviews. This helped focus the current review on the electronically published literature and on the more recent studies which have been designed to correct for various statistical flaws in earlier survey designs. Surveys to collect social and/or economic data, for example, were generally not included.

2.2.1 Monitoring approaches

Common past approaches

In Australia there have been a range of approaches used to survey recreational fishers. Their methods varied depending on the survey objectives and the region being targeted. Most have quite broad objectives that can include assessments of fishing effort, places fished, species fished, catch rates and effort/resources spent fishing. Most surveys targeted smaller local areas and mainly used methods to intercept fishers and collect information in person ('intercept' surveys, Table 2-6), such as access point, roving creel, door-to-door, aerial surveys, or on-site fisher counts (Griffiths *et al.*, 2010). Whereas broader-scale surveys (e.g., State-wide) used remote methods such as phone surveys, diary-based surveys, or combinations of remote methods (Complemented surveys). Each of these approaches has strengths and weaknesses and we have summarised those below (Table 2-7).

Traditional intercept methods, such as roving, access point or vantage point surveys via direct observation from platforms, cars, boats, or air (Pollock *et al.*, 1994) are, per replicate, expensive to collect (Wood *et al.*, 2016). They also have a range of other biases that are difficult to correct for (Table 2-7). Survey designs that rely on the more well established approaches (e.g., mail, telephone, diary, door-to-door etc) appear to have diminishing effectiveness with: i) the increasing use of mobile telephones; ii) the exclusive use of landlines for internet connections (Grande and Taylor, 2010; Barr *et al.*, 2012); iii) an increase in 'refusals' due to telemarketing saturation (Curtin *et al.*, 2005; Groves, 2006); iv) non-contact bias (contact refusal or failure to sample, Groves, 2006); and v) other forms of survey refusal. For this reason, it is important that emerging technologies and new approaches are a key inclusion in any new assessment of recreational fishing survey design.

Table 2-6. Summary, in number of surveys, for the most common recreational fishing monitoring survey types in Australia since 1990 (based on Griffiths *et al.*, 2010).

Survey type	Brief definition	Local	Regional	State	National
Mail	Questions and responses sent and received by mail	-	-	1	-
Telephone	Questions and responses received by telephone; often used with diary survey	-	2	3	-
Diary, logbooks	Fisher-completed calendar-based diary; typically, after fishing is completed; often used with telephone survey	1	2	6	-
Intercept	Survey staff intercepting fishers at specific times and places to record data relating to their fishing activities, such as number of fishers, catch and effort.	26	3	-	-
Complemented	When two or more basic survey methods are used.	8	7	9	1
Total		35	14	19	1

Recent approaches and emerging technologies

Here we also describe a suite of emerging and/or recent approaches for collecting catch and effort data from recreational fishers (summarised from Griffiths *et al.*, 2010). These approaches have been

grouped into five categories, along with a brief description of their main attributes (below and Table 2-7).

Technology-based self-reporting

There have been recent successes in monitoring recreational fishing in Australia using new technologies (Table 2-7). Recent uses of remote or off-site self-reporting methods can cost-effectively sample a large number of fishers. They include online reporting, online logbooks, text message reporting and phone reporting. These are potentially low-cost methods (due to low labour and operating costs), easy to use and allow for real-time data collection to an online database. However, these types of self-reported data have significant biases. They can severely limit the usefulness of catch estimates for stock assessment due to i) the need for computing, smart phones, or internet access; ii) the prevalence of non-reporting of zero catch trips; and iii) difficulty in extrapolating the data due to unknown population sizes of potential participants (Griffiths *et al.*, 2010). However, their main disadvantage is that they rely on fisher self-reported data, for which the quality and legitimacy can often not be verified without conducting follow-up surveys (Griffiths *et al.*, 2010). In an international review Skov *et al.* (2021) note that smartphone Apps that target recreational fishers are growing in abundance and are being used in several European countries. The strengths and weaknesses of self-reporting approaches are described in Table 2-7.

A notable recent example of technology-based self-reporting is the *Trachmyfish* App which uses a citizen science approach to collect data (Figure 2-2). This App records marine species reported through competitions as well as year-round. Data collection requires a smartphone device and includes taking a photo of the animal on a background ruler, as well as recording GPS location and other information. The program (run by *Infofish*) analyses data, reports aggregated summaries, and includes fishing locations reported at the region level. Importantly, the program provides analysed and mapped data back to the users. It currently has >10,000 users and has reported >44,000 marine organisms from >300 species in the past 2 years in Australia and New Zealand (Stefan Sawynok, *Infofish*, pers. comm.).

The FRDC recently funded (\$1 M) a project to develop a smart-phone App for monitoring recreational fisheries: 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* (Crystal Beckmann (PI), University of Adelaide). This project demonstrates a high level of confidence in this form of Technology-based self-reporting within the national industry.

Community-based monitoring (citizen science)

Community-based monitoring has emerged in recent times as a community-driven method for providing information to resource managers. They have the advantage of being a potentially cost-effective way to collect data, often using one of the off-site methods mentioned above (Table 2-7). They can also increase the fishers' sense of ownership of the process and any subsequent uptake of new management measures. Recreational fishing groups, such as *Sunfish*, have undertaken numerous citizen science research projects, including one of Australia's longest running tagging programs, *Suntag*.

Steneke & Sahlqvist (2011) review six recreational fisheries community monitoring programs in Australia and found they can: i) provide some types of biological data with reliability and over a long term; ii) encourage the fishing community to participate in research and sustainable management of fisheries. However, they had not provided an estimate of total recreational catch and fishing effort

suitable for management, nor the funding to ensure the quality and credibility of data. Other concerns from assessment scientists include that community-operated projects are unlikely to generate reliable catch estimates due to a range of significant biases, including avidity bias (over-representation of avid fishers). However, there are examples where these programs have worked successfully, with close scientific engagement, such as the CapReef program in central Queensland (CapReef, 2009) (Griffiths *et al.*, 2010).

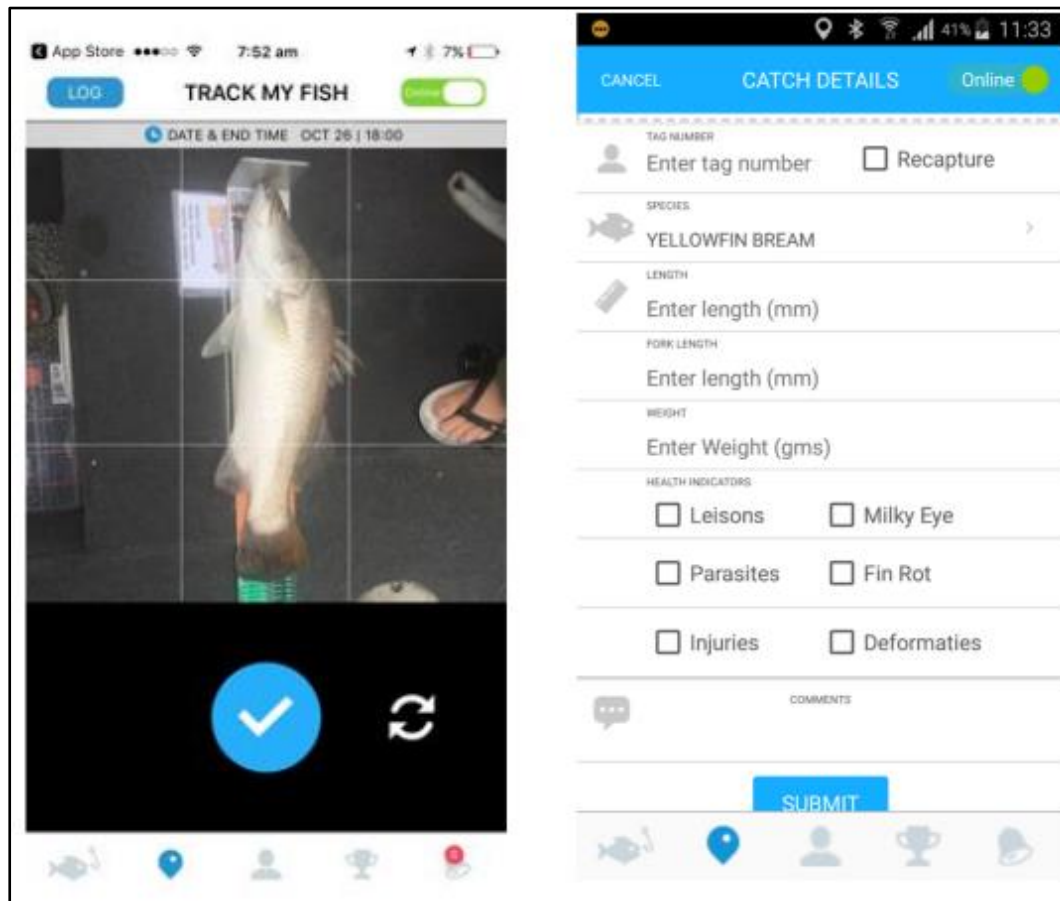


Figure 2-2. Image of a smart device screen to capture images and details using the *Trachmyfish* App (duplicated from Sawynok *et al.*, 2018).

Remote surveillance

Remote surveillance approaches include aerial surveillance, remotely sensed imagery, traffic counts and remotely operated cameras. Remote camera technology is in relatively early-stage development and uses high-resolution photo-mosaic time-series imagery for monitoring patterns of human use (Wood *et al.*, 2016). Remote surveillance approaches, such as remote cameras, are cost-effective tools for measuring effort and behaviour, and are most useful at the scale of vessel detection, including trailer-boat counts and traffic counting. Remote surveillance can be a cost effective and reliable method for monitoring fisher activity due to its ability to collect large amounts of data without a full-time, on-site human data recorder (Wise and Fletcher, 2013; Blight and Smallwood, 2015). They can also allow for better coverage of the temporal sampling frame for fishing effort compared to other methods and can provide time-stamped images. And they can improve precision

of estimates for some on-site survey designs and improve accuracy of estimates from some off-site surveys (Steffe et al., 2017). However, remote surveillance approaches are much less useful for collecting specific information on species caught, levels of effort and other specific catch information from recreational fishers. Remote surveillance is most usefully used on large commercial fishing vessels where species-specific video information can often be collected for catches of large animals such as Threatened, Endangered and Protected species (TEPs). The strengths and weaknesses of remote surveillance approaches are summarised in Table 2-7.

Expert elicitation (and Bayesian models)

According to Griffiths et al. (2010), expert elicitation approaches can overcome some key constraints of other methods and therefore may be powerful and cost-effective tools for monitoring some recreational fishing activities. They use qualitative models to analyse stakeholder expert knowledge (e.g., to quantify anecdotal or patchy data sources such as catch, effort and size composition) (Griffiths et al., 2010) (Table 2-7). They allow for the integration of different types of information into quantitative models, including scientific judgment or expert opinion of fishers, while formally accommodating and incorporating the uncertainty in the information provided (Griffiths *et al.*, 2010). Successful applications of Bayesian models have been applied to a range of ecological and social situations to facilitate the use of expert knowledge (Kuhnert *et al.*, 2005; McCarthy and Masters, 2005; Griffiths *et al.*, 2007), including in Torres Strait to investigate factors influencing indigenous participation in the Torres Strait TRL fishery (van Putten, 2013). However, expert elicitation methods are complex in that they require a Bayesian modelling approach to guide the interpretation of anecdotal information and expert data and are usually used because high quality catch and effort data cannot be (cost-effectively) collected other ways. They are usually best for general issues only rather than specific catch information.

Chain-referral sampling and respondent-driven sampling (RDS)

Chain-referral sampling and respondent-driven sampling are non-random statistical methods that work by the researcher interviewing a randomly chosen set of initial subjects from the target population, who serve as “seeds” for an expanding chain of referrals and interviews. Subjects from each ‘wave’ then refer subjects of subsequent waves (Griffiths et al., 2010). They are useful where fishing members of populations are rare, hidden, or physically difficult to locate within the general population (Griffiths et al., 2010) (Table 2-7). Potential biases include the non-random selection of the first set of seed subjects (seeds) leading to ‘volunteerism’ bias (Erickson, 1979); and non-response bias where participants may refuse to refer the researcher to their peers or provide false or incomplete contact details (‘masking’ bias) (Griffiths *et al.*, 2010), which can have significant ethical ramifications in some situations (Heckathorn, 2002).

Past recreational fishing surveys in Torres Strait

The Queensland Department of Agriculture and Fisheries (QDAF) has conducted statewide surveys of non-commercial fishers in 2010, 2013/14 and 2019 (Taylor *et al.*, 2012; Webley *et al.*, 2015; Mission *et al.*, 2019). These surveys used predominantly telephone-diary combination approaches (Mission *et al.*, 2019). The method used is depicted in Figure 2-3.

Most of the estimates reported in these surveys are grouped into regional summaries and the reliability of the estimates produced is dependent on sample size and activity. While there is no intentional focus on different regions within Queensland, in practice, sampling effort tends to be positively correlated with regional population. Consequently, Torres Strait has always had a low sampling effort during this program, which has resulted in uncertain estimates for that region

(QDAF). QDAF also has a policy of not disclosing estimates that it considers to be unreliable (i.e., where the relative standard error exceeds 50% of the estimate). Due to variability and low sample sizes many of the estimates for the Torres Strait fishing region are not disclosed. For this reason, we only report the limited data that is specifically reported for Torres Strait.

The top 10 species from the 2010 and 2013/14 surveys were reported for Torres Strait (Figure 2-4). These two surveys have little overlap between the species reported, indicating high variability between years. This could be due to a number of factors relating to species regime shifts and/or fisher behavioural change. However, the reliability of the data (as explained above) is a more likely explanation given that it is limited due to low sample sizes within each survey.

The Statewide surveys also reported that the percentage of shore-based and boat-based fishers in Torres Strait was ~25% and ~75%, respectively, in 2010; and ~78% and ~22%, respectively in 2013/14. This high variability may also reflect low sample sizes, rather than a major shift towards shore-based fishing between these two surveys.

An estimated 5,776 ($\pm 2,515$ SE) fisher days were reported for Torres Strait in 2010. However, in 2013/14 the estimate is not reported due to being considered unreliable (a likely reflection of low sample sizes). There is no other data reported from Torres Strait specifically for recreational fishing, as this survey contacts households by phone and does not categorise between Traditional Inhabitants and non-Traditional Inhabitants. However, it uses the definition of relevant catches as being 'fishing for recreation or fun'; as opposed to 'fishing for food' (Traditional fishing).

The QDAF statewide surveys adopt an efficient method for obtaining statewide estimates. However, different methods are more suitable for making estimates at smaller spatial scales. The QDAF data summaries demonstrate the need for a different sampling method where estimates at smaller spatial scales are required. This appears to be the case in order to provide reliable catch and effort estimates for Torres Strait. Alternatively, a relatively large investment is required to modify the QDAF survey to include far greater samples sizes than are currently allocated. And even then, this survey would be restricted by the biases of using a telephone-diary combination approach. Further collaboration with QDAF will be needed to determine a way forward for any further comparative analyses between surveys.

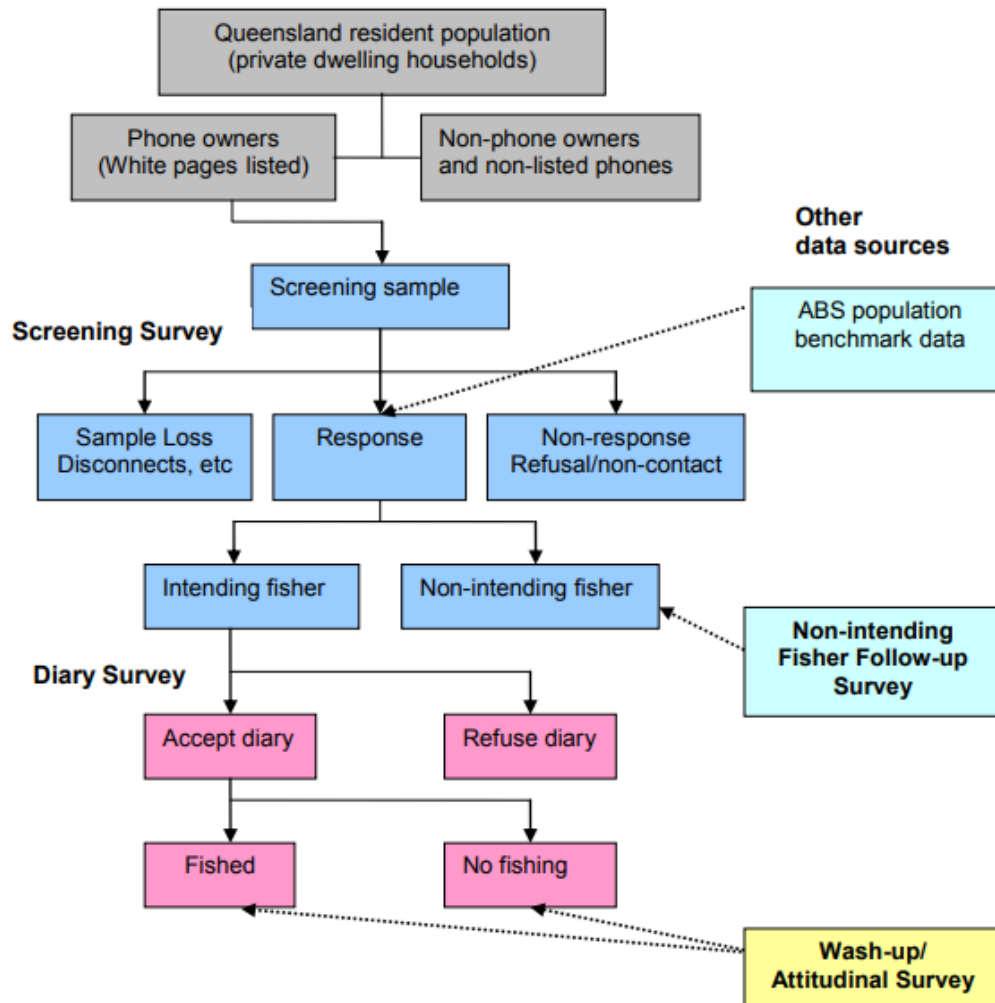


Figure 2-3. Queensland State-wide recreational fishing survey stages (2010, 2013/14). (Mission *et al.*, 2019)

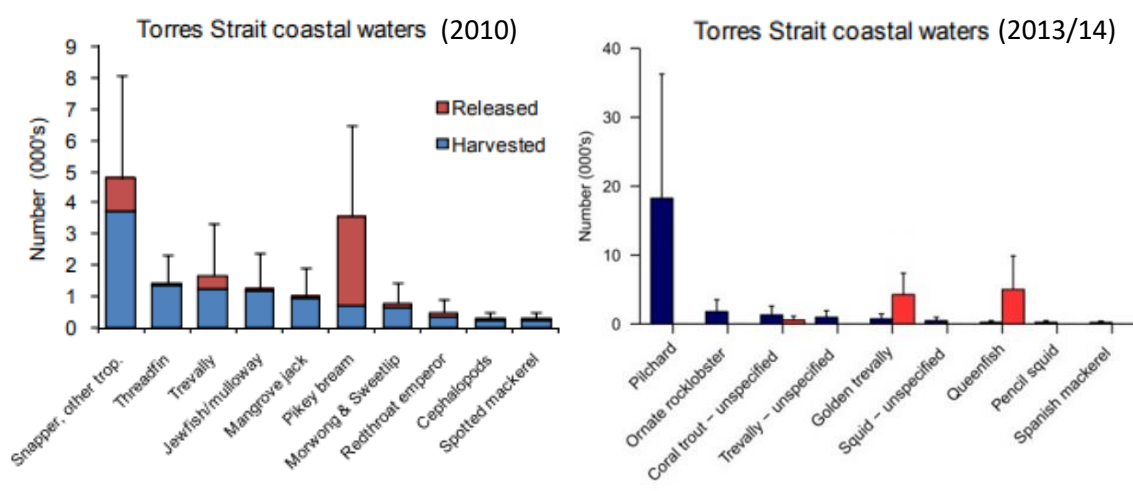


Figure 2-4. Top 10 species caught by fishing region (+SE), taken from the QDAF statewide reports (Taylor *et al.*, 2012, Webley *et al.*, 2015).

Table 2-7. Summary of recreational fishing monitoring approaches and their strengths and weaknesses.

Survey type	Brief definition	Strengths	Weaknesses
Mail	Questions and responses sent and received by mail.	Can be cost effective. Catch and effort can be recorded from fishers who also fish at night or return to private docks, jetties and moorings.	Susceptible to a range of biases (non-response, recall, prestige, rounding, and intentional deception) that often cannot be validated or corrected. Data is self-reported with little or no validation, so data reliability may be an issue. Relies on recall bias and a diminished memory of catch. Survey results are unlikely to reflect the behaviour of the wider recreational fishing community, since more motivated or frequent fishers are more likely to accurately and consistently complete diaries.
Telephone	Questions and responses received by telephone. Often used with diary survey.	As above.	As above
Diary	Fisher-completed calendar-based diary, typically after all fishing is completed. Often used with telephone survey.	As above.	As above. Labour-intensive and expensive; many species groups may need to be lumped under broader categories. Diaries can create 'false effort' as some fishers may feel obligated to fish between each monthly reporting period.
Intercept (includes access point, roving creel, door-to-door, aerial surveys and fisher counts on site)	Survey staff intercepting fishers at specific times and places to record data relating to their fishing activities, such as number of fishers, catch and effort.	Can target only groups or areas of interest. Non-response bias not likely to be a major factor (Pollock <i>et al.</i> , 1994). Can provide species-specific catch rates and size composition data. Catches can be inspected to collect accurate species and size composition data. Biological information can be recorded from retained animals (Roach <i>et al.</i> , 1999).	Labour-intensive, logistically cumbersome, and potentially expensive. Generally, only representative of the daytime catch, making total head counts difficult and prone to underestimation (see O'Neill, 2000; Williamson <i>et al.</i> , 2006). Fishers may use several access points over time and survey staff may not be able to survey all fishers if the number of access points is large (Malvestuto, 1996). 'Length of stay' bias - where fishers who fish for longer periods are more likely to be interviewed - is difficult to correct for (e.g., overall mean trip length

Survey type	Brief definition	Strengths	Weaknesses
		Recall accuracy of fishing effort and details of released animals can be high. Fishers can be interviewed before their trip is complete.	for roving surveys may be considerably longer than the mean trip length determined from completed trip surveys). The over-representation of avid fishers (those who participate more frequently) in a survey can also lead to 'avidity bias', and fishing effort per fisher can be grossly overestimated. Interviewers may contact mainly people that are easy to find to fill their monitoring quota (and fulfill the sample design criteria).
Complemented	When two or more basic survey methods are used.	Useful for dealing with large complex surveys to estimate catch and effort, but they are also useful for correction of biases.	Requires running more than one approach in parallel and using a tightly co-ordinated and potentially complex analytical process. Many of the weaknesses of the individual methods involved may also be relevant.
Technology-based self-reporting (includes online reporting, online logbooks, reporting Apps and text message reporting)	Self-reporting using fast, digital media such as computers and smart phones.	Can cost-effectively sample a large number of fishers. Real-time data collection. Data usually instantly stored electronically. Unique ability to collect accurate temporal and spatial distributions of fishing effort and fisher behaviour.	Requires ownership of personal electronic devices. Self-reporting biases, due to the 'opt-in' strategy are likely to require verification, at least initially. Zero-catch reporting can be highly underestimated. Data extrapolation can be difficult due to unknown sampling frame. Lack of currently available useful Apps
Community-based monitoring (citizen science, e.g., through a fishing club)	Community driven data collection; usually via a range of off-site reporting methods.	Can cost-effectively sample a large number of organised and/or motivated fishers. Can create strong sense of fisher ownership and hence uptake of new measures.	Unlikely to generate reliable catch estimates due to a range of significant biases (including avidity bias). Appropriate quality assurance procedures and training are critical for ensuring the quality of data collected (Stenekes & Sahlqvist, 2011).
Remote surveillance (includes aerial surveillance, remotely sensed imagery, traffic)	Uses visual recording and/or counting of patterns of human activity.	Cost-effective and reliable methods of capturing large amounts of accurate activity data, as well as a	Usually cannot collect information of species caught, levels of effort and other specific catch information.

Survey type	Brief definition	Strengths	Weaknesses
counts and remotely operated cameras)		broader representation of the temporal sampling frame.	
Expert elicitation (and Bayesian models)	Uses qualitative models to analyse stakeholder expert knowledge, e.g., to quantify anecdotal or patchy data sources (e.g., catch, effort and size composition (Griffiths <i>et al.</i> , 2010)	Can be employed to quantify anecdotal or patchy data sources. Can incorporate uncertainty into estimates.	Usually used because high quality catch and effort data cannot be (cost-effectively) collected. Relies on anecdotal information, usually best for general issues only rather than specific catch information.
Chain-referral sampling and respondent-driven sampling (RDS)	A seeded, fisher-to-fisher referral method to locate fishers and collect information to estimate population sizes, catch and effort.	Can identify and survey fishers that would normally be difficult to locate. Useful method when sampling frames do not exist.	Some biases, including the non-random selection of the initial seed subjects (volunteerism bias). Non-response bias (refusal to refer the researcher to their peers or provide false or incomplete contact details) ('masking' bias).

2.2.2 Discussion

Previous recreational fishing surveys for Torres Strait have occurred as part of a State-wide survey. These reported most information summaries for a grouped “Far North or Far North Hinterland” region and had relatively low samples sizes for Torres Strait. One feature of the State-wide surveys worth noting is their definition of recreational fishing, which is: ‘fishing for recreation or fun’; as opposed to Traditional fishing: ‘fishing for food’. This definition will potentially result in some Traditional Inhabitants’ data being included into their recreational fishing survey, which contrasts to the definition used in this review (Section 2.1).

Regardless of jurisdiction, the common need for undertaking recreational fishing surveys is to obtain a reliable estimate of the catch for inclusion in stock assessments and other management objectives, usually relating to sustainable fishery management. In this review we describe a wide range of established and emerging recreational fishing survey approaches that have been applied in Australia, along with their strengths and weaknesses. It is likely that no single survey approach will work in all situations (Griffiths *et al.*, 2010). Consequently, it is critical that any newly designed survey needs to be tailored specifically to the Torres Strait situation based on the objectives of the program and local factors.

Most state agencies in Australia have used some type of complemented survey design; usually either a telephone-diary survey or a telephone-access point survey (Griffiths *et al.*, 2010). However, these designs suffer from biases, with the largest being the lack of a complete list frame (or population list) to estimate total effort or to draw a representative sample of subjects for a diary survey (Griffiths *et al.*, 2010). Other issues were demonstrated in a recent survey in Victoria (Ryan *et al.*, 2009), where around 60% of fishers were found to be exempt from holding a licence, while around 50% of fishers failed to provide a phone number when interviewed during on-site surveys.

In determining which method is most likely to successfully collect high quality data from recreational fishers in Torres Strait, the range of issues - including data requirements (objectives) and the methods’ strengths and weaknesses - need to be critically assessed for a Torres Strait setting. This review provides a snapshot of potential methods and where available, their strengths and weaknesses. However, their assessment for application in Torres Strait will be determined through an assessment process, including use of a multi-criteria analyses and consideration by an expert Advisory Committee. Synergies with a parallel process for assessing a monitoring approach for the Traditional (non-commercial) fishing sector will also be considered.

The review outputs will form the basis for designing and assessing potential future monitoring programs. We will marry these learnings with the information collected on stakeholder needs to tailor potential future monitoring program options to assess the most likely approaches for implementing a persistent, robust, and acceptable program

3 Stakeholder needs

Designing a successful Traditional fishery monitoring program in the Torres Strait requires addressing the needs and issues for all stakeholders. The failure to address the broadest possible range of stakeholder needs will put the success of any future program at risk. We separate the needs into two overarching categories – ‘data needs’ and ‘program requirements, constraints and risks’ and assess these for the following stakeholder groups:

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

Although the PNG National Fisheries Authority (NFA) are the main international stakeholders in Torres Strait fisheries issues, inclusion of PNG stakeholders in the needs' assessment was not within the scope of this project.

In order to obtain detailed stakeholder needs information we completed a range of activities:

1. Review of past fishery monitoring program publications as a guide to help ensure that a comprehensive list of data needs, approaches and issues will be considered during any monitoring program design (Section 2, above)
2. Pre-project consultation with Traditional Inhabitants (Appendices 2, 3 & 4)
3. Summaries of statements from recent PZJA meetings where non-commercial fishing data has been discussed
4. Questionnaires (via e-mail), face-to-face, and remote consultation (phone, video call) with Traditional Inhabitants (Appendix 6)
5. Questionnaires (via e-mail), and remote consultation (phone, video call) with fishery managers (Appendix 6)
6. Questionnaires (via e-mail), and remote consultation (phone, video call) with current assessment and research scientists (Appendix 6)
7. Incorporation of learnings from previous and current Traditional fishery monitoring projects relevant to National stakeholders (appendix 6)
8. Project team workshops
9. PAC feedback and comments during virtual meetings and review of draft reports

The collated needs for each stakeholder group were summarised and assigned a priority from 1 to 3 (Table 3-1) to indicate their importance to achieving the objectives of the monitoring program for Torres Strait. The priority 1 and 2 program needs were categorised into design criteria used to assess a range of traditional fishery monitoring options (Section 4). These design criteria and their prioritisation were also reviewed by the PAC.

Table 3-1. Description of priority levels attributed to identified design criteria.

Priority level	Description
1	Identified design criteria is a critical need for key stakeholders and critical to achieve the core objectives of the monitoring program.
2	Identified design criteria is an important need for key stakeholders and important to achieve the core objectives of the monitoring program.
3	Identified design criteria would make a useful addition to the core objectives of the monitoring program.

3.1 PZJA committee statements on non-commercial fishing data

1. Torres Strait Scientific Advisory Committee (TSSAC No 73)

In the May 2019 TSSAC noted that:

- the proposed non-commercial monitoring project should be a community-led project;
- any non-commercial catch data collection should not put TIB data collection at risk; and that this may be a matter of timing (e.g. wait until CDR rollout has happened);
- the project remains a priority, but agreed to the scoping component initially;
- collecting information about the importance of seafood to communities (and species cultural roles, catch dynamics) could guide the PZJA and other Government agencies in protecting these species for the future livelihood and culture of communities;
- the programs' data could support monitoring and predict climate change effects on these species (currently not monitored) and allow communities to better prepare and plan for future changes;
- all TIB members supported this project going forward, although collecting commercial data needs to remain the priority, and shouldn't be could put this at risk by other activities;
- the program should include "ways to rebuild confidence with communities around sharing data, given past issues where communities felt their fishing data was improperly used.

2. Fin Fish Resource Assessment Group (FFRAG No 8)

In the November 2020 the FFRAG noted that:

- the project is likely to recommend an education campaign to help communities understand why the collection of these data is important especially as part of an ecosystem based management system rather than considering a single species at a time;
- collecting data on non-commercial catches is a key issue for the fishery;
- 2021 rounds of community visits and any consultation by AFMA/TSRA should add communicating the outcomes of the non-commercial catch project to the agenda to help communities' understanding.

3. Fin Fish Working Group (FFWG)

In the November 2020 the FFWG noted that:

- it is priority at this time to develop estimates of catches taken outside the fishery and for the TAC to be reduced accordingly; and that this work should commence, further highlighting the importance of the Torres Strait Non-commercial fishery monitoring project;
- Traditional take catches have been very good; and that Spanish mackerel is an important resource for Traditional fishers;
- there were concerns by Ugar community members that Spanish mackerel being taken for subsistence and recreational fishing are significant (maybe more than the TIB catches) but are not being recorded;
- it is important to collect more accurate catch data for TIB Traditional fishing (kai kai) and that they were eagerly awaiting the outcomes of the scoping study investigating options for monitoring Traditional take catches being led by Kenny Bedford.

3.2 Pre-project consultation with Traditional Inhabitants

As part of the project proposal process, we provided a consultation plan (Appendix 2) and project summary (Appendix 3) for approval by the TSSAC/AFMA/TSRA. The original expanded proposed project summary was emailed, with a covering letter, to all current PBC Chairs and TSIRC Councillors.

We also sent the project summary and cover letter to the TSRA for dissemination to the Fishery portfolio member (TSRA), and subsequently to other TSRA officers deemed appropriate by the Fishery portfolio member.

The results of the pre-project consultation, including any comments received, were submitted as a supplementary document to the original full proposal to the TSSAC EO in May 2020, and are presented in Appendix 4. This included responses from 13 of the targeted stakeholders (21%), with 11 being supportive (85%) of the proposed project, one against and one uncertain.

Most of the community stakeholders recognised the importance and benefits of collecting data on the non-commercial fishery catch and two suggested their community would be interested in being involved in the pilot program. Two main concerns expressed were: 1) that (some) community members will think that information may be used to restrict their catch/access to the fishery; and 2) that recreational fishers may not be included in the monitoring. The messaging around these and similar concerns, as well as communicating the benefits for sustainable fisheries, will be critical to the success of the project.

3.3 Project Advisory Committee

The Project Advisory Committee (PAC) was formulated with the following membership:

- Councillor Francis Pearson (Poruma Island Traditional Owner; TSIRC Councillor, PZJA consultative Traditional Inhabitant representative)
- Jon Tabo (Murray Island Traditional Owner; PZJA consultative Traditional Inhabitant representative)
- John Morris (Masig Island Traditional Owner; PBC Chair)
- Councillor Rocky Stephen (Ugar Island Traditional Owner; TSRA Member, STIRC Councillor, PZJA consultative Traditional Inhabitant representative)
- Frank Loban (James Cook University, Badu Island Traditional Owner, Zendath Kes Fisheries Interim Director)
- 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)
- TSRA Fishery Program representative

This membership provided expert assessment by two key stakeholder groups: Traditional Inhabitants and subject matter experts. Five Traditional Inhabitants represented different Torres Strait communities and the two subject matter experts are national experts in Traditional fisheries, Traditional fisheries monitoring, Indigenous livelihoods and natural resource management.

The PAC was engaged through two (remote online) workshops, where the project methods and outputs were described, followed by feedback and group discussion. Feedback and additional information were also received through requests for comments on draft outcomes, by way of the draft written report.

The PAC deliberations resulted in several changes to project outcomes and made recommendations on the implementation of a specifically designed pilot program.

3.4 Stakeholder data needs

Here we summarise the data needs for different stakeholder groups associated with the non-commercial catch sector monitoring project in Torres Strait based on the literature review (Section 2), stakeholder consultation (Appendix 6), feedback from the Project Advisory Committee, and project team deliberations. These data needs are then distilled into design criteria that are further prioritised according to their importance for the design and implementation of future monitoring strategies in Torres Strait (Table 3-1; Section 4).

Traditional Inhabitants

Traditional Inhabitants are highly reliant on marine resources for food and income, and many of these will also have significant cultural and spiritual value. This importance is demonstrated by customary resource management that has been in place for several millennia. However, the recent advent of local and non-islander commercial fisheries, increased catch efficacy, and other global drivers (e.g., climate change, market demand) has resulted in the need for more data driven approaches to modern customary resource management. Although regional management agencies have taken an increasing role in the management of commercial species there is an ongoing aspiration among Traditional Inhabitants in Torres Strait to take more responsibility for managing Traditional and commercial fishery resources under customary management approaches.

Information on the catch of key selected species from Traditional fishing will support local decision making. For example, annual catch for culturally important species that are of local concern (e.g., rabbitfish on Erub) will allow the application of customary fishery management or other local management processes (e.g., potential Traditional fishery harvest strategies). Catch information could also underpin future development of commercial fishing where communities are not currently maximising economic benefits from local marine resources (e.g., Spanish mackerel on central island communities such as Poruma). Having information on trends in fishery catches over time will help communities see the type of changes that are occurring. This information can help communities adapt to changes in marine species availability that may be driven by management or regional drivers such as overfishing or climate change.

Seasonal patterns in fished species (e.g., based on high resolution temporal data) can also have relevance to customary management through the application of fishing seasons (e.g., ceremonial occasions, tombstone openings, holidays). Similarly, data on the location (at reef or other appropriate scale) of catches can underpin spatial fishing practices (e.g., home reefs, closed reefs) and provide assessments on whether there are regionally specific impacts from fishing or other sources.

Information on catch, effort, and behaviours (including catch use/fate) of different demographic groups (e.g., women, elders) will provide an understanding of socio-economic development needs for Traditional Inhabitants (e.g., needs that underpin sustainable community livelihoods, such as tailored support for women fishers).

The above data needs for Traditional Inhabitants and their importance (priority level) for designing a monitoring approach for Torres Strait can be summarised thus:

Data needs - Traditional Inhabitants	Priority level
Annual catches of all fished species in the community	Priority 1
Seasonal patterns in catches	Priority 2
Location of catches (reef scale)	Priority 2
Disaggregation of catch, effort, use by key demographic and other groups (e.g., women, children, TIB fishers)	Priority 2
Household social and economic data	Priority 3

Fishery managers

The primary fishery management agency in the Torres Strait is the Protected Zone Joint Authority (PZJA). The PZJA is supported by four government agencies (known as ‘PZJA agencies’) – the Australian Fisheries Management Authority (AFMA), the Commonwealth Department of Agriculture, Water and the Environment (DAWE), the Queensland Department of Agriculture and Fisheries (QDAF) and the TSRA.

Australia and PNG established the TSPZ with the principal purpose of acknowledging and protecting the traditional way of life and livelihood of the Traditional Inhabitants of both Parties, including their Traditional fishing and free movement. In managing Protected Zone Commercial Fisheries the PZJA must acknowledge and protect the traditional way of life and livelihoods of the Traditional Inhabitants. This includes their rights in relation to Traditional fishing; protection and preservation of the marine environment; the development and implementation of licensing policy, and fostering economic development in the TS and employment opportunities for traditional inhabitants. Consequently, PZJA needs to have sufficient understanding of the nature and extent of Traditional fishing in order to protect it whilst managing commercial fisheries and the sustainability of fished populations into the long term. This translates into having robust data from all fishing activities and sectors to ensure that the total take of any one species does not exceed its Recommended Biological Catch (RBC).

Accurate, comprehensive, and representative data from all fishery sectors (e.g., Sunset, TIB, PNG commercial², non-commercial fishery sectors) will allow managers to make more robust allocation decisions where there are competing sector allocations for a finite catch, whereas uncertain catch information necessitates conservative decision making and lower catch allocations to some sectors. A high priority is the annual allocation of Sunset sector licence TACs for Spanish mackerel and coral trout in Torres Strait. This allocation is important as it provides a revenue stream that supports broader economic development and capacity building, such as provision of community fishing infrastructure and other opportunities that help maintains continuity of market supply.

Improved understanding of the catches from both the commercial and non-commercial fishery sectors will provide a more accurate analysis of catch sharing between these two sectors and consequently a more accurate allocation of catch to the Sunset sector. Without accurate data, more conservative decisions need to be implemented by fishery managers, which can lead to fewer Sunset

² There are no current PNG commercial fisheries taking fished species in the Torres Strait, although there is provision for PNG catch sharing within the Treaty.

licences being taken up, or loss of the Sunset sector. Both scenarios reduce (i) income to the TSRA through licencing arrangements and (ii) the amount of data collected by the Sunset sector. A complete loss of the Sunset sector (a scenario that has been discussed in recent Finfish Working Group meetings for the Spanish mackerel fishery) will also have a substantial impact on the ongoing assessment of stock status, possibly leading to significantly less accurate assessments in the short to medium term.

Management agencies also have a broader responsibility to manage all Traditional fisheries and protect and promote community livelihoods and economic development. Information on the catches and status of all species in the Traditional fishery (~200 species – Harris *et al.*, 1995) will help fulfil these obligations. However, the data needs required for management of non-commercial species in the Traditional fishery catch is less certain. While a lower priority for managers than the commercial species (Spanish mackerel, coral trout and TRL), annual catch estimates for 200 or so non-commercial species will still be a high priority for Traditional Inhabitants to help describe and understand variations in marine species year biomass and impacts of exploitation and other environmental factors.

Managing for environmental sustainability in Traditional fisheries, includes management of issues related to localised depletion. This will require information on the location of catches, or other information related to spatial differences in fishery removals. For commercially fished species, this spatial information should complement other spatial data collection strategies.

Catch information differentiated by gender, age and possibly other demographic factors will provide an improved understanding of Traditional catches over time that drive seafood consumption and its value to the community. This knowledge will be important to fishery managers for implementing programs focussed on community development and vulnerability, including the contribution fishing makes to the regional economy.

Tracking fishery products through the processing chain can be important for catch data validation, maximising returns and reducing waste. Combining or comparing catch data from different sources also often requires product conversion ratios due to differential processing methods. These can be estimated by data gathered at different processing stages. Similarly, information on costs and revenues of fishing are useful for economic and non-market value analyses - key drivers of fishing effort and promoting sustainable local industries.

The above data needs for fishery managers and their importance (with priority level) for designing a monitoring approach can be summarised thus:

Data needs - Fishery managers	Priority level
Annual (accurate, comprehensive, and representative) estimates of the non-commercial catch of TRL, Spanish mackerel and coral trout (four species)	Priority 1
Annual catch of all other species in the Traditional fishery (potentially ~200 species)	Priority 2
Location of catches (logbook zones)	Priority 2
Catch and catch use by Traditional Inhabitants (TIB fishers, women, children etc)	Priority 2
Conversion ratios for fishery products through processing chains	Priority 2
Economic information on the revenues and costs of fishing, and value chains	Priority 3

Stock assessment scientists

Stock assessments underpin sustainable natural resource use by providing estimates of stock status and management advice to resource managers and resource owners. The degree of certainty in stock estimates impacts on recommendations for future sustainable catches, with less certainty resulting in more precautionary TACs. Accurate fishery data results in more accurate assessments which leads to potentially more appropriate management recommendations and lower risk to the fishery populations.

Robust stock assessments require fishing mortality from all sources to be considered. For commercial species that are also caught in the non-commercial fishery sectors, such as Spanish mackerel, coral trout and TRL, the biggest gap in fishery catch information is for the non-commercial Traditional take. Besides the retained catch, information on fishery discards, particularly those discarded species that have a high mortality upon release, is also important for assessing overall fishery mortality.

Stock assessments, particularly those heavily reliant on fishery-dependent data, are usually built on time series of data spanning several years at least. Therefore regular (e.g., annual), ongoing, time series of fishery dependent data is desirable. Inter-year (e.g., monthly, or seasonal) catch data can also provide important information on population status, movement patterns and ontogeny (developmental life history).

It is critical, for all the above, that marine species identification is to an appropriate level of accuracy (to species where possible). This is because different species have different life history characteristics and unique responses to management interventions. Any grouping of species or uncertainty in identification reduces the accuracy and reliability of assessment outputs. For example, stock assessments for coral trout are hampered using a coral trout 'basket' category, where four species are grouped into this one catch category, instead of each species being treated separately.

Data integrity and reliability are critical to reliable and accurate stock assessments and other research outcomes. Data biases result in inaccurate stock assessments and potentially over-estimated TACs and overexploited stocks. Where possible, fishery datasets will benefit from data validation processes where independent data is collected for comparison and/or integration with fishery-dependent information, thereby substantially minimising potential bias.

Apart from estimates of the catch, additional information, such as fishing effort (e.g., number of hours fished) that allows for the calculation of catch per unit effort (CPUE), is usually required for robust stock assessments. In more sophisticated age-structured models (such as used for Torres Strait finfish and TRL fisheries), such high-quality data is required (standardised CPUE, age/size and sex data). Size at age can be estimated using length measurements or estimates, and/or weights and count data. More precise age and sex information could be gathered through the provision of finfish frames, otoliths, or other samples.

Fishing location is potentially important for assessing spatially patchy stocks within a fishery managed area and may also provide information to scientists on whether populations are present and differentially impacted between regions. These data can improve the accuracy of assessments by allowing for finer scale spatial population models to underpin overall regional assessments. This level of spatial detail (e.g., logbook region as per the current Fish receiver System docket books) does not need to be at the fine scale as required for customary management (i.e., reef scale), and can be negotiated, as fishers often do not want to provide exact locations of fishing.

Very often, observations by fishers (anecdotal information) on stock trends, animal movements, spawning times and areas and other aspects of fishery biology and ecology can be particularly useful to stock assessment scientists to improve the understanding of population dynamics and validate the conclusions from data driven stock assessments. The collection of such information on a regular or structured basis would have considerable utility for robust stock assessments.

Where there is an interaction between the Traditional and commercial fishery sectors, data collected should be complimentary so that the analysis can be done on a unit stock basis. This may be overcome where different data forms can be converted to match the key data being analysed (e.g., fish lengths being reliably converted to weights).

The collection of abiotic parameter measurements can be used to establish baseline measures and assess changes in patterns/environmental relationships that can be correlated with changes in stock availability and/or behaviour. While not a primary focus of the proposed monitoring program, there is the potential for local fishers to contribute to abiotic data collection as an auxiliary activity.

Following fishery products through the processing chain can be important if data is gathered at different processing stages, and conversion ratios becomes necessary for combining or comparing data from different product stages. Similarly, information on costs and revenues of fishing are useful to scientists for economic analysis - a key driver of fishing effort.

Tissue samples for genetics' studies, which could be used to investigate stock boundaries, natural mortality and/or stock connectivity, have been identified as a high priority for Spanish mackerel. They can also be used in studies looking at contaminant loads. These could potentially be collected, stored, and transported to laboratories as part of the monitoring process.

The above data needs for stock assessment scientists and their importance (priority level) for designing a monitoring approach can be summarised thus:

Data needs – Stock assessment scientists	Priority level
Annual (and seasonal) non-commercial catch (including discards) of commercially fished species such as Spanish mackerel, coral trout (4 species), and TRL that are comprehensive, representative, and accurate	Priority 1
Annual (and seasonal) catch (including discards) of non-commercial species that are comprehensive, representative, and accurate	Priority 2
Fishing effort and gear type	Priority 2
Marine species size/weight/age and sex information	Priority 2
Location of catches (logbook zones)	Priority 2
Fishers' observations on catch trends and fishery biology and ecology	Priority 2
Data should be complimentary and comparable to other sectors of the fishery	Priority 3
Abiotic parameter measurements (e.g., water temperature, turbidity, wind strength etc)	Priority 3
Post-harvest value chains analyses, by species	Priority 3
Provision of fish frames, otoliths, or tissue samples for aging, genetic or seafood contaminants studies	Priority 3

National stakeholders

National stakeholders of Torres Strait fisheries include national, international, and state fishery and environmental research and management agencies (NIAA, DEWE, Qld DEH, FRDC, ABARE, PNG NFA etc), and large NGOs (WWF, AMCS, QSIA). Many of these agencies will have data needs related to

the Traditional fishery in Torres Strait, mostly concerned with demonstrating sustainability of fisheries, environmental stewardship and promoting indigenous industry and economic development. In this sense, many data requirements will be similar to regional fishery management agencies (as above). However, additional information needs relate to the development and implementation of Traditional catch monitoring programs more broadly throughout Australia.

The Fisheries Research and Development (FRDC) Indigenous Research Group (IRG) are focussed on a broad initiative to improved data on Aboriginal and Torres Strait Islanders fisheries resource use, driven by sustainability, resource ownership and stewardship, and economic development goals. This is reflected in the outputs of the FRDC Project 2018-016 - *Improving data on Aboriginal and Torres Strait Islander marine resource use to inform decision-making* (Moyle et al., 2020)). This project developed a framework for improved data on Aboriginal and Torres Strait Islander fisheries resource use to help manage the challenges and opportunities that are often shared between communities. *"This framework and the ongoing development of data collection methodologies aims to facilitate the sharing of Indigenous fishing data that ensures a more holistic and collaborative approach to fisheries resource management. The sharing of these data, incorporating catch related information and Indigenous knowledge should allow an improved understanding of the needs (culturally, socially, economically) of Indigenous communities and resource managers."*

The FRDC also recently funded a relevant project in 2020: 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* (Crystal Beckmann (PI), University of Adelaide). This project may offer highly mutually beneficial opportunities to trial an App for non-commercial catches in the Torres Strait.

While they have developed overarching principles for Traditional fishery data collection (many of which have been included here), practical implementation of data collection methodologies that fulfill these guidelines are still in development. Learnings from the development of the monitoring program in Torres strait will have utility for these programs nationally and provide opportunity to collaborate with case studies in selected locations through the joint development and application of programs.

The above data needs for national stakeholders and their importance (priority level) for designing a monitoring approach can be summarised thus:

Data needs – National Stakeholders	Priority level
Improved data on Aboriginal and Torres Strait Islanders fisheries resource use	Priority 1
Information of monitoring program implementation, utility and limitations	Priority 2
To improved government policy	Priority 3

3.5 Stakeholder requirements, constraints, and risks

Traditional Inhabitants

Previous research on monitoring Traditional fishery catches and discussions with Traditional Inhabitants have emphasised that Traditional fishery catch monitoring programs must be culturally appropriate (see above), focused on local stakeholder needs, and have a high degree of local control and use. Often, Traditional Inhabitants feel that information on the Traditional fishery catch could be used against them to close or restrict access to resources, resulting in low levels of participation and cooperation.

One of the best ways to counter this issue is through the co-development of monitoring programs with Traditional Inhabitant communities and the provision of genuine local control. For example, data (e.g., higher-level summary data) should only be supplied to external agencies on an agreed basis, and with communities having veto power over access to information by outside stakeholders. Appropriate representative community groups that will take primary responsibility for managing this process will need to be identified and supported. We note here that some personal information should never be made publicly available, even to these local groups.

Regional agencies (e.g., TSRA, AFMA, Malu Lamar (TSI), Registered Native Title Body Corporate (RNTBC)) will most likely be required to take a lead role in formulating and administering the data systems needed to hold the monitoring data (e.g., based on the existing TEK database used by the Torres Strait ranger program). This should be done with the agreement of local communities and with well documented and transparent protocols in place.

To ensure confidentiality, the process for the transfer of information from the Traditional fisher to the database needs to be secure and uncomplicated (e.g., have the least number of steps). If paper forms are used, then processes need to be put in place to secure datasheets and facilitate transport to data entry points. Any data entry portal should be designed so it connects directly to secure data systems. Individual information, sensitive data, and Tradition Knowledge (TEK) must be demonstrably protected.

The monitoring program implementation should also recognise and value the time that local fishers will need to spend contributing to data collection, and that this time impost should be kept to a minimum and/or incentivised. Since this time is likely to be unpaid, the value proposition for providing fishery information will be critical.

The monitoring process should be as straight forward as possible and easy to understand and implement. Any data interface must not be too technical and/or challenging – as is generally the case with all public information elicitation programs. The simpler the better.

There is considerable scope for Traditional Inhabitant communities to benefit from employment and training opportunities that locally implemented monitoring programs can provide. This capacity building has the potential to increase local involvement, foster trust and improve data quality.

The above requirements and constraints for Traditional Inhabitants and their importance (priority level) for designing a monitoring approach can be summarised thus:

Program requirements and constraints - Traditional Inhabitants	Priority level
Program is socially and culturally acceptable to Torres Strait Islander communities	Priority 1
Monitoring program should be co-designed with communities	Priority 1
Data management responsibility sits with communities or their representative leadership/bodies	Priority 1
Data is held in a secure database	Priority 1
Follow ethical principles, e.g., protection of identity of individual fishers	Priority 1
Data provision needs to be technically easy and uncomplicated	Priority 1
Provision of data by fishers should take up the least amount of time	Priority 1
The monitoring program should include capacity building and/or employment opportunities for community members	Priority 1

Fishery managers

The desired (and stated) goals for management agencies in Torres Strait is to work with Traditional Inhabitants in the overall management of marine resources. Therefore, it is critical that management agencies and Traditional Inhabitants develop a trusted relationship based on shared aspirations, recognition of past experiences, transparency regarding how the data will be used and managed, and having effective local control and information security. A Traditional fishery monitoring program is at the nexus of this trusted relationship, where both parties have a legitimate stake. Building and maintaining a high level of trust will be critical to its success.

Fishery management agencies will not only be an important user of monitoring data (or at least authorised summaries of catch data) but will also likely be key contributors to the resourcing and implementation of the program. To this end, their investment will be predicated on an expectation that the program will provide information for their needs (see 3.2 Data needs) based on risk-catch-cost considerations – being the trade-off between: the risks associated with decisions based on data from the program; the quantum of catches that can be safely recommended; and the cost of the monitoring program. A costly monitoring program may not be justified in the long term if the benefits of creating demonstrably lower risk to marine species stocks or higher catches are not realised.

As key implementers of at least the technical aspects of the program the program, Fishery managers will require the approach to be highly feasible, with minimal levels of ongoing specialist technical assistance. Additionally, they will be responsible for the occupational health and safety (OH&S) of staff working on the program, as well as having a vested interest in ensuring fisher safety during any monitoring activities.

The above requirements and constraints for fishery managers and their importance (priority level) for designing a monitoring program approach can be summarised thus:

Program requirements and constraints – Fishery managers	Priority level
Program needs to include trust building based on shared aspirations, recognition of past experiences, transparency regarding how the data will be used and managed, legitimate local control, and information security	Priority 1
Program needs to be affordable, and cost be proportional to data accuracy and precision (risk-catch-cost trade-offs)	Priority 1
Approach needs to be logistically feasible, and relatively straight forward to implement	Priority 1
Overall program must meet implementing agency OH&S guidelines	Priority 1

Stock assessment scientists

As is the case with regional management agencies, scientific agencies and individual scientists will be required to develop relationships, protocols, and agreements with Traditional Inhabitants regarding the provision, use and dissemination of data and research outputs. This will be facilitated by current and developing ethics protocols and agreements with the appropriate cultural authority (e.g., Malu Lamar, RNTBCs) and/or individual Traditional Inhabitants. This will include obtaining internal ethics approvals implemented by most research agencies and the roll out of ethics and consultation processes in the project development phase. Current ethics agreements usually contain strict rules to ensure that data systems are highly confidential, and that personal information is not released without permission of the information provider – e.g., by only reporting large scale locational

information. This will help ensure that data and information is not misused and maintains trust and long-term participation in monitoring programs.

The co-development of data gathering protocols will also build trust between Traditional Inhabitants and scientists, and ideally will be part of a broader co-management framework (e.g., as part of a formal fishery co-management harvest strategy). The development of these broader co-management strategies could be seen as an aspirational goal by all stakeholders. These instruments could provide the platform to ensure an ethical and culturally appropriate approach to the collection and use Traditional fishery catch information by stock assessment scientists.

Trust and cooperation will also be facilitated by the provision of effective communication materials from scientific outputs. This will include dissemination of the results of research to underpin customary management and to help provide clear incentives for data collection (e.g., explaining why the data is important and will benefit communities).

The above requirements and constraints for stock assessment scientists and their importance (priority level) for designing a monitoring program approach can be summarised thus:

Program requirements and constraints – Stock assessment scientists	Priority level
Data collection should be accompanied by comprehensive ethics agreements to ensure an ethical and culturally appropriate way to collect, securely store and use the Traditional fishery catch information	Priority 1
Co-development of monitoring programs should occur with the community, perhaps as part of broader co-management strategies	Priority 1
Communication material is sufficient to inform, educate and increase capacity (e.g., provision of training and species guide to minimise misidentification)	Priority 1

National stakeholders

As with management and scientific agencies, national stakeholders will require that data collection and reporting is ethical and culturally appropriate, and that data outputs are only used with the permission of Traditional Inhabitants. This may be difficult in cases where there are no direct agreements between national agencies and local communities. In this case, national agencies will rely, to a large extent, on the implementing agencies protocols and processes. The provision of written agreements and data “chain of custody” protocols will be important for demonstrating that the process meets these requirements.

The above requirements and constraints for national stakeholders and their importance (priority level) for designing a monitoring program approach can be summarised thus:

Program requirements and constraints – National stakeholders	Priority level
Program is socially and culturally acceptable to Torres Strait Islanders	Priority 1
Formal agreements covering all aspects of the monitoring program must be developed and ratified	Priority 1

3.6 Discussion

The stakeholder needs described above were developed using information from previous monitoring programs and input from the key stakeholders of Torres Strait fisheries. Not surprisingly, it includes aspects that are important to monitoring strategies (and assessments) for almost all fisheries. However, it also includes needs and issues that are more specific to Traditional fisheries and/or

Torres Strait (e.g., the need for community level agreements). These may be best summarised by the PZJA representative fishery committees who recognise the need for data from all fishery sectors and strongly support the process to develop a cost-effective and acceptable non-commercial fishery monitoring program.

In order to recommend a successful monitoring strategy for non-commercial fishing in Torres Strait, we used the priority 1 and 2 data needs, and program requirements, constraints and risks in an assessment of potential monitoring strategies. These are described in Section 4 (below) and were subject to feedback from the PAC.

While the above needs and issues analysis was focused on the Traditional fishery, many of the same issues apply to recreational (non-islander) fisheries. In this sense, we have some confidence that the Traditional fishery monitoring program assessment will also be suitable for monitoring recreational catches in Torres Strait. This has the major advantage of not having to develop and roll out separate programs for each of these two sectors. This issue is also discussed following the assessment of different monitoring approaches (below) to test whether the above assumption holds.

4 Options for non-commercial catch sector monitoring

Here we assess a targeted range of options for monitoring the non-commercial catch sector to meet the needs of the key stakeholders in Torres Strait. The selection of potential options used information from (i) the outcomes of a review of approaches to monitoring the non-commercial catch sector of Indigenous communities in Torres Strait and more broadly (Section 2); (ii) consultations with local stakeholders; (iii) the expert views of the PAC; and the project team. We score each of the options against the needs of key stakeholders in Torres Strait (from Section 3) in a multi criteria analysis. This produced a score for each option and illustrates their strengths and weakness. This process resulted in a ranking of options and recommendations for a preferred candidate monitoring approach.

The assessment focused on monitoring the Traditional non-commercial catch sector. Recreational (non-islander non-commercial catch sector) fishing will be considered post-hoc to assess if it is possible to collect data from this sector using the same monitoring approaches selected during this initial selection process. This may require modification or additional components to the primary monitoring, or, if this is not possible, a new separate process.

Six potential options were formulated to assess an acceptable non-commercial catch data monitoring strategy in Torres Strait (Table 4-1). These reflect previously used monitoring strategies in Torres Strait, but also incorporate potentially suitable features from the range of monitoring methods assessed in Section 2. They were also moderated or refined to incorporate the needs of any future program that were described in Section 3. They were also reviewed by the PAC.

Table 4-1. Non-commercial catch sector monitoring strategy options for the Traditional fishery catch in Torres Strait.

No.	Title	Description
1	Self-reporting via monitoring app	Reporting of daily catch and other information when fishing. Self-reporting (fisher level) via an App tool linked to a central secure database.
2	Self-reporting via catch datasheet	Daily reporting of catch and other information. Self-reporting (fisher level) using a catch data sheet which is then sent to a central location for entering into a secure database.
3	Self-reporting via periodic catch datasheet	Periodic reporting of catch (e.g., for previous month) and other information. Self-reporting (likely at household level) using catch data sheets is then sent to a central location for entering into a secure database.
4	Embedded observers via catch datasheets	Periodic reporting of catch (e.g., for previous month) and other information. Information collected by an embedded community-based observer collecting information from households.
5	Creel surveys by roving observers	Daily reporting of a temporal sample (e.g., quarterly for 5 days) for each community by independent observers based on roving (bus route) periodic sampling. Creel (landing point) survey of daily catch and other information.
6	Creel surveys by periodic roving observers	As above, but only done on every 2 to 5 years.

4.1 Multi-criteria analyses

The priority 1 and 2 design criteria that were formulated from the Stakeholder needs assessment (Section 3) were grouped and used as descriptors for 14 criteria in a multi-criteria analysis (MCA) to assess options for a Traditional (and recreational) fishery catch monitoring program. Each of the criteria were in turn grouped into five higher-level criteria groups: cost, benefit, feasibility, culture, and sustainability (Table 4-2), to ensure that standard MCA criteria were adequately represented and provide insights into the factors driving the selection of preferred options.

Note that, in addition to the design criteria stipulated above, we have also included a criterion that considers environmental sustainability, including minimising environmental harm and greenhouse gas production.

Table 4-2. Priority 1 and 2 stakeholder needs (Section 3) categorised into criteria and five high-level criteria groups: cost, benefit, feasibility, cultural considerations, and sustainability.

No.	Criteria groups / Criteria	Priority 1 and 2 Stakeholder needs
1	Cost	
1.1	Financial cost	<ul style="list-style-type: none"> Program needs to be affordable, and costs proportional to data accuracy and precision (risk-catch-cost trade-offs) (Priority 1)
1.2	Fisher recording effort	<ul style="list-style-type: none"> Provision of data should take up the least amount of time (Priority 1)
2	Benefit	
2.1	Traditional Inhabitant data needs	<ul style="list-style-type: none"> Annual catch information for all fished species (~200 species) by the community (Priority 1) Seasonal patterns in catches (Priority 2) Location of catches (reef scale) (Priority 2) Fishing effort and gear (Priority 2)
2.2	Fishery managers data needs	<ul style="list-style-type: none"> Annual estimates of the non-commercial catch of commercially important species. (Priority 1) 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)
2.3	Scientific data needs	<ul style="list-style-type: none"> 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 trends and fishery biology and ecology (Priority 2)
2.4	National data needs	<ul style="list-style-type: none"> Improved data on Aboriginal and Torres Strait Islanders fisheries resource use (Priority 1) Information of monitoring program implementation, utility, and limitations (Priority 2)

No.	Criteria groups / Criteria	Priority 1 and 2 Stakeholder needs
2.5	Capacity building	<ul style="list-style-type: none"> The monitoring program should include capacity building and / or economic opportunity for the community (Priority 1)
3	Feasibility	
3.1	Method feasibility	<ul style="list-style-type: none"> 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)
3.2	Data reliability	<ul style="list-style-type: none"> Data is comprehensive, representative and accurate (Priority 1)
3.3	OH&S requirements	<ul style="list-style-type: none"> Overall program must meet implementing agencies OH&S standards (Priority 1)
4	Culture	
4.1	Social and cultural acceptance	<ul style="list-style-type: none"> 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)
4.2	TEK security	<ul style="list-style-type: none"> 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)
4.3	Social equity (e.g., gender, age)	<ul style="list-style-type: none"> Social equity of catch, effort and catch use information (TIB fishers, women, children etc) (Priority 2)
5	Sustainability	
5.1	Environmental harm	<ul style="list-style-type: none"> The program should minimise environmental harm, including minimising greenhouse gas production (Priority 2)

Each of the criteria were subsequently described using the following characteristics (Table 4-3):

1. The criteria metric range. For each criteria, what is the range of values that could occur. This range of values is then scored as 1 (lowest) to 5 (highest).
2. Whether the criteria were deemed as mandatory. This identifies criteria that have a limit where the success of the monitoring program would be severely jeopardised — and for all mandatory criteria, what is the minimum acceptable score.
3. The criteria weighting – for each criteria, the weighting used for calculating criteria group option score (and ultimately the overall score). This was primarily related to the proportion of priority 1 needs within each criteria but included some expert assessment by the project team and the PAC. Note that criteria group weightings are estimated as the maximum criteria weighting of the individual criteria in that group.

Each criteria were then scored from 1 (min of range) to 5 (max of range) by the project team during a workshop in August 2020 (Table 4-4). The scores were then reviewed and moderated by the PAC at meetings in September and November 2020 (Table 4-4). Criteria group scores were calculated as the

weighted average of the criteria scores in that group. As criteria group scores were calibrated as “higher is better”, some criteria scores were transformed using the formula $(6 - [\text{criteria score}])$ for the calculation of criteria group averages (Table 4-4).

Table 4-3. Characterisation and metrics for the assessment criteria used to score options for monitoring the Traditional catch. M flags the minimum score that is a mandatory requirement the monitoring program for selected criteria.

No.	Criteria / Criteria groups	Description	Metric range (0-5)	Mandatory (Min)	Weight (1-5)
1	Cost				
1.1	Financial cost	Average \$ cost over first 3 years	\$50k-\$200k		5
1.2	Fisher recording effort	Time effort by fishers	1 min/d - 15 min/d		5
2	Benefit				
2.1	Traditional Inhabitant data needs	Meets data needs of Traditional Inhabitants and communities	Not met - Met	M (4)	5
2.2	Fishery managers data needs	Meets data needs of fishery managers	Not met – Met	M (4)	5
2.3	Scientific data needs	Meets data needs of stock assessment scientists	Not met – Met		4
2.4	National data needs	Meets data needs of State, Commonwealth, and other national agencies	Not met – Met		2
2.5	Capacity building	Employment and training opportunities at various levels	Low - high		3
3	Feasibility				
3.1	Method feasibility	How easy is the method to implement and use	Low - High	M (4)	5
3.2	Data reliability	Data is comprehensive, representative and accurate	Low - High	M (4)	5
3.3	OH&S requirements	Meets OH&S and Risk assessment requirements	Low - high	M (4)	5
4	Culture				
4.1	Social and cultural acceptance	Program is socially and culturally acceptable to Torres Strait Islander communities	Low - high	M (4)	5
4.2	TEK security	Security of data stream	Low - high	M (4)	5
4.3	Social equity (e.g., gender, age)	The program is representative and accessible to all members of the community	Low - high		4
5	Sustainability				
5.1	Environmental harm	Risk to the environment including relative production of CO ₂ emissions	Low - high		2

Table 4-4. Preliminary output for multi-criteria analysis for 6 possible monitoring strategies for non-commercial catch sector monitoring in Torres Strait. (Unmet mandatory criteria are shown in yellow). The standard deviation (SD) and weighted standard deviation (SD-weighted - weighted by criteria weight) of criteria scores is also shown.

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	SD	SD - weighed
COST			5	4.0	3.0	4.0	4.0	3.0	4.0	0.52	0.52
Financial cost*	\$50k - \$200k	0	5	2	1	1	3	5	3	1.52	1.52
Fisher recording effort*	1 min - 15 min/d	0	5	2	5	3	1	1	1	1.60	1.60
BENEFIT			5	4.8	4.3	3.8	4.2	4.3	2.6	0.77	0.59
T.O. data needs	Not met - met	4	5	5	4	4	4	4	3	0.63	0.63
Fishery manager data needs	Not met - met	4	5	5	5	4	5	5	3	0.84	0.84
Scientific data needs	Not met - met	0	4	5	5	4	5	5	3	0.84	0.67
National data needs	Not met - met	0	2	5	4	4	4	4	2	0.98	0.39
Capacity building	Low - high	0	3	4	3	3	2	3	1	1.03	0.62
FEASIBILITY			5	4.3	4.3	4.0	3.3	3.7	3.3	0.46	0.46
Method feasibility	Low - high	4	5	4	4	4	3	3	3	0.55	0.55
Data reliability	Low - High	4	5	4	4	3	3	4	3	0.55	0.55
Satisfies OH&S requirements	Low - high	4	5	5	5	5	4	4	4	0.55	0.55
CULTURE			5	4.4	4.0	4.0	3.6	4.0	3.6	0.27	0.25
Social and cultural acceptance	Low - high	4	5	5	5	5	4	5	4	0.52	0.52
TEK security	Low - high	4	5	4	3	3	3	3	3	0.41	0.41
Social equity	Low - high	0	4	4	4	4	4	4	4	0.00	0.00
SUSTAINABILITY			2	4.0	4.0	4.0	2.0	4.0	3.0	0.84	0.33
Environmental harm*	Low – high	0	2	2	2	2	4	2	3	0.84	0.33
OVERALL SCORE				4.3	3.9	4.0	3.6	3.8	3.4		
MANDATORY UNMET				0	1	2	3	2	5		

* For these criteria, the criteria scores are transformed using the formula $(6 - [\text{criteria score}])$, for calculation of criteria group average

4.2 Results

The monitoring strategy option with the highest score from the MCA was *Self-reporting via a monitoring app*, followed by *Self-reporting via periodic data sheet* and *Self-reporting via daily data sheet* (Table 4-4). The three options using external observers scored lower, with *Embedded observers* being the best of these. *Self-reporting via a monitoring App* was also the only strategy that had no mandatory criteria unmet, followed by *Self-reporting via daily data sheets*. The *Periodic roving observes* performed the worst for unmet mandatory criteria (Table 4-4).

Two variation statistics were calculated for criteria scores. The standard deviation (SD) is a measure of the variation in raw scores, and the weighted standard deviation (SD-weighted) indicates the criteria's influence on the overall score (Table 4-4). The criteria group that had the greatest influence on the overall score (as indicated by SD-weighted) was *Benefit*, followed by *Cost* and *Feasibility* (Table 4-4). Interestingly, the criteria that made up the *Cost* criteria group had the highest individual variation. However, the two criteria, *Financial cost*, and *Fishery recording effort*, tended to counteract each other—i.e., when *Financial cost* was high, *Fishery recording effort* was low, and vice versa. *Capacity building* and *National data needs* criteria also had high scoring variation but had low influence due to their lower weightings (Table 4-4).

Culture criteria group had the lowest raw score variation and overall score influence, indicating that, whichever method was applied, the cultural considerations could be addressed to a similar extent. However, the *TEK security* criteria had the highest number of unmet mandatory scores (4) indicating the apparent practical difficulty of achieving this requirement, particularly where physical datasheets were required to be collected and transferred before entry into a secure database.

Sustainability criteria had the highest score variation, due to the significant difference in travel related greenhouse gas emissions between the various options. However, it only had a low influence on the overall score.

4.3 Complemented survey

Although a census of all fishing and catches is the aspirational goal, no matter which monitoring option is used, it is very unlikely that 100% coverage will be achieved. This means that available data will need to be extrapolated to produce an estimate for the total non-commercial catch sector in the Torres Strait. The assessment of (and accounting for) selection bias and measurement errors are important to help improve the accuracy of catch estimates from any monitoring program, but especially 'opt-in' and self-reporting methods. Selection bias can occur, for example, if the fishers that respond to the survey are the best or most avid fishers. This means that averaging up their catches to the whole population will result in an overestimate (sometimes called 'avidity bias' (Griffiths *et al.*, 2010)). Similarly, some self-reporting strategies can suffer from 'prestige bias', where the catch estimate is systematically reported as larger than the true catch (Berg and Kaiser, 2017).

Obtaining estimates of the catch using different methods will indicate possible biases in the different approaches, and allow for adjustment, correction, or initiate changes in the primary data collection method. For example, if self-reported catch information is used as the primary method to estimate catch, a periodic structured interview survey, may also be used to validate the fisher records and provide additional information (e.g., an estimate of socio-economic characteristics and summary catch data). Fisher-based, self-reported survey data may also be augmented with information that can be cross referenced with other fishers, such as estimates of coverage rates. For example, asking each respondent how many people are fishing on anyone recording day (e.g., Harris *et al.*,

1995), then comparing responses from different fishers may be useful in estimating the proportion unreported and/or for making a more informed estimate.

A complimented survey approach should be initiated early and broadly applied, with the possibility that it can be reduced or even eliminated once the primary data gathering strategy has been tested, modified and well established.

5 General discussion

In this study we provide a comprehensive review of possible approaches to providing an acceptable and robust approach to monitoring recreational fishing in the Torres Strait (Section 2.2). However, rather than trying to assess approaches for monitoring both the Traditional and recreational sectors separately, we have focused on assessing the Traditional fishery with a view to recommending that the same or similar approach for recreational fishing. The main reason for this approach being to keep the entire process as simple as possible, but without sacrificing too much utility of the program for recreational fishing.

The overall objective of this project was to recommend an approach to monitor the non-commercial fishery catch sectors in Torres Strait. Although the initial impetus for this project was to focus on species that are also fished commercially (Spanish mackerel, coral trout and TRL) the scope quickly expanded to the entire marine non-commercial catch sector due to its importance to Traditional Inhabitants livelihoods and communities. Similarly, both the Traditional (fished by Traditional Inhabitants) and non-traditional (recreational fishing by non-indigenous people) were also included in the scope of the project. In hindsight, this expanded scope presented a daunting undertaking. Monitoring the Traditional fishery catch and that of recreational fishers are both challenging tasks that have not been successfully (or at least routinely) accomplished in Torres Strait or more broadly.

In any case, this report does present a comprehensive review of both Traditional and recreational fishery monitoring approaches from the Torres Strait and Australia, along with their strengths and weaknesses. It also contains a thorough review of the needs of key stakeholder groups in Torres Strait in relation to non-commercial fishery monitoring, and a broad consideration of their specific issues and risks. Based on these outputs, and the consideration of the project team and the PAC, we have assessed likely options for monitoring and made a series of recommendations for implementing a monitoring program in Torres Strait.

To this end, we have focused on the Traditional fishery – it being the largest, the most diverse, and most important (from a food security and cultural point of view) of the non-commercial fisheries in the Torres Strait. This also came with the realisation that (i) the monitoring program for the Traditional fishery would likely be adaptable to the recreational fishery in Torres Strait, and, (ii) running two separate programs would be more difficult for a variety of reasons (cost, equity, data compatibility etc).

Review of approaches

The review was able to investigate and assess a wide range monitoring programs focussed on the non-commercial fishery catch of both Traditional and recreational fishers. These monitoring programs were carried out using a wide range of approaches and with variable levels of local engagement.

The Traditional fishery monitoring review was restricted mainly to the Australian scene, with an emphasis on past studies in Torres Strait. This reflects the historic recognition that fishing has a uniquely important place in the lives of Torres Strait people, and the subsequent need to understand the specific dynamics of this activity to help design monitoring programs to manage for long-term sustainability. This emphasis also reflects the fact that fishing activities in Torres Strait are unique in an Australian context, with many remote island communities having distinct Traditional cultural fishing behaviours and a hierarchical cultural setting with individual, clan, community and language group structures. The range of species fished in Torres Strait also varies with location and tradition and has a unique species mix of species not fished in other Australian locations.

A common conclusion at the completion of previous monitoring projects was that any attempt to implement a non-commercial monitoring program will require strong cooperation and engagement of stakeholders at all levels, but particularly at the fisher and local community level. The factors that most studies identified as key for conducting a successful monitoring program included:

- i. a high degree of local involvement
- ii. engaging key local people
- iii. good communication with local community members and,
- iv. sufficient resources to maintain adequate sampling levels.

The recreational fishery monitoring review took a broad look at monitoring approaches used to assess the impacts of recreational fishing in Australia. It found that, despite a long history and multiple studies, monitoring the recreational catch is equally if not more challenging than monitoring the traditional catch.

Most attempts (and certainly the most successful ones) have used some type of complemented survey design; usually either a telephone-diary survey or a telephone-access point survey. However, the largest challenge was consistently estimating the full recreational fisher population to estimate total effort and extrapolate sample outputs.

Stakeholder needs

Stakeholder needs (including data needs, and program requirements, constraints and risks) were assessed for several stakeholder groups in Torres Strait. The most important needs and issues that arose during this process were:

- provision of data that was adequate to manage the various fisheries at various levels, including socio economic and cultural aspects
- the monitoring program needs to be socially and culturally acceptable to Torres Strait Islander communities
- program implementation needs to build trust based on shared aspirations, recognition of past experiences, transparency regarding how the data will be used and managed, legitimate local control, information security and co-development approaches
- the monitoring program should be underpinned by comprehensive agreements and processes, perhaps within a broader harvest strategy framework
- the control of information dissemination should sit primarily with communities through an appropriate (and agreed) representative/leadership system
- the program should be supported with communication material that is sufficient to inform, educate and increase capacity
- any data monitoring approach needs to be logistically feasible and technically uncomplicated
- the data must be held and managed in a secure way
- program needs to be affordable, and cost be proportional to data accuracy and precision
- the monitoring program should include capacity building and/or economic opportunity for the community
- overall program must meet implementing agency OH&S guidelines.

This assessment provided a comprehensive range of needs that were then used as design criteria for assessing monitoring strategy option in Torres Strait. This approach makes direct links between meeting those stakeholder needs and the successful implantation of the program. It assumes that the failure to address these needs, especially for Traditional Inhabitants and fishery managers (that

will most likely resource and administer the program) will put the success of any future program at risk.

Assessment of approaches

A multi-criteria assessment (MCA) of monitoring strategy options scored *Self-reporting via a monitoring App* higher than other approaches. It was also the only option that had no mandatory criteria unmet. In general, options using external observers scored lower than self-reporting approaches. Periodic roving observes performed the worst for unmet mandatory criteria.

The development and implementation of a monitoring App will allow fishers to directly provide daily catch data, and also provide useful information back to fishers and community members in almost real time. This system should be linked electronically to a secure database that has transparent and robust security and permission protocols. The details relating to the design and implementation of such an App can be guided by the detailed information provided in the current reviews, assessments and discussion.

Note that the Traditional fishery catch also includes any catch from the TIB commercial sector that is kept by fishers for home consumption, community sharing or barter. In this case, the catch of the TIB fishers will be recorded in two separate catch recording systems - the animal being sold commercially are being recorded in the FRS, and the rest being recorded as non-commercial catch in the new non-commercial catch sector monitoring program.

The development an application of a monitoring App has a high feasibility. Mobile network and internet coverage in Torres Strait is widespread and reliable. Several apps have been developed that can provide examples and learnings for recreational and/or Traditional fishing (e.g., CAPReef, 2009, French *et al.* 2014, Sawynok *et al.*, 2018), and other new approaches are being developed (e.g. FRDC project 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* - this project may offer highly mutually beneficial opportunities to trial an App for non-commercial catches in the Torres Strait).

In addition, the implementation of a monitoring App can provide a platform for an efficient and targeted information flow back to the fisher, including: their own recorded catch data, data summaries (at an appropriate level); species information and other relevant capacity building and communication information.

It is also highly desirable to implement a complimented survey approach, where estimates of catch are made using an additional, different (and possibly less frequent) method from the primary data collection method. This would provide validation and potentially improve catch estimates. In the longer term, the validation aspect of any complimented approach could be reduced or even eliminated once the primary data gathering strategy has been tested, modified and well established. The best candidate for this complimentary method, based on the experience of other previous programs, are periodic structured interviews (e.g., 'recent recall' method), potentially done at the household level to provide additional socio-economic information about the family unit.

Data security and access

An important aspect in the design of the program will be data security and access. Data security, where an individual's data is not disseminated without their written approval, will be paramount. Access to data and data summaries will need to be tightly controlled and negotiated. This is a critical

aspect of the program that will need to be co-designed with Traditional Inhabitants early in the implementation phase.

Gender equity

Gender (and age) equity should be a primary consideration during the design and implementation of the monitoring program. Female fishers can be underrepresented in monitoring programs where there is a majority working-aged, male dominance of both commercial and intensive fishing effort (Kleiber et al., 2014; Mangubhai and Lawless, 2021). Even projects managed at the community level can lack equity in the application and return of benefits to community members because the needs of less vocal or less powerful members of the community can be overlooked (Stacey et al., 2019). As is the case with non-indigenous society, women and youth can be marginalised, reflecting the dominance of men in public positions of power and influence (Davies *et al.*, 1999; Kleiber et al., 2014).

Women will usually fish a different suit of species and use different fishing methods than men (e.g., gleaning). Therefore it is imperative to sample them proportionally to get a true presentation of the catch (Kleiber et al., 2014; Tilley et al., 2021). In addition, the application of species-specific, spatial and other management strategies can impact on women, and therefore, the unique social role of womens' fishing disproportionately. Disaggregated data on fishing effort and catch will be required for equitable and socially beneficial management at all levels (Mangubhai and Lawless, 2021).

Information gathered during this project indicates that women will feel empowered to participate in data collection using a phone App approach. Based on the responses from Torres Strait Islander women interviewed for this project, it is highly likely that women would participate in a non-commercial catch recording program, particularly if they are made aware of the potential social benefit of the monitoring. This is due to their generally high social awareness, the pivotal role of non-commercial catch in household seafood consumption and their widespread use of phone technology.

There is strong anecdotal evidence of the widespread access to internet connected technology (e.g. smart phones and tablets) by Torres Strait women and youth, such as their high levels of social media usage. Information on non-commercial fish catches are already being shared on social media, particularly among women and youth. Torres Strait islander women we spoke to also indicated that alternative access to an App by anyone that did not have their own device was likely within family groups.

Much of the focus regarding gender equity will centre on the implementation process and ongoing engagement. This will need to include mechanisms to target women, youth and other potentially under-represented groups (Lawless et al., 2017; Kleiber et al., 2019; Mangubhai and Lawless, 2021). In many regards, the self-reporting approaches recommended in this report will go some way to providing an equitable platform for representative reporting. However, the complimented sampling strategy should assess gender equity as a key objective.

Consultation and engagement

The key partnership required for the successful implementation and ongoing success of the monitoring program will be between Traditional Inhabitants that will supply the data and fishery managers that will likely resource and implement the program. A primary mechanism to manage this partnership is through the Protected Zone Joint Authority (PZJA) network, who's main purpose is to manage the interests of Australian fisheries in the Protected Zone (PZJA, 2020; Butler et al., 2012).

The currently existing working groups, resource assessment groups, management and advisory committees can provide suitable fora for consultation and co-development functions related to non-commercial fishery monitoring (noting that the current focus is mostly on commercial fisheries). However, due to the commonality of issues related to monitoring and managing Traditional and recreational fisheries, there may be a need for a new consultative forum under this framework focused only on the non-commercial fisheries; noting that there is already a process and structure in place for dugong and turtle fisheries.

In addition to the PZJA network, there will likely be the need for formal bilateral agreements between communities and the implementation agency/s that will be required to outline all aspects of the program (Figure 5-1). Agreements could be with individual communities, clusters, or a single Torres Strait wide agreement. This agreement could build on existing community-based Dugong and Turtle Management Plans that have been developed with individual Torres Strait Islander communities (PZJA, TSRA, unpublished data), or standalone agreements. PNG Treaty villages could be included in this process in future versions.

Fishery scientists are another key stakeholder group that will need to develop and maintain relationships, communicate and synergise with the two other groups. The two current instruments that outline these relationships include research contracts (with managers) and ethics agreements (that outline relationships and obligations with respect to indigenous communities) (Figure 5-1). Recently implemented consultation and engagement processes that researchers are required to carry out during the research proposal phase (Nakata and Nakata, 2011; Nakata, 2018) will fulfill these requirements to a large extent.

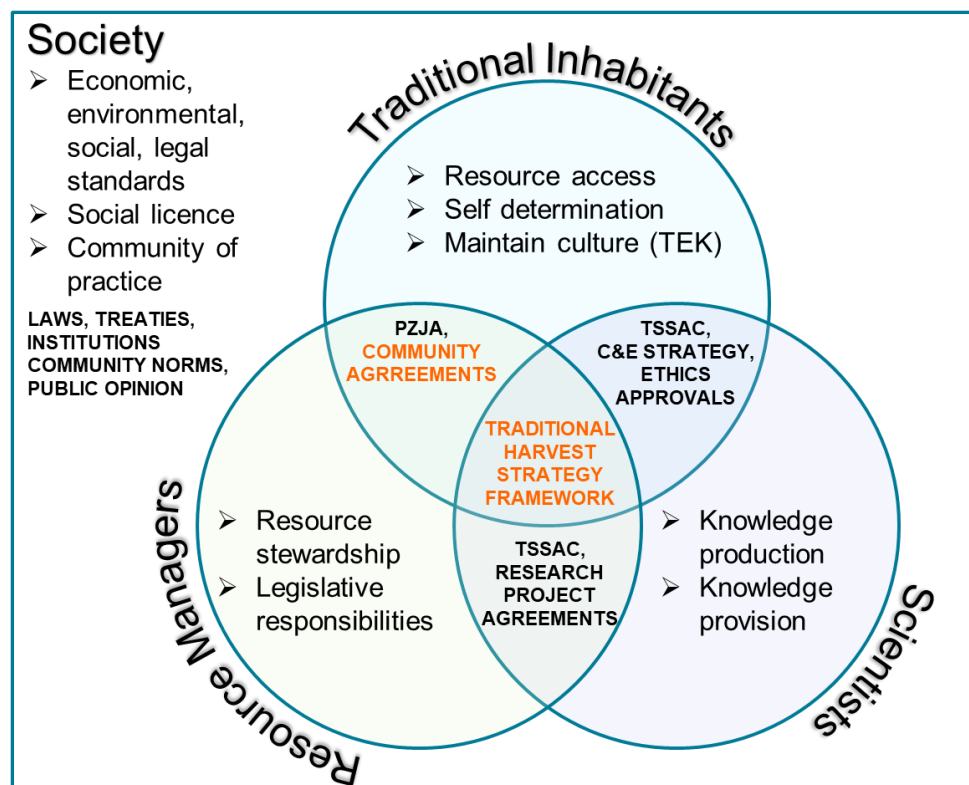


Figure 5-1. Consultation and engagement objectives, relationships and instruments (black for existing, orange for proposed) for three main stakeholder groups associated with the Torres strait Traditional fishery (PZJA = Protected Zone Joint Authority; TSSAC = Torres Strait Scientific Advisory Committee; C&E = Consultation and Engagement).

This triumvirate of Traditional Inhabitants, managers and scientists will have bilateral relationships that will need to be recognised, fostered and managed (Figure 5-1). However, the development of an overarching process or agreement may be beneficial for the overall development and implementation of the non-commercial monitoring program. This could take the form of a Traditional fishery harvest strategy, which could provide the platform for all stakeholders to express their objectives, rules, and operational guidelines that could build on existing and developing fishery harvest strategies (prawn, TRL, sea cucumber, finfish; AFMA, 2011; 2019a; 2019b), and the community based management plans implemented for turtle and dugong (PZJA, TSRA, unpublished data; Butler et al., 2012); which were, in fact, envisaged as a template for other Traditionally-fished resources (TSRA, 2016).

The ranger program has also been flagged as a possible resource/partner program for the non-commercial monitoring program, as it has the potential organisational capacity and personnel to assist in the implementation of such a program. The Ranger program operational model, their infrastructure, and the community controlled TEK database could assist in implementing a Traditional fishery monitoring program in the future.

Communication strategy

Communication will be critical at the beginning, and throughout the monitoring program to build the sense of ownership among communities. This will include the reporting of information (e.g., catch summaries and other information) back to communities to assist to make customary management decisions, raise local capacity and maintain program transparency. A process for determining how and what the flow of information back to communities will look like will need to be co-developed during the initial implementation phase.

Communication material needs to be sufficient to inform, educate and increase capacity (e.g., provision of training and species guide to minimise mis-identification). The data analysis should be automated as much as possible to facilitate the timely return of information back to fishers, and provide security to program summaries and other products.

5.1 How suitable is the recommended strategy for monitoring the recreational catch?

While the outputs of the stakeholder needs and options assessment was focused on the Traditional fishery, many of the same issues will also apply to the recreational (non-islander) fishery. This includes the technical aspects of obtaining catch estimates from individual fishers, but also data security and protection of individual data. Because of this, we believe that the Traditional fishery monitoring approach outlined in this report may also be suitable for monitoring recreational catches. This has the major advantage of not having to develop and roll out different programs for each of these two sectors.

The difference between the two sectors will be mostly related to the value proposition (i.e. what are the incentives to ensure participation) and the treatment of data analysis outputs (i.e. who gets access to the catch data summaries). This will need to be addressed in the implementation phase with consultation with recreational fishers and with agreement from communities.

5.2 Assessment against AFMA's *risk-cost-catch trade-off approach* to managing fisheries

The trade-off between the cost of management, the risk to the resource and the catch benefit that a fishery gains from exploitation is known as the risk-cost-catch trade-off (Sainsbury, 2005). These

trade-offs are often unknown and likely to be non-linear (Dichmont et al., 2017). In most recent fisheries contexts, risk is couched in terms of fishery reference points — such as what are the risks associated with not achieving the target reference point or falling below the limit reference point. This information is unknown for Torres Strait non-commercial fishing.

Understanding of the *risk-catch-cost trade-off* to managing Traditional and some recreational fisheries will help with program design in relation to its alignment with management agencies. The issue is how to trade the risks associated with managing a fishery, against the costs of management and the socio-economic benefit obtained from the catch (Dichmont et al., 2017). In low economic value fisheries, such as Traditional and some recreational fisheries, there is a real need to understand the trade-off between ecological and economic risk associated with harvesting; the benefits of harvesting, and the costs associated with management (Dichmont et al., 2017). The assessment of monitoring approaches should trade these factors off in order to make an appropriate recommendation.

The MCA assessment of options carried out in this study incorporates the main components of the risk-catch-cost trade-off approach. Therefore, we consider that this assessment provides a relatively robust review of potential monitoring approaches in terms of the risk-cost-catch trade-off.

5.3 Communicating benefits

Communication of the benefits of the monitoring program outputs will be critical to engaging local fishers. Most islanders will recognise that it is important for the sustainability of commercial stocks that the catches are quantified. For the non-commercial fishery, it will be critical to clearly and fully describe the need/s for this data for all stakeholders. Some of these needs will be common across stakeholder groups (such as general sustainability concerns). However, the use of that data and management actions will differ and conflict between stakeholders in this aspect of monitoring and management will hamper any program that relies on goodwill and effort at all levels to succeed. Good communication, shared understanding, recognition of stakeholders needs and concerns, data security, information control, and finally a negotiated framework for implementing a monitoring program will be necessary for success.

If participation in a monitoring program for non-commercial catches is poor, consequences include:

- Poor return on investment from program funding
- Relatively weak or non-representative information stemming from the program
- Opportunity loss for the potential new understanding of catches and catch trends
- Opportunity loss for local cultural fishing communities to have a stronger impact in the co-development with AFMA/TSRA of fishing strategies that include their fishing areas.

The Traditional fishery is of great social and cultural value to Torres Strait islanders, including providing significant health, well being, lifestyle and economic benefits. It expresses the vital link between Traditional Inhabitants and *Zenadth Kes* (Torres Strait), and reinforces their spiritual beliefs governing their existence and responsibility for their land and sea country (Davies *et al.*, 1999). It is recognised that Torres Strait islanders are acutely aware that natural resources are limited (contrary to some studies that promote a “boundless seas” attitude). This is demonstrated by countless customary and practical activities that promote sustainability (Johannes and MacFarlane, 1991; Davies *et al.*, 1999). Most Traditional Inhabitants hold the view that fishing should be accompanied by some kind of monitoring, which can underpin management decision-making processes, particularly local customary management. However, this is not usually enough on its own to

convince a fisher to provide data on their catch on a long term basis due to the perceived and real risks and costs (including loss of access, effort, other disincentives and risks).

Convincing Traditional Inhabitants to fully commit to monitoring will require a deep mutual understanding of the monitoring and management context, and a framework that establishes a “bottom up” approach to monitoring and management. There also needs to be a recognition that purely customary management may also be ineffective due to increases in population growth and increasing fishing efficiency, as well as global environmental trends such as climate change. A full cooperative, co-designed, monitoring and management model, supported by capacity building programs, is required to bridge these divides – something that has rarely been achieved (Davies *et al.*, 1999).

There is a primary driver for this data, being for government management agencies, particularly for non-commercial use of otherwise commercial species (Spanish mackerel, coral trout and TRL). However, there is the potential for local and collaborative management that requires accessible and credible monitoring data, especially for adaptive management that by its very nature is often rapid and local (Grayson, 2011; Danielsen, 2009). This will be a critical objective for providing the benefit and “value proposition” for prolonged provision of local catch data by community members. Outlining and communicating this “value proposition” will be important to promoting and maintaining Traditional fisher involvement and will require high levels of honesty and transparency about program drivers, approach and process, and ultimately, build local knowledge and capacity.

The community benefits (along with risks) for any proposed community-based fishery catch monitoring activity should be clearly understood to enable an informed assessment of options and appropriate support. Here we provide a high-level summary of the community benefits of a non-commercial fishery monitoring program to compliment the more detailed assessments below.

Community benefits

1. Sustainable populations of marine species

Accurate data on the catches of all marine species from Traditional fishing will (i) improve the efficacy of management for commercially and Traditionally-fished species. This will reduce the risk of their overexploitation and help maintain the benefits of fishing for local communities.

2. Health and well being

The Traditional fishery is of great social and cultural value to Torres Strait islanders, including providing significant health, wellbeing and lifestyle benefits. Knowledge of the status of traditional fishes species will help improve their local management to ensure long-term supply of these critical ecosystem services.

3. Management of marine resources for food and culture

Provision of ongoing Traditional fishery catch data and trend information to Traditional Inhabitants can be used to support management of marine resources at the local and regional level. Knowing whether catches are trending up or down could be critical for understanding how to manage marine resources in future. These could include supporting a better understanding of:

- the impacts of fishing on key species and on other species and ecosystems
- the impacts of climate regime shifts on population status and distribution
- the impacts of introduced pest species on endemic/Traditionally-fished species

- the impacts of terrestrial inputs from PNG and Australia on population status and distribution

4. *Healthier ecosystems*

Broad information on the full range of species catches from the Traditional fishery will underpin ecosystem level management. For example, inaccurate management resulting in heavy depletion of apex predators (e.g., mackerel, coral trout) in coastal Torres Strait waters could substantially change food web dynamics, including altering populations of some Traditionally-fished species. Resource sharing and catch allocation methods require accurate data from all sectors to ensure equitable access to catches, that for Traditional fishery sector protects a food source and associated TFK systems.

5. *Sustainable and equitable communities*

Information on fishing practices collected in a socially equitable way within communities can provide an appropriate characterisation and recognition of the contributions of different demographic groups to community health, social, and cultural wellbeing by way of their contribution of local seafood to local diets.

6. *Self determination*

Information on the Traditional fishery catch will improve the potential for customary management of marine resources which will enhance the level of self-management by Torres Strait communities. It may also build capacity for the new roles/tasks required to run and manage a non-commercial catch sector monitoring program.

New data-management agreement and processes developed in this program will form part of a new community-based monitoring program should include a data ownership model and agreement. This process will enhance current self-management of marine resources by Torres Strait Islanders.

7. *An improved understanding of recreational fishing catches*

Monitoring recreational fishing, a sector that is currently very poorly quantified, will help improve the assessment and management of commercially fished species and lead to more sustainable marine species populations and a healthier marine ecosystem.

5.4 Conclusion

Based on a comprehensive review of previous approaches, a detailed assessment of stakeholder needs, significant consultation and the assessment of a broad range of monitoring options, we have recommended a design for a non-commercial catch sector monitoring program that can deliver acceptable estimates of the non-commercial fishery catch within Torres Strait communities. This approach should also be considered for in-community recreational fishing. This monitoring data will:

- be incorporated into annual fishery assessments by the AFMA and the TSRA to account for the non-commercial fishing on selected priority fishery populations (e.g., Spanish mackerel, coral trout, TRL)
- allow more accurate allocations of catch for each of the commercial sectors
- provide the AFMA and TSRA with relatively accurate and up-to-date estimates of the catch from these sectors on the Traditional and recreational catch
- enable the assessment of change in a range of non-commercially important species that are important to Traditional fishers and their communities.

Key aspects of a successful non-commercial catch sector data collection program will include: the development of an effective consultation and engagement framework; capacity building around basic fisheries management and data use; the co-development of a data collection, storage and information dissemination model; the co-development of effective monitoring tools; strong communication strategies and community buy-in; and an adequately resourced and trained implementation team. In Torres Strait, the involvement of community organisations and leadership, along with government support will be critical to ensuring the successful implementation of a long-term, community-based monitoring program.

6 Implementation

Here we provide a way forward for implementation of a non-commercial fishery monitoring program, based on the projects' core recommendations. We recommend that the implementation take a staged approach to (i) minimised risk and (ii) simplify the early-stage processes. This allows the key data to be collected from the outset, but without overly-complex, and/or potentially off putting or confusing expectations or activities. This was a strong recommendation of the PAC. A pilot program in a limited number of communities will help fine tune and improve its functionality and acceptance to all stakeholders (Figure 6-1), before the rollout of the Torres Strait wide monitoring program. Products that help inform stakeholders of the program and its concepts, as well as provide feedback on results and success/issues, should be a non-negotiable aspect of program implementation (see below).

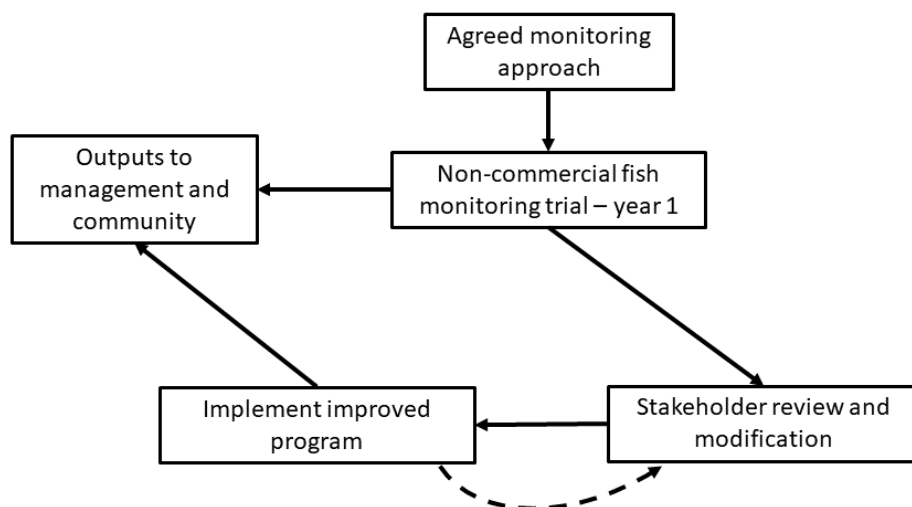


Figure 6-1. Proposed simplified approach to trialling an endorsed non-commercial catch sector monitoring strategy

The following broad recommendations act as a guide. Much of the detail should be developed with key stakeholders. We recommend a staged approach to the implementation following agreement on an approach for assessing non-commercial catches, including the following tasks. Task 1. and 2. could be packaged as a next step.

1. Community consultation and sign on:

This task would carry out a community-based consultation process to co-design and get agreement on all aspects of the monitoring approach, but particularly data collection and control, analysis and reporting. The process can provide the basis for a monitoring and data management agreement between the implementing agency and communities. An ongoing consultation and governance framework could also be designed during this process.

During this phase, particular focus should be on ensuring consultation and participation of representatives gender and age cohorts, either through targeted engagement and/or subgroup consultation. Other key groups include:

- Traditional Owner representative groups – e.g. PBCs
- Local fisher associations – e.g. EFMA, MDWFA, KAIA
- Zenadth Kes Fisheries

- Torres Strait Ranger Program
- PZJA consultative committees Fishery RAGs, WGs, SAC
- Wapil Regional Fisheries Development Project
- Fishery buyers and agents on islands

This will also require the development of a detailed and comprehensive communication and engagement strategy, including ongoing consultation mechanisms that could be built into the broader PZJA framework and involve a new dedicated forum or group focussed on the non-commercial fishery.

Task summary

- Develop comprehensive communication and consultation strategy
- Carry out initial consultation with communities:
 - Hold community workshops (at community or at least cluster level – in community)
 - Codesign of pilot program
 - Codesign of governance structure
 - Codesign of catch data collection and information feedback flow (to inform App design)
 - Codesign of complemented sampling strategy

Indicative cost: \$15k-\$25k plus workshop travel and operating

2. App design and development options:

There are a range of potential partners including external funding agencies and projects that may provide a cost-effective approach for monitoring App development. Examples could include:

- FRDC Indigenous Reference Group (National fisheries funding)
- QDAF (current agency monitoring Torres Strait recreational fishery catch)
- Current funded project: FRDC 2018-016 - *Improving data on Aboriginal and Torres Strait Islander marine resource use to inform decision-making* (Moyle et al., 2020)
- Current funded 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* (Crystal Beckmann, PI; University of Adelaide)
- Partners for Indigenous Land and Sea Corporation (ILSC)

This stage would also include the design of the complemented monitoring strategy to validate the App-based data (e.g. periodic household interviews).

Tasks

- Identify and engage potential App development partners
- 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 full-scale implementation options

Indicative cost: \$10k-\$20k plus travel and operating

3. Develop App, database and data flow infrastructure

The monitoring program will also require the design and implement of an agency-based, central data system, including strict data security and information flow protocols. This should be based on a centralised database and automated (as much as possible) data analysis approaches. The system should be designed so that it can allow access to information to be control at the level of individuals, communities and management agencies. It could involve agreements with Traditional Inhabitants and RNTBCs to help ensure that the raw data is in safe and secure hands.

Once the database and App specifications have been developed, and potential partners identified (see above), the App and linked secure database will need to be built. This should include communication tools that will sit within the App to enhance two-way communication and capacity building – e.g., species ID guide and monitoring manual. App and database development will require the engagement of technical experts to build prototype using agreed specifications. The design of monitoring tools can benefit greatly from past or existing approaches (e.g., CAPReef, 2009, French *et al* 2014, Sawynok *et al.*, 2018), and other new approaches being developed.

Tasks

- Build App prototype (could be a modification of a currently used App)
- Build and implement database

Indicative cost: Scoped in Task 2.

4. Community rollout – pilot (2 communities)

This stage will require the identification and resourcing of an implementing agency and training (if necessary) of responsible personnel.

Identifying, training and resourcing local program contacts (or champions) will also be critical to the long-term success of the monitoring program, and to help change the culture for community-based data collection.

We suggest that two communities be selected for the pilot rollout, and that the program be implemented for one year. A review of the program would then be carried out based on the outcomes of the pilot.

Tasks

- Training of implementation team
- Identify and train local champions
- Implement App and complimented sampling strategy in communities
- Summarise (and distribution of) results (one years sampling) including comparison of complimented strategy with App results
- Final report and recommendations for full-scale rollout

Indicative cost: Scoped in Task 2.

5. Community rollout – full-scale

If successful, plan for Torres Strait wide implementation, based on the learnings from the pilot study, including:

- collection of feedback information from key stakeholders on success and improvement of the system (App use, data parameters collected, form of data feedback, etc)
- pilot study report back to decision making bodies on successes, limitations, way forward.

Tasks

- As per Task 4. But on all PZJA communities

Indicative cost: Scoped in Task 2.

Note that we recommend a parallel stream for each of these activities that would target recreational fishers within communities, for little additional cost.

6. Traditional fishery harvest strategy

Consider developing a new Traditional Fishery Harvest strategy for locally fished resources. This would contain the background including values and needs and begin the process for developing indicators and harvest control rules for sustainable management of the Traditional fishery.

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Appendices

Appendix 1. Statement addressing Guidelines for Ethical Research in Australian Indigenous Studies (GERAIS) priorities for ethical assessment

Research project: Measuring non-commercial fishing (Traditional and recreational fishing) in Torres Strait to improve fisheries management and promote sustainable livelihoods.

Project summary

This research project aims to review past approaches for monitoring non-commercial/Traditional catches of marine species and recommend a process and method for a long-term monitoring program to assess these catches in future. The project outputs are intended to provide the basis for instigating a trial monitoring program to collect non-commercial catch data into the future. It is largely a desktop review with some consultation with community representatives likely. An Advisory Committee, including Traditional Inhabitant representatives, will be used to help guide recommendations. There is no in-community consultation component. However, any Traditional Inhabitant representatives spoken to about the project will be provided with an approved project information sheet and invited to complete a consent form (both previously submitted to AFMA).

Statement addressing GERAIS priorities for ethical assessment

Axis	GERAIS Principle	Project team comments
<i>Rights, respect and recognition</i>	1. Recognition of the diversity and uniqueness of peoples, as well as of individuals, is essential	<p>The project team is led by a Torres Strait Traditional Inhabitant and includes two other members experienced in working with Traditional Inhabitant individuals and communities. We recognise the diversity and uniqueness of Torres Strait Peoples, communities and individuals.</p> <p>Any future monitoring program will: Consider the inclusion of men, women, children, Traditional Inhabitants, other Indigenous and non-Indigenous community members. Take into consideration all communities across Torres Strait Provide appropriate and accessible communication material.</p> <p>Participation of individuals in the discussion of project ideas is voluntary and the rights of individuals to choose to participate in the research or not is recognised and</p>

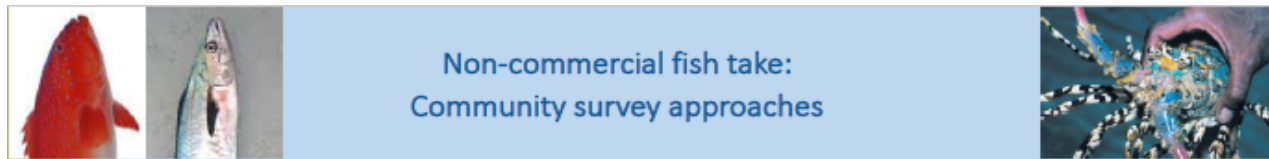
		respected. It is understood that extrapolations cannot be made from one community to another regarding their views on future fishery monitoring.
	2. The rights of Indigenous peoples to self-determination must be recognised.	Recommendations about future fishery monitoring will only be made following an appropriate level of consultation and agreement by community representatives, noting that project outcomes are only a first step towards implementation of a future program. Traditional Knowledge and sensitive commercial fisheries information will be protected through a range of mechanisms (below).
	3. The rights of Indigenous peoples to their intangible heritage must be recognised.	Any participation of individuals in the research project is completely voluntary and the rights of individuals to choose to participate, control and protect their Traditional knowledge will be recognised and respected.
	4. Rights in the Traditional knowledge and Traditional cultural expressions of Indigenous peoples must be respected, protected and maintained.	Appropriate acknowledgement of contributors will be made in any reporting and communications, including strict use of personal anonymity of views and information sources. Project staff will ensure that Prior Informed Consent is in place before any discussion/interviewing is undertaken.
	5. Indigenous knowledge, practices and innovations must be respected.	Any participation of individuals in the research project is completely voluntary and the rights of individuals to choose to participate, control and protect their Traditional knowledge will be recognised and respected. We will ensure transparency around our approach for acknowledgement of contributors in any reporting and communications, including strict use of personal anonymity of views and information sources.
<i>Negotiation, Consultation, Agreement and Mutual Understanding</i>	6. Consultation, negotiation and free, prior and informed consent are the foundations for research with or about Indigenous peoples.	Our project will largely review past monitoring approaches and make recommendations for future ways forward for collecting and assessing data on community-based non-commercial and recreational fishing. Any views obtained or discussed about the merits of approaches for data collection will be made using an inclusive and consultative outlook and method. Project staff will ensure that Prior Informed Consent is in place before any discussion/interviewing is undertaken. The project will provide options for future monitoring accompanied by information about strengths and weaknesses and use an Advisory Committee of subject matter experts and Traditional Inhabitants to guide recommendations.
	7. Responsibility for consultation and negotiation is ongoing.	Project staff are aware of and will adhere to the Procedural Framework for Researchers in Torres Strait (Nakata 2018) and the TSRA Cultural Protocols Guide

		(TSRA 2011) when planning and conducting work with Traditional Inhabitants and Indigenous Peoples of Torres Strait. Project staff will work with and seek advice from PZJA consultative committees both during and after the timeframe for the project activity. And project staff will be available for further consultation outside these fora if required.
	8. Consultation and negotiation should achieve mutual understanding about the proposed research	Any views obtained or discussed about the merits of approaches for data collection will be made using an inclusive and consultative outlook and approach. Any recommendations for fishery monitoring methods will be made by an Advisory Committee of subject matter experts, including Traditional Inhabitants and/or Indigenous community representatives, following appropriate meeting time to ensure issues and options are discussed to the extent that all involved are clear about their detail. This will include circulation of draft project information and material prior to the meeting. The Advisory Committee will ensure an experienced Chairperson is engaged to ensure mutual understanding of the research outputs and background information relating to any recommendations.
	9. Negotiation should result in a formal agreement for the conduct of a research project.	The structure of the project governance relating to recommendations for future fishery monitoring includes engagement of an Advisory Committee of subject matter experts and Traditional Inhabitants. The committees' recommendation will be provided to PZJA consultative committees for further input and advice.
<i>Participation, collaboration and partnership</i>	10. Indigenous people have the right to full participation appropriate to their skills and experiences in research projects and processes.	The project team is led by a Torres Strait Traditional Inhabitant. Individual views will be welcomed and included in project assessments, although a more widespread consultation phase is planned for inclusion in later phases of the broader project program. This initial, largely desktop phase of the project, will provide options accompanied by information about strengths and weaknesses and will use an of subject matter experts and Traditional Inhabitants to guide recommendations. Project results will be reviewed by Traditional Inhabitant community representatives on the PAC and on several PZJA fishery committees.
<i>Benefits, outcomes and giving back</i>	11. Indigenous people involved in research, or who may be affected by research, should benefit from, and not be disadvantaged by, the research project.	The research project was identified as a high priority by the PZJA consultative committees, including TSSAC and FFRAG and FFWG (advisory groups to the PZJA made up of industry members who are Traditional Inhabitants or Indigenous representatives active in the fisheries, management agencies and scientists).

		<p>The project will collect information that will help to ensure that future stock assessments of fished species will have the most accurate data possible from the community non-commercial fishing sector. Empowering Traditional Inhabitants and other Indigenous community members to better manage their local and regional fisheries is an identified purpose of this project work.</p> <p>The accuracy of this information improves stakeholder confidence in future assessments and decisions about the management of fished stocks. These assessments will, therefore, be more effective in delivering against fishery objectives designed to ensure the long-term sustainability of Torres Strait fisheries and fished populations.</p>
	<p>12. Research outcomes should include specific results that respond to the needs and interests of Indigenous people.</p>	<p>The research outcomes from this project are aimed at improving the PZJA's ability to manage fished populations in a way that ensures the long-term sustainability of those species; and hence their availability for both commercial and Traditional fishing by the Indigenous Peoples of the region.</p> <p>The research project was identified as a high priority by the PZJA consultative committees, including TSSAC and FFRAG and FFWG, including gaining the endorsement of the Traditional Inhabitants and Indigenous representatives on those committees.</p>
<p><i>Managing research, use, storage and access.</i></p>	<p>13. Plans should be agreed for managing use of, and access to, research results.</p>	<p>Plans are in place for managing use of, and access to the research results. The data and information collected during the project will be provided to AFMA for application and distribution to stakeholders. Appropriate acknowledgements of contributors and funding sources will be made in any reporting and communications.</p> <p>Project staff will ensure that Prior Informed Consent is in place for the acknowledgement, attribution, and citation of local Traditional knowledge and fisheries data. Confidential data and information, including any Traditional knowledge, collected during discussions with Traditional Inhabitants will remain confidential. Any information published that is sourced from individuals will be in a format that ensures that no data or information from any individual or island group may be identified.</p> <p>AFMA will publish the research results, making them publicly available and accessible. Information will also be summarised as feedback to stakeholders.</p>

		<p>The recommendations from the project for a future monitoring program will be considered by a range of PZJA committees. The implementation of an agreed trial monitoring program within Torres Strait communities will be subject to committee agreement, TSSAC approval and agreement by community leaders from targeted trial areas. Any such plans will be accompanied by a range of agreed information dissemination, such as factsheets, posters, social media stories, presentations, phone calls.</p>
Reporting and compliance	<p>14. Research projects should include appropriate mechanisms and procedures for reporting on ethical aspects of the research and complying with these guidelines.</p>	<p>Project staff are aware of and will adhere to the Procedural Framework for Researchers in Torres Strait (Nakata 2018) and the TSRA Cultural Protocols Guide (TSRA 2011) when planning and conducting work with Traditional Inhabitants of Torres Strait. The projects' governance relating to recommendations for future fishery monitoring includes engagement of an Advisory Committee of subject matter experts and Traditional Inhabitants. The committees' recommendation will be provided to PZJA consultative committees for further input and advice. Project staff will work with and seek advice from PZJA consultative committees, both during and after the timeframe for the project activity.</p> <p>The project will be applied as outlined in the measures described above. Any ethical issues that arise during the research project will be followed up with the appropriate individuals or organisations responsible such as AIATSIS, AFMA, TSRA, Queensland Government, community groups, or other appropriate body depending on the circumstances of the issue. An appropriate response will be formulated based on advice from these agencies.</p> <p>The final report will outline the process of stakeholder engagement and any other ethical aspects of the research that was conducted during the project.</p>

Appendix 2. Consultation plan for the pre-proposal phase.



Measuring non-commercial fishing (indigenous subsistence fishing and recreational fishing) in the Torres Strait in order to improve fisheries management and promote sustainable livelihoods.

Engagement Strategy - Full-proposal phase

Consultation during the formulation of the full proposal will include management and community stakeholders from all Torres Strait communities – for although this project will only carry out pilot catch monitoring on two selected islands, the program will potentially be rolled out across all Torres Strait communities.

Stakeholders to be contacted (all Torres Strait PZJA communities) include:

- Finfish Working Group and RAG Traditional Inhabitant representatives
- GBK/PBC Chairs
- Island Councillors
- Island Fishery Associations

Initial engagement will be through email, phone calls and face-to-face meetings where possible, and include dissemination of the project flyer and a structured questionnaire to gauge support, outline any concerns and provide any insights or ideas for project activities and fish monitoring approaches.

Special consideration will be taken with any traditional knowledge collected during this (and subsequent) stages of the project. Traditional knowledge will only be used with the express permission of the traditional owners.

Engagement Strategy – Project phase

Phase 1

Communication and consultation with management and islander representative organisations will take place through correspondence and meetings with the project oversight body. [Note: costs associated with project oversight body, including any potential fee for service, have not been included in the project budget due to uncertainty of membership and potential for incorporation with established consultation processes (e.g. Torres Strait finfish working group).

Key stakeholders to be consulted during this phase will include the TSRA, AFMA, Malu Lamar and Gur A Baradharaw Kod (GBK), Councillors, PBC Chairs, PZJA working group representatives, and the CDP Provider.

Phase 2



We propose to engage a minimum of two outer islands communities to pilot study the monitoring program for both subsistence and recreational fishing. Broad community consultation will occur early in Phase 2 on the two selected island communities.

This will include broad community communication and consultation, with as many people that live in the communities as possible. Targeted consultation will also be held with local PBC chairs, Councillors, TSRA Members and heads of local fishers associations. The local rangers and CDP trainers are potentially key collaborators during the pilot study phase of the project.


A range of communication engagement approaches will be used, including community notices, community meetings, household visits and direct phone conversations. Face to face meetings will be held with community representatives and leadership. We will also take advice on other approaches to inform communities about the project, such as media releases (radio and newspaper articles) and presentations at Working groups etc.

There will likely be a strong training component for locally engaged monitoring support positions (e.g. community monitors, rangers etc).

Appendix 3. Project plan - community flyer information sheet

Non-commercial fish take:
Community survey approaches



Project goal: To develop an approach for measuring the non-commercial fishing in Torres Strait in order to improve fisheries management and promote sustainable livelihoods

Project Need

There are commercial fisheries in Torres Strait that are very important for the economic wellbeing of Torres Strait islanders, such as the Spanish mackerel, coral trout and tropical rock lobster fisheries. These and other species also make up part of the non-commercial (subsistence and recreational) catch that communities rely on for everyday kikai. It is important that all catches, both commercial and non-commercial, are measured when considering the long-term future of these important fished populations.


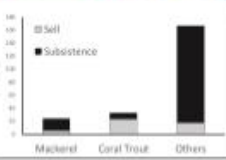
While catch reporting processes are in place for the commercial sectors, the non-commercial sectors have almost no ongoing catch data collection, and historical catch estimates are uncertain or out of date. Accurate and acceptable estimates of catches will allow a better overall assessment of the population health for the main fish species caught, reduce the risk of over-exploitation and protect Torres Strait Islander livelihoods.

This project will build on previous experiences in Torres Strait and other indigenous communities to design an approach for estimating the non-commercial catch of Spanish mackerel, Coral trout and Tropical rock lobster in Torres Strait, including ensuring there is strong community ownership, local partnerships, and the potential for locally engaged fishery monitors.


Proposed Work


Current project (funded)


1. Review of past and current non-commercial catch survey approaches in Torres Strait and more broadly.
2. Review stakeholder needs (for communities and management) for the collection of catch information over the longer term.
3. Develop an approach for collecting catch information from Torres Strait communities and providing to management agencies and communities for monitoring and assessment.
4. The current project assessment will be considered before any future trial data collection program is started.
5. The current project will be completed by mid-2020.



Erub, Masig, Mer catch (Bussalachi, 2008)








Australian Government
Australian Fisheries Management Authority

Non-commercial fish take:
Community survey approaches



How will my community be affected?


Broad consultation with community stakeholders will take place during the current project, mostly by phone with some face to face meetings on Thursday Island. The vast majority of community members and broader stakeholders will be informed about project progress and outputs through communication materials (e.g. information flyers, media), via representatives on management forums (e.g. TSRA, Fishery working groups), or via direct contact from project team members.

Benefits of the Project

- Better management of fisheries for a sustainable future
- Protection of local traditional food fishing
- Training and personal development for local fishery observers


Respecting Traditional Knowledge


Special consideration will be given to any Traditional Knowledge collected during the project. Traditional Knowledge will only be used with the express permission of the traditional custodians. Guidance will be sought from local Island leaders and the TSRA to ensure full local support and agreement over the handling of traditional knowledge.



Please contact for more information or with any questions:

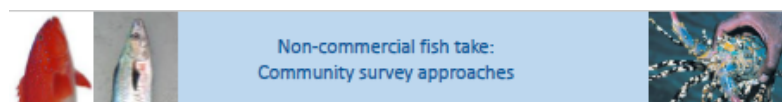
<p>Kenny Bedford Debe Mekik Le Consultancy PO Box 7507, Cairns Qld kennybedford@hotmail.com Phone: 0408 848 761</p>	<p>Allison Runkit TSRA Thursday Island allison.runkit@tsra.gov.au Phone: (07) 4069 0706</p>	<p>Lisa Cocking AFMA Canberra lisa.cocking@afma.gov.au Phone: (02) 6225 5451</p>
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Appendix 4. Pre-project community survey information sheet



Measuring non-commercial fishing (indigenous subsistence fishing and recreational fishing) in the Torres Strait in order to improve fisheries management and promote sustainable livelihoods.

Engagement Strategy - Full-proposal phase

Consultation during the formulation of the full proposal included a broad range of community stakeholders from all Torres Strait communities – for although this project will only carry out pilot catch monitoring on two selected islands, the program will potentially be rolled out across all Torres Strait communities.

Stakeholders contacted included:

- PBC Chairs
- Island Councillors
- TSRA members
- Island Fishery Associations representatives

Note that finfish Working Group and RAG Traditional Inhabitant representatives were contacted through the respective PZJA support structures and will report directly to the TSSAC.

Initial engagement was through email, with follow-up phone calls and face-to-face meetings where possible. The e-mail included an introduction to the project, the project flyer, and requested feedback. Several telephone and face to face meetings were then held with key contacts and a structured questionnaire was used to gauge support, outline any concerns and provide any insights or ideas for project activities and fish monitoring approaches. Individual responses are shown in Appendix 1.

Special consideration was taken with traditional knowledge collected during the consultation. Any knowledge that could possibly be considered as Traditional knowledge was only used with the express permission of the traditional owner.

Summary of responses

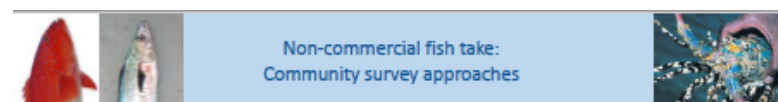
Response group	No. surveyed	No. responses received	No. supportive	No. not supportive	Uncertain
PBC Chairs	21	9	7	1	1
TSIRC counsellors	13	2	2	0	0
Community fisher reps	9	1	0	0	1
TSRA board members	20	3	3	0	0
Total*	63	13*	11*	1*	1*

* Some respondents hold more than one position

Summary of responses

Responses from community representatives were mostly positive. Most recognized the importance and benefits of the project. Two suggested their community would be interested in being involved in the pilot program (Masig and Poruma). Two main concerns expressed were: 1) that (some) community members will think that information may be used to restrict their catch/access to the fishery; 2) that recreational fishers are not included in the monitoring.

We reiterated that recreational fishers will be included in the pilot monitoring program. Assuring community members that there is little risk to future fishery access will be important to get community support. This messaging, as well as communicating the benefits for sustainable fisheries will be critical to the success of the project.



Engagement Strategy - Project phase

Phase 1

Communication and consultation with management and islander representative organisations will take place through correspondence and meetings with the project oversight body. (Note: costs associated with project oversight body, including any potential fee for service, have not been included in the project budget due to uncertainty of membership and potential for incorporation with established consultation processes (e.g. Torres Strait finfish working group).

Key stakeholders to be consulted during this phase will include the TSRA, AFMA, Malu Lamar and Gur A Baradharaw Kod (GBK), Councillors, PBC Chairs, PZJA working group representatives, and the CDP Provider.

Phase 2

We propose to engage a minimum of two outer islands communities to pilot study the monitoring program for both subsistence and recreational fishing. Broad community consultation will occur early in Phase 2 on the two selected island communities.

This will include broad community communication and consultation, with as many people that live in the communities as possible. Targeted consultation will also be held with local PBC chairs, Councillors, TSRA Members and heads of local fishers associations. The local rangers and CDP trainers are potentially key collaborators during the pilot study phase of the project.

A range of communication engagement approaches will be used, including community notices, community meetings, household visits and direct phone conversations. Face to face meetings will be held with community representatives and leadership. We will also take advice on other approaches to inform communities about the project, such as media releases (radio and newspaper articles) and presentations at Working groups etc.

There will likely be a strong training component for locally engaged monitoring support positions (e.g. community monitors, rangers etc).

Appendix 5. Information request form used during consultation with Traditional Inhabitants

Non-commercial fishery monitoring project - Community views and concerns

Question 1 – Is it important for us to collect data about non-commercial catches

Question 2 - What benefits do you see in collecting and assessing non-commercial fishery catch information for individuals, families and communities?

Question 3 – What are some of the drawbacks or risks of collecting and assessing non-commercial fishery catch information from individuals or communities?

Question 4 – Do you think community members are willing to provide information on local non-commercial fishery catches? Why or why not?

Question 5 – What are the obstacles and how can we overcome them?

Question 6 – About how often would a member of your household fish for kai kai (not commercially)? – No of times per month

Name.....(Optional)

Affiliation.....(Optional)

Q1 – Why collect catch data
Q2 – Benefits
Q3 – Drawbacks
Q4 – Community attitudes
Q5. – Obstacles
Q6. – How often

Appendix 6. Stakeholder needs and issues – detailed information

a. Stakeholder data needs, data uses and benefits

Stakeholder	Data needs	Data uses and benefits
1. Traditional Inhabitants (community leaders, fishers, Women)	<ul style="list-style-type: none"> • Annual catches of all fished species in the community • Changes in fishing behaviours and effort • Fishing effort and catch by community sectors (TIB fishers, women, children etc) 	<ul style="list-style-type: none"> • Underpin future commercial fishery for current non-commercial spp (e.g., mackerel from Poruma) • Info to underpin sustainable use of trad/local resources of various non-commercially important spp (e.g., rabbit fish), and for future trad harvest strategies for these spp • Communities can apply Traditional Knowledge and management to fishing practices • Communities can adapt to changes in marine species availability and stock status • Will provide an understanding of socio-economic development needs (e.g., needs by community sectors re sustainable livelihoods, such as tailored support for women fishers)
2. Non-Traditional Recreational fishers (TI residents, visitors)	<ul style="list-style-type: none"> • Annual catches of all fished species • Restrictions, minimum sizes, local protocols 	<ul style="list-style-type: none"> • Knowledge of which species to target • Knowledge of the current status of potentially fished species
3. Resource/fishery managers (AFMA, TSRA, QDAF)	<ul style="list-style-type: none"> • Total catch of all individual marine species taken from outside the commercial sectors to inform fishery management decision making, e.g., total annual biomass • The ability to measure changes and trends in total catches and species composition over time • Priorities are Spanish mackerel, coral trout, TRL • The non-commercial catch of TRL is currently assumed as there is little data 	<ul style="list-style-type: none"> • Sustainable management of marine resources, particularly of Traditional fishery resources. • Protection of community access to Traditional fishing resources • Allocation of catch shares to sunset licence holders.

Stakeholder	Data needs	Data uses and benefits
	<ul style="list-style-type: none"> • Total catch by geographical area to help manage any potential impacts on Traditional fishing and to assess potential stock issues • Data on number of fishers to provide CPUE data to help with fishery characterisation and future trends and assessments • An understanding of the fishing dynamics by gender, age and other factors that drive seafood consumption and its value to the community • Data that uses a risk-catch-cost approach; data that may be used as a 'proxy' for informing a risk-management approach • Data that provides economic information on the contribution fishing makes to the regional economy (QDAF) • Data on the social benefits and importance that fishing provides and means to the local community. (QDAF) 	
4. Data assessment & research scientists (QDAF, Uni Qld, CDU)	<ul style="list-style-type: none"> • Catches/catch rates by species including: species, number, weight and location • Effort: where, when, how many days/hours, gear • Size and sex ratio of species in the catch • Seasonality of catches • Past harvest sizes by species, to help inform the status of the stock • Fishers' observations about trends, spikes/troughs in catches, observations on environment status • Role of fishers and non-fishers in communities to help understand drivers of fishing effort, or who to go for re data collection • Age data from random samples (e.g., frames, otoliths + lengths) • Independent surveys to validate catch data 	<ul style="list-style-type: none"> • Numbers <u>and</u> weights provide information on mean size • Size and sex ratio can indicate health of stock and life history information • Better stock assessments for target species - especially requiring data on catch BY SPECIES e.g., coral trout group split into actual species. • Better advice for sustainable catch recommendations • Very clear and consistent effort metrics. Effort should be by hour but if by day then hopefully fish same length of time over day. Also, effort by dory. If begin using mothership then still stick to effort by dory. • Better advice for sustainable catch recommendations • Better understanding of the social and economic benefits of fishing (QDAF)

Stakeholder	Data needs	Data uses and benefits
	<ul style="list-style-type: none"> • Abiotic parameter measurements to establish baseline measures and assess for changes in patterns/environmental relationships • Collection of tissue samples for genetic assessments as needs arise; these can be stored for a few years if necessary to potentially inform close-kin genetics studies which would shed light on natural mortality but also importantly on stock connectivity in Torres Strait and GBR etc • Sporadic or regular tissue samples to check for contaminants • Monitoring of parasite diversity and loads to assess a range of dynamics • Record any bycatch impacts – what are the main species caught and discarded – the impacts on bycatch could have repercussions to system health • Economic information on the revenue and costs of fishing, processing 	
5. National stakeholders	<ul style="list-style-type: none"> • Ability to demonstrate success or otherwise through data collection • Community-based data collection • Need to ensure community voices are being heard • Collecting data from a broader range of species supports a more ecosystem-based approach 	

b. Monitoring program requirements, constraints and risks

Stakeholder	Program requirements, constraints	Program risks
1. Traditional Inhabitants (community leaders, fishers, others??)	<ul style="list-style-type: none"> • Program has to be easy contribute to, with small time and technical requirements • Local communities wish to take responsibility of local fisheries and management, therefore monitoring program should support this aspiration. • Monitoring strategies should be co-designed with the community • Clarity on the benefits to local communities • Information collected to be summarised and reported back to communities – an informed community about the need for data collection, as well as the data outputs is critical for their ability to participate in management decisions • Representative community groups are probably good options for holding/managing sensitive data. • Complete transparency about how the data will be used • Communities should have first access to information • Communities have veto power over access to information by outside stakeholders • Identity of individual fishers is protected • Database is controlled by local community, e.g., via research agreements with the community • Identification of data champions to help change the culture for community-based data collection • Needs to be easy for community members to provide data • Design so it can plug into a larger connected system to manage all land and sea resources and provide ability for a wholistic approach to management • Collect data from households rather than just individual fishers 	<ul style="list-style-type: none"> • Community view that data will be used against them • Fisheries closed to Traditional fishing • Community participation/cooperation low due to lack of trust
2. Non-traditional Recreational	<ul style="list-style-type: none"> • Identity of individual fishers protected • Needs to be easy to provide data 	<ul style="list-style-type: none"> • Local backlash against recreational fishers

Stakeholder	Program requirements, constraints	Program risks
fishers (TI residents, visitors)	<ul style="list-style-type: none"> • Unobtrusive 	
3. Fishery managers (AFMA, TSRA, QDAF)	<ul style="list-style-type: none"> • Needs to be replicable through time – including in tight funding scenarios • Frequent enough sampling to fulfil objectives • Needs to be affordable (what resources likely to be available?) • Needs to be logistically feasible • Needs to be socially and culturally acceptable to Torres Strait Islander communities • Trust rebuilding based on past program failures: loss of control, intrusions and data sharing issues • Resourcing – limited funds available • Must be equitable and culturally appropriate • Incentivisation to encourage engagement in the program • Transparency re how the data will be used and managed • A working harvest strategy to manage times when catch levels change • Data needs to be representative and accurate (QDAF) 	<ul style="list-style-type: none"> • Potential backlash from communities if it goes wrong • Inaccurate data will result in unsustainable fishing, reduced access by local communities, or lost revenue from sunset licence fees.
4. Data assessment research scientists (CSIRO, QDAF, Uni Qld)	<ul style="list-style-type: none"> • Need to be regular and ongoing • An overlapping period of data collection between when the commercial sector data is the mainstay assessments to when the Indigenous fishing sector data becomes the mainstay assessments. This will allow the needed calibration between assessments during the period of change. • Species guide to minimise mis-identification, available to all fishers • If any tissue, genetic or other samples taken, need to ensure these are adequately labelled and stored • High quality communication materials and strategy – includes to help focus on providing clear incentives for data collection (eg explaining why TACs need be less conservative as more data become available) and also penalties (which could be converse situation of more conservative TACs) • Should be an emphasis on trust development and maintenance 	<ul style="list-style-type: none"> • Data bias will result in inaccurate stock assessments and potentially over estimated TACs and overexploited stocks; over and underestimates of species catches, in particular • Species mis-identification; especially requiring data on catch by species e.g., coral trout group split into actual species • Very clear and consistent effort metrics. Effort should be by hour but if by day then hopefully fish same length of time over day. Also, effort by dory. If begin using mothership then still stick to effort by dory • Recognition that a proportion of community members will not want to provide information

Stakeholder	Program requirements, constraints	Program risks
	<ul style="list-style-type: none"> • Ensure database systems are highly confidential – e.g., measures such as only recording large scale location caught or only making this info available at end of season • Build an information database about why people will or will not be involved in providing catch information to help improve program trust and success • High levels of honesty about program drivers, approach and process • Need to take a long-term view about participation of Traditional Inhabitants • Ensure an ethical and culturally appropriate way to collect the Traditional fishery catch information • Clarity on data infrastructure (where the information is recorded) • Need to ensure appropriate cultural authority, governance and process over the information & cultural (e.g., approval of the data during a PBC meeting) • Need for a genuine co-management approach re managing stocks • Another helpful way to communicate the benefits of shared data is to share information on local and international market prices etc so that these are transparent and fishers are more empowered about the supply chain • Data needs to be representative and accurate (QDAF) 	
6. National stakeholders	<p><i>Improved data on Aboriginal and Torres Strait Islanders fisheries resource use</i></p> <p>DRAFT Workshop 2 Outcomes Report (FRDC Project 2018-016).</p> <p>Some overarching principles or requirements were identified, including:</p> <ul style="list-style-type: none"> • Data collected by community is owned by community. Community want to manage the data they collect. • Sharing of data by community is a choice, including what data are shared and how they are shared. • Community, at this current point in the relationship, do not want government to know about the cultural information. Government need 	<ul style="list-style-type: none"> •

Stakeholder	Program requirements, constraints	Program risks
	<p>to have trust in the Traditional Inhabitants and community regarding their ability to manage their resource use.</p> <ul style="list-style-type: none"> • The data collection process should be driven and led by community (facilitated by Government) to create investment and ownership within the community. It should include capacity building and / or economic opportunity for the community. • Survey methods should be as simple as possible. • A formal agreement covering all aspects of the co-development of the data collection methodology must be developed and signed. <p>Other national stakeholders</p> <ul style="list-style-type: none"> • Validating of fisher-dependent data collected 	

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TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 - 15 October 2021
CLIMATE CHANGE IMPACTS ON TORRES STRAIT FISHERIES (CSIRO)	Agenda Item 5.5 For NOTING & ADVICE

RECOMMENDATIONS

1. That the Resource Assessment Group (RAG):

- a) **NOTE** the recorded video presentation to be provided by Dr Leo Dutra (CSIRO) at the meeting on the outcomes of the project *Climate variability and change relevant to key fisheries resources in the Torres Strait — a scoping study* (climate change scoping project).
- b) **NOTE** the Torres Strait Scientific Advisory Committee (TSSAC) considered the projects outcomes and recommendations at its 79th meeting on 9-10 June and agreed that a further climate change project needs to:
 - (i) be made a priority, as there are very real climate change threats to the Torres Strait;
 - (ii) be tackled at a national /political scale and funding beyond TSSAC will need to be secured due to the high cost of the project;
 - (iii) provide clear guidance on risks, threats and opportunities (if any) associated with climate change, and actions to address them;
 - (iv) identify other participants both for funding and end users; and
 - (v) that the modelling should start with focusing on commercial fisheries, and then can be upscaled to have more information on other fisheries.
- c) **DISCUSS** and **PROVIDE ADVICE** on the project recommendations for further research on evaluating the implications of climate variability and change on Torres Strait Fisheries.

KEY ISSUES

2. The TSSAC funds projects that are applicable across Torres Strait Fisheries. Two such projects that were funded in 2019-20 are the *Climate variability and change relevant to key fisheries resources in the Torres Strait – a scoping study* and *Measuring non-commercial fishing (indigenous subsistence fishing and recreational fishing) in the Torres Strait in order to improve fisheries management and promote sustainable livelihoods*.
3. The need to better understand the species-specific effects of climate change and variability on Torres Strait Fisheries was initially identified as a research priority by TSSAC in December 2018 (meeting 71). TSSAC agreed that as a starting point, a scoping study should be undertaken on the possible methods and resources needed to build an information framework that can evaluate the implications of future climate variability and change scenarios on fisheries to better allow fisheries managers and industry to respond and adapt to any changes.
4. The project scope that went out in the 2019-20 TSSAC call for research funding proposals is provided as **Attachment 5.5a** for the RAG's reference. The project was funded by AFMA and finalised on 31 January 2020. A summary of the suggested components and estimated

costs for a full climate modelling project are outlined in **Attachment 5.5b** and the full project report is provided as **Attachment 5.5c**.

5. The project builds on a literature review of the main climate change drivers in Torres Strait affecting tropical rock lobster, bêche-de-mer (sea cucumber), finfish, prawns, turtles and dugongs to provide detailed specification and costings for a future project that will produce the over-arching data framework at the appropriate spatial scales, as required to address future climate variability and change scenarios for Torres Strait fisheries. The report also includes detailed information about data availability, and specifications on data storage, management and data accessibility issues.
6. The TSSAC considered the project's outcomes and recommendations at their 79th meeting on 9-10 June 2021 and agreed that if the project was to progress beyond this scoping phase, it would provide a range of information that is of value to fisheries management, including:
 - Understanding interactions between fisheries and ecosystems.
 - Understanding impacts that different climate change scenarios could have on fisheries/ species.
 - Understanding impacts of changes in catchment conditions and rainfall.
 - Understanding impacts of incidences.
 - Assisting fisheries managers and communities with preparation for adaptation, where possible.
 - Providing predictions of changes in abundance, growth, reproductive capacity and distribution.
 - Helping to differentiate between the relative effects of fishing and environmental (climate) change on marine resources.
 - Use existing, and new data to be collected, to generate information of value to other sectors beyond fisheries, e.g. water circulation, winds, predicted sea level rise, rainfall and wind speed.
7. Given the limited annual research budget, the TSSAC agreed that other funding sources need to be explored including the Fisheries Research and Development Corporation (FRDC) and other agencies such as councils and state environment agencies.

BACKGROUND

Other research to date on climate change impacts on Torres Strait Fisheries

8. In terms of assessing the likely impacts of climate change on Torres Strait Fisheries the following has been undertaken:
 - a) Qualitative Sensitivity Analysis: Assessing the vulnerability of Torres Strait fisheries and supporting habitats to climate change (Welch and Johnson 2013);
 - b) Management Strategy Evaluation to integrate climate changes into the TRL Stock Assessment: An Integrated Management Strategy Evaluation (MSE) for the Torres Strait Rock Lobster *Panulirus ornatus* fishery (Plaganyi *et al* 2012);
 - c) System Modelling: Models of Intermediate Complexity of Ecosystems (MICE) – applied to TRL in the Torres Strait. Used in the following projects:

- (i) AFMA project 2017/0816 – Environmental drivers of variability and climate projections for the Torres Strait tropical lobster *Panulirus ornatus*. (Plaganyi *et al* 2018).
 - (ii) Decadal-Scale Forecasting of Australian Fish and Fisheries (Fulton *et al* 2018). A non-technical summary of the decadal-scale forecasting project¹ is provided at **Attachment 5.5d**.
9. In June 2018 the TSRA and National Environmental Science Programs (NESP) Earth Systems and Climate Change Hub convened a workshop on climate change implications for fisheries and marine ecosystems in the Torres Strait. The workshop identified initial thoughts on priority areas for research that may help fisheries and marine ecosystem management in the Torres Strait (**Attachment 5.5e**).

Adaption of Commonwealth fisheries management framework to climate change project (FRDC 2016-059) (the climate adaptation project)

10. The climate adaptation project is due for completion in 2021 and looked at the readiness of Commonwealth Fisheries Management Arrangements to the potential impacts of climate change and options to adapt to changes. Its key output is a climate adaption handbook that provides detailed steps for fisheries and other stakeholders to conduct climate risk assessment of their fishery management arrangements and operations. During the project, AFMA worked with the CSIRO, IMAS and other researchers to answer the following questions:
- a. *What changes does AFMA need to make to its regulatory system so that it can effectively deliver its management objectives?*
 - b. *What are the consequences of those changes for the fishing industry and other fishery stakeholders?*
11. While AFMA's current management strategies have flexibility built in them, it was important to assess the extent to which the direct and indirect impacts of climate change will challenge Australian fisheries and the management framework that they are currently managed under. The climate adaptation project did this by developing a risk assessment approach that tests the adaptability of current and potential management arrangements to projected, climate driven, changes of fish stocks on three case study fisheries, the Northern Prawn, Heard and MacDonald Island and Southern Bluefin Tuna Fisheries as part of the project.
12. The project consulted with key stakeholders from those fisheries, as well as recreational, indigenous and state fishery stakeholders to develop the final approach.
13. The project considered is likely to give some guidance around future research investment into possible management responses to the impacts of climate change on Torres Strait Fisheries, RAG advice is sought on the benefit of extending the outputs of the project to Torres Strait Fisheries.

¹ AFMA led project *Adaption of Commonwealth fisheries management framework to climate change project (FRDC 2016-059)*

Torres Strait Scientific Advisory Committee 2019-20 financial year research project scope

Project Title: Climate variability and change relevant to key fisheries resources in the Torres Strait — a scoping study.

Project Need:

Key commercial species in Torres Strait fisheries, such as tropical rock lobsters, prawn, finfish and beche-de-mer, are likely to be influenced by current and future climate variability and change. Fisheries management and assessments will need to take account of the implications of future variability and change that may affect stocks. These may manifest through effects on recruitment pathways, mortality rates, and critical habitats among other processes. Previous reviews have qualitatively assessed the vulnerability of the Torres Strait to climate change effects; however, future assessments need to account for these in a quantitative manner for fisheries management to respond appropriately. A quantitative MICE model (Model of Intermediate Complexity) has already been completed in the Torres Strait region for tropical rock lobster, as a part of understanding annual variability in abundance. Separate fishery specific assessment models for multiple species, will all require essentially the same over-arching regional-scale data. This data should cover future climate and environmental variability, potentially including currents, winds, temperature, rainfall etc, at an appropriate spatial extent and grid-resolution.

The requirement is to scope a future project that can deliver the over-arching data requirements that are needed from e.g. global atmospheric and/or oceanographic models, down-scaled to the broader Torres Strait region. This can be used as a framework to derive separate fishery specific models that will evaluate the implications of future climate variability and change scenarios on these fisheries. The down-scaled atmospheric and/or oceanographic outputs will need to be produced in way that meets the input data needs of the various fishery specific sub-models.

The scoping study will need to consider previous reviews of climate implications for Torres Strait; consult with relevant fishery researchers, managers and key stakeholders regarding the necessary inputs; identify a range of potential sources of co-investment funds to support the main future project. The scoping study could potentially include a workshop, if cost-effective, with relevant fishery modelling expert end-users and stakeholders.

Desired Outputs:

1. A detailed specification and costing for a future project that will produce the over-arching data framework at the appropriate spatial scales, as required to address future climate variability and change scenarios for Torres Strait fisheries.

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Summary of the main outcomes and recommendations of the project *Climate variability and change relevant to key fisheries resources in the Torres Strait — a scoping study*

Main outcomes/ recommendations	Estimated cost
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.	Unknown. It is difficult to estimate costings for data collection programs, as some data is already being collected across fisheries. This issue can be discussed at the meeting. The PI will provide some estimates of cost associated with collecting hydrodynamic information.
<p>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:</p> <ul style="list-style-type: none"> • Development and implementation of data framework to support future modelling efforts in Torres Strait – approx. cost • Development of integrated ecological or socio-ecological models capable of integration with a regional hydrodynamic model: <p>For example, combining existing data and models (Tropical Rock Lobster, beche-de-mer, and dugongs) into an integrated spatial MICE, which will form the basis for a hybrid MICE-ATLANTIS ecosystem model;</p>	<p>Approximately 0.4-0.5 FTE for 1 year or rough estimate of AUD \$130,000.</p> <p>Approximately 0.5-0.7 FTE over each of 2 years, or rough estimate of \$460,000.</p>
<p>Dedicated regional hydrodynamic model, including physics and biogeochemistry for Torres Strait, for example similar to eReefs.</p> <p>Include the key findings – recommendations from each project, and the costs.</p>	Approximately 0.3-0.5 FTE over each of 2 years, or rough estimate of \$350,000 .
Total estimated costs for costed components of project (this excludes data collection components)	\$940,000

TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 -15 October 2021
RESEARCH Finfish Fishery Research Priorities	Agenda Item 5.6 For DISCUSSION & ADVICE

RECOMMENDATIONS

1. That the RAG **NOTE**:

- a) The current status of recently identified research needs, as last reviewed by FFRAG 7 (held via videoconference on 8 October 2020) (**Table 1**); and
- b) that although not yet funded, approximately \$477,000 of the 2022/23 available research budget is expected to fund multiyear Finfish and TRL related projects including:
 - (i) Torres Strait Spanish mackerel stock assessment (**Agenda item 3.1**);
 - (ii) Spanish mackerel and coral trout biological sampling (**Agenda item 5.2**); and
 - (iii) Scoping study for an alternative index of abundance for the Torres Strait Spanish mackerel stock (**Agenda item 5.3**).
- c) That this means that at present (i.e. in the absence of securing further funding) expected remaining AFMA and TSRA research funding available in the 2022/23 financial year is approximately \$93,000 across all Torres Strait fisheries.

2. That the RAG, having considered the above, **DISCUSS** and provide **ADVICE** on the research priorities provided in the rolling five year research plan for 2022/23 to 2026/27 (the Research Plan) for the Torres Strait Finfish Fishery (**Attachment 5.6a**), including advice on feasibility, timing and indicative costing of essential, unfunded research project(s).

KEY ISSUES

Research priorities for the Finfish Fishery

3. The FFRAG last discussed research priorities on 8 October 2020 for the 2021-22 TSSAC research funding round (summarised in **Table 1**) and recommended that:
 - a) **Biological sampling for Spanish mackerel** (essential) **and coral trout** (desirable) remain ranked as the number one priority;
 - b) **Undertaking a stock assessment for Spanish mackerel** remains an essential research priority (ranked second);
 - c) **Development of a harvest strategy for the Torres Strait Finfish Fishery** also remains an essential priority (ranked third);
 - d) **Developing an alternative index of abundance for Spanish mackerel** though a scoping study of close kin mark recapture genetic studies remain as an essential priority (ranked fourth);
 - e) **Understanding environmental drivers** that may be affecting the Spanish mackerel assessment is an essential priority but not recommended as a near future priority (following completion of the recently funded project presented under Agenda item 5.1).
 - f) **Development of a coral trout stock assessment** recommended as a desirable priority but not in the 2021-22 funding round;

- g) Understanding Spanish mackerel stock structure and ecology, shark depredation, otolith morphology and understanding the ratio of B_{MSY} to B_{MEY} are desirable priorities but not recommended for immediate funding.
- 4. The RAG noted at FFRAG 8 (4-5 November 2020) that additional research priorities are desired to support a coral trout stock assessment. The fishery has remained under-utilised for some time, and the TSRA member sought RAG advice on what information is needed to support a more accurate/reliable stock assessment which could then be used to adjust the TAC.

The RAG noted that the research priorities to address gaps in the preliminary stock assessment were identified by the RAG in 2019. The priorities being to undertake further habitat mapping work, analyse the mid-90s CSIRO dive survey data, improve catch and effort data from TIB fishers and collect fishery independent data, such as an underwater survey and/or biological sampling.

The RAG noted previous advice that there a significant advantage to undertaking a fishery independent dive survey of abundance prior to any significant fishing pressure being applied. Such a survey would act as a baseline to measure the potential productivity of the fishery.
- 5. Following FFRAG 7, AFMA prepared four draft scopes to suit the four RAG identified essential priority needs for consideration by the TSSAC, which were called for publicly in November 2020.
- 6. A pre-proposal was received for each of the four tactical research needs, which was reviewed by the TSSAC at their teleconference on 8 April 2021. The TSSAC decided not to support the finfish harvest strategy project, noting that:
 - a) it was the lowest priority of the four projects put forward;
 - b) there was insufficient funding to support all four projects; and
 - c) given the past work that has already occurred on the finfish harvest strategy, the project proposal presented highlighted a need to further refine the scope of this project before seeking proposals again in future years,
- 7. The remaining three projects were supported and are currently funded under multiyear projects until 2023/24.

Broader research priorities for Torres Strait Fisheries

- 8. There are two recently funded (in 2019-20) and completed projects that are applicable across all Torres Strait Fisheries. These are:
 - a) *Measuring non-commercial fishing (indigenous subsistence fishing and recreational fishing) in the Torres Strait in order to improve fisheries management and promote sustainable livelihoods* (presented under **Agenda Item 5.4**); and
 - b) *Climate variability and change relevant to key fisheries resources in the Torres Strait – a scoping study* (presented under **Agenda Item 5.5**).
- 9. The RAG is invited to provide feedback to the Torres Strait Scientific Advisory Committee (TSSAC) on the outcomes of these projects, in particular recommendations from the projects for future research. The project outcomes and recommendations were considered by TSSAC at its meeting on 9-10 June 2021.

BACKGROUND

TSSAC Research Funding Process

10. Each year the PZJA TSSAC invites applications for funding to undertake research to support the management of Protected Zone Fisheries. The TSSAC seek input from each fishery advisory committee to identify research priorities.
11. PZJA fisheries research is generally funded by AFMA. The AFMA research budget is generally set at around \$420,000 each year. In addition to the AFMA research funding, TSRA has recently committed in-principle to contributing \$150,000 each year towards PZJA fisheries research. This allows around \$570,000 annually for all Torres Strait research.
12. Additional funding can also be sought from other bodies such as the Fisheries Research and Development Corporation (FRDC), when needed, and when projects align with FRDC objectives.
13. Assuming no change to available AFMA and TSRA funding, considering expected research commitments and in the absence of securing further funding, available researching funding across all Torres Strait Fisheries in the 2022-23 financial year will be around \$93,000.
14. A detailed breakdown of committed TSSAC funds for multi-year projects 2021/22 – 2024/25 is provided at **Attachment 5.6b**.

TSSAC Fisheries Strategic Research Plan 2018-2023 and rolling five-year fishery specific research plans

15. TSSAC operates under a SRP which guides priority setting for research in Torres Strait fisheries over a five year period. The SRP specifies the research priorities and strategies that the PZJA intend to pursue in Torres Strait fisheries, and provides background to the processes used to call for, and assess, research proposals. The research priorities can be broad, covering all topics within the SRP, some of which may be funded by AFMA, and some of which may require funding from other funding bodies.
16. There are 3 research themes within the SRP, under which the FFRAG and FFWG could identify research priorities for the Finfish Fishery (**Attachment 5.6c**). There are several strategies under each theme and suggested ideas to help RAGs and Working Groups to think about the sorts of projects which may fit within these themes and strategies.
17. The TSSAC requires each fishery to develop a rolling five year research plan, which fits into the themes identified in this SRP.



DRAFT Rolling Five Year Research Plan 2022/23 - 2026/27

Torres Strait Finfish Fishery



Compiled by AFMA with FFRAAG advice
September 2021

ABOUT THIS PLAN

The Torres Strait Scientific Advisory Committee (TSSAC) seeks input from each fishery advisory body (Resource Assessment Group (RAG), Management Advisory Committee (MAC) or Working Group (WG)) to identify research priorities over five year periods from 2022/23 to 2026/27. This template is to be used by the relevant advisory body to complete their five-year plan. The plans are to be developed in conjunction with the TSSAC Five-year Strategic Research Plan (SRP) with a focus on the three research themes and associated strategies within the SRP.

All fishery five-year plans will be assessed by the TSSAC using a set of criteria, and used to produce an Annual Research Statement for all Torres Strait fisheries.

The TSSAC then develop scopes for the highest ranking projects in order to publish its annual call for research proposals. There are likely to be more scopes that funding will provide for so TSSAC can consider a number of proposals before deciding where to commit funding.

The fishery five-year plans are to be reviewed and updated annually by the Torres Strait forums to add an additional year onto the end to ensure the plans maintain a five year projection for priority research. Priorities may also change during the review if needed.

RESEARCH PRIORITIES

Table 1. Five-year Torres Strait Finfish Fishery research plan for 2022/23 to 2026/27.

Proposed Project	Objectives and component tasks	Year project to be carried out and indicative cost*						Evaluation		
		2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	Priority essential / desirable	Priority ranking 1-5 (1 = highest)	Theme
Biological sampling program (length freq, sexing, ageing)	Project funded for age, sex and length data for Spanish mackerel to support stock assessment.	\$122,000 (currently funded)	\$128,000 (currently funded)	\$135,000 (currently funded)	0	0	0	Essential	1	1a
Spanish mackerel stock assessment	Need for ongoing assessment of key commercial species.	\$57,000 (currently funded)	\$59,000 (currently funded)	\$61,000 (currently funded)	0	0	0	Essential	2	1a
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.	0	Not currently funded, requires an indicative cost estimate.	0	0	0	0	Essential	3	1a
Ecological Risk Assessment (ERA)	It is a condition of the FF WTO that by 30 June 2023 an ERA must be undertaken for the TS Finfish Fishery	0	\$20,000 (not funded)	0	0	0	0	Essential	3	1a
Alternative index of stock abundance	Develop an alternative to CPUE data to provide stock status/abundance	\$93,000 (currently funded)	0	0	0	0	0	Essential	4	1a
Coral trout stock assessment	Need for ongoing assessment of key commercial species.	0	\$30,000 (not funded)	\$30,000 (not funded)	0	0	0	Desirable	5	1a
Management Strategy Evaluation (MSE) of draft harvest strategy	Requirements of Cwth HS Policy and Guidelines to undertake MSE prior to implementation.	MSE work requires funding and HS development to be completed first						Desirable	5	1a
Stock structure of Spanish mackerel.	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.	Not funded, genetic samples banked for future studies. Not designed or costed. Torres Strait otoliths collected under sampling project will be stored to facilitate future genetic sampling.						Desirable	5	1a, 1b
Estimating catches outside the commercial fishery.	Acquiring data of catch taken from non-commercial fishers.	Outcomes of scoping project (funded in 2019/20) will inform likely future work if a program is to be implemented.						Desirable	5	1a, 3b

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).	Not designed or costed	Desirable	5	
Otolith morphology	Developing an index of mackerel ages based on the shapes and sizes of otoliths recorded	Not designed or costed. Torres Strait otoliths collected under sampling project will be stored and could be used for this project.	Desirable	5	
Optimum ratio of B_{MSY} (maximum sustainable yield) to B_{MEY} (maximum economic yield)	While stakeholders may select a higher future target reference point (e.g. B_{60}) 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.	Not designed or costed	Desirable	5	1a

Table 1. Overview of recent research needs identified or discussed at previous FFrag and RFFWG meetings with an update on current status.

Key:

Currently funded

Project recently completed

Unfunded and/or not scoped

Research need	Detail	FFRAG Prioritisation	Status (as of September 2021)	Comments/Questions
Biological sampling (Spanish mackerel and coral trout)	RAG has noted an essential need for mackerel biological sampling noting the gap since last available information (2019 sampling is the first since 2005). The RAG noted the data poor nature of the trout fishery and suggested broadening the information available through sampling to support future development of the stock assessment once complete.	Essential (1) (as per FFRAG 7 advice)	Multiyear project currently funded for 2021/22 – 2023/24.	
Spanish mackerel stock assessment	Evident decline of Spanish mackerel abundance based on CPUE series has been the scientific and management focus of the fishery.	Essential (2) (as per FFRAG 7 advice)	Multiyear project currently funded for 2021/22 – 2023/24.	
Harvest strategy development	Need a HS framework with agreed reference points (target, limit) and harvest control rules. Though not formally adopted, certain elements of a strategy have been adopted by management as interim reference points with the focus on keeping mackerel stock above the default B_{LIM} of 20 per cent of virgin biomass and building the stock in a positive direction. It is a condition of the FF WTO that by 30 June 2023 a HS must be developed for the fishery.	Essential (3) (as per FFRAG 7 advice)	Not currently funded and requires an indicative cost estimate.	<ul style="list-style-type: none"> Remains an essential research need in the fishery with a project required to continue development of a Strategy for the TSFF. Commonwealth best practice is to manage a fishery under a strategy to gain long term efficiencies and focus science, monitoring and management. ESSENTIAL Ranked as the number 3 priority for research funding. 14 Project could focus on mackerel first, rather than both mackerel and trout, if funding was limited.
Alternative index of abundance for Spanish mackerel – scoping study	Developing an alternative index of abundance using the novel Close Kin Mark Recapture genetic technique.	Essential (4) (as per FFRAG 7 advice)	Multiyear project currently funded for 2021/22 – 2023/24	Update on the project to be presented under Agenda Item 5.3

Research need	Detail	FFRAG Prioritisation	Status (as of September 2021)	Comments/Questions
Environmental drivers that may be affecting the Spanish mackerel assessment	<ul style="list-style-type: none"> Seen as a key scientific issue for Torres Spanish mackerel assessment, but also across northern Australia (not just limited to Torres Strait). Strong need to know why Spanish mackerel CPUE varies up or down over time and what factors underlie trends in the data. May require ongoing analyses post the 2020-21 funded examination. Has interaction with the TS climate change project. RAG to monitor outcomes of this project and provide future advice on what a project may look like to address this need. 	Essential Not recommended as a near future priority. (as per FFRAG 7 advice)	Project (2019/0831) recently completed.	FFRAG 7 noted that further consideration would need to be given to what the objectives and scope of a future project might be. Update on the project to be presented under Agenda Item 5.1
Ecological Risk Assessment (ERA)	<ul style="list-style-type: none"> It is a condition of the FF WTO that by 30 June 2023 an ERA must be undertaken for the TS Finfish Fishery 	Essential	Not scoped or funded. Estimated cost \$20,000	
Coral trout stock assessment development	<ul style="list-style-type: none"> RAG has noted work required to further develop the preliminary stock assessment and address the range of uncertainties identified. The additional data priorities are: <ol style="list-style-type: none"> 1) analysing the identified 1994-95 CSIRO survey data 2) examining improved TIB catch and effort data 3) incorporating underwater visual survey data if conducted. 	Desirable (as per FFRAG 7 advice)	No research planned or funded.	A small tactical project to update CPUE in 2020 but was not supported by TSSAC.
Management Strategy Evaluation (MSE) of draft harvest strategy	<ul style="list-style-type: none"> Requirements of Cwth HS Policy and Guidelines to undertake MSE prior to implementation. 	Desirable	No research planned or funded.	MSE work requires funding and HS development to be completed first
Spanish mackerel stock structure and ecology	With most available catch data coming from the Bramble Cay breeding aggregation RAG has identified a need to where recruits to the fishery are coming from, the structure within Torres Strait stock as well as level of connectedness with adjacent	Desirable Noted as scientifically important but not recommended as a priority for the fishery at this stage.	No research planned or funded.	

Research need	Detail	FFRAG Prioritisation	Status (as of September 2021)	Comments/Questions
	stocks in other fisheries. It is also important to understand the related ecological factors - what is driving recruitment (spawning success), feeding patterns, where spawning aggregations occur and to use this info to manage the Torres Strait stock e.g. predict where good fishery catch rates might occur, where/when protection may be required.	(as per FFRAG advice)		
Estimating catches outside the commercial fishery	Acquiring data of catch taken from non-commercial fishers.	Desirable	Outcomes of scoping project (funded in 2019/20) will inform likely future work if a program is to be implemented.	
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 recommended as a priority for the fishery at this stage. (as per FFRAG 7 advice)	No research planned or funded.	FFRAG suggested that a broader scale project across northern Australia could be formed to investigate a number of fisheries that lose catch to sharks and could be funded by FRDC for example.
Otolith morphology	Developing an index of mackerel ages based on the shapes and sizes of otoliths recorded	Desirable Not recommended for immediate funding (as per FFRAG 7 advice)	No research planned or funded.	
Optimum ratio of B_{MSY} (maximum sustainable yield) to B_{MEY} (maximum economic yield)	While stakeholders may select a higher future target reference point (e.g. B_{60}) 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 recommended for immediate funding (as per FFRAG 7 advice)	No research planned or funded.	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.

Committed Torres Strait Scientific Advisory Committee (TSSAC) funds for multi-year projects 2021-22 to 2024-25

Research priority theme	Project Title	Cost per year			
		2021/22	2022/23	2023/24	2024/25
1a - Fishery stocks, biology and marine environment.	Fishery independent survey, stock assessment, Harvest Strategy and Recommended Biological Catch calculation for the Torres Strait Tropical Rock Lobster Fishery	\$291,000	yet to be scoped (estimate \$290,000)	yet to be scoped (estimate \$290,000)	yet to be scoped (estimate \$290,000)
1a - Fishery stocks, biology and marine environment.	Finfish Fishery: Coral Trout and Spanish Mackerel Biological Sampling 2021-2024	\$122,000	\$128,000	\$135,000	
1a - Fishery stocks, biology and marine environment.	Finfish Fishery Spanish mackerel stock assessment	\$57,000	\$59,000	\$61,000	
1a - Fishery stocks, biology and marine environment.	Designing a close-kin mark-recapture study for Torres Strait Spanish mackerel	\$93,000			
Total cost for all projects (including yet to be scoped TRL)		\$563,000	\$477,000	\$486,000	\$290,000
Available research budget (if TSRA funding continues at \$150,000 and AFMA at \$420,000 per year) ¹		N/A – funding round complete	\$570,000	\$570,000	\$570,000
Remaining funding available if TRL project continues funding in future		N/A	~\$93,000	~\$84,000	~\$280,000

¹ The TRL stock assessment and survey is ongoing work generally funded each year. This work usually costs around \$290,000 a year. Although this project proposal will be assessed against all others, its considered a high priority for Torres Strait research and is likely to be funded. This can be taken into account when looking at the likely funding available for 2022-23 and beyond.

Torres Strait fisheries strategic research themes, strategies and research activities

Theme 1: Protecting the Torres Strait marine environment for the benefit of Traditional Inhabitants	
Aim: Effective management of fishery stocks based on understanding species and their biology and ecological dependencies so it can support Traditional Inhabitant social and economic needs.	
Strategy 1a - Fishery stocks, biology and marine environment	<p>Possible research activities under this theme may include:</p> <ol style="list-style-type: none"> Stock assessment and fishery harvest strategies for key commercial species. Ecological risk assessments and management strategies for fisheries. Minimising marine debris in the Torres Strait. Addressing the effects of climate change on Torres Strait fisheries through adaptation pathways for management, the fishing industry and communities. Incorporating Traditional Ecological Knowledge into fisheries management. Methods for estimating traditional and recreational catch to improve fisheries sustainability.
Strategy 1b – Catch sharing with Papua New Guinea	<p>Possible research activities under this theme may include:</p> <ol style="list-style-type: none"> Status of commercial stocks and catches by all sectors within PNG jurisdiction of the TSPZ. Good cross-jurisdictional fisheries management through better monitoring and use of technology.
Theme 2: Social and Economic Benefits	
Aim: Increase social and economic benefits to Traditional Inhabitants from Torres Strait Fisheries.	
Strategy 2a - Promoting social benefits and economic development in the Torres Strait, including employment opportunities for Traditional Inhabitants	<p>Possible research activities under this theme may include:</p> <ol style="list-style-type: none"> Models for managing/administering Traditional Inhabitant quota Understanding what influences participation in commercial fishing by Traditional Inhabitants. Understanding the role and contribution of women in fisheries. Capacity building for the governance of industry representative bodies Methods for valuing social outcomes for participation in Torres Strait fisheries. Identifying opportunities and take-up strategies to increase economic benefits from Torres Strait fisheries.
Theme 3: Technology and Innovation	
Aim: To have policies and technology that promote economic, environmental and social benefits from the fishing sector.	
Strategy 3a – Develop technology to support the management of Torres Strait fisheries.	<p>Possible research activities under this theme may include:</p> <ol style="list-style-type: none"> Electronic reporting and monitoring in the Torres Strait, including for small craft. Technologies or systems that support more efficient and effective fisheries management and fishing industry operations.

TORRES STRAIT FINFISH RESOURCE ASSESSMENT GROUP	Meeting 9 14-15 October 2021
FFRAG PRIORITIES AND DATE FOR THE NEXT MEETING	Agenda Item 6 For DISCUSSION & ADVICE

RECOMMENDATIONS

1. That the Resource Assessment Group:
 - a) **NOTE** the management priorities for 2021-22 for the fishery supported by the Finfish Working Group at their meeting on 26 November 2020.
 - b) **DISCUSS** and **PROVIDE ADVICE** on priorities for the RAG together with a work plan for addressing recommended priorities;
 - c) **REVIEW** the proposed dates for future meetings.

KEY ISSUES

2. Having agreed priorities (RAG issues to focus on) and a corresponding work plan aims to achieve a more efficient RAG process.
3. The RAG may have a standing item at its meetings to discuss assessment, data collection and research needs for the Torres Strait Finfish Fishery. This may be informed by the RAG's meeting discussions, advice from individual members of the RAG and/or advice from the Finfish Working Group (FFWG).
4. At its meeting on 4-5 November 2020, the RAG noted the proposed management and research priorities for 2021 and made recommendations on how to progress some of those priorities. These are summarised in Table 1 below.
5. Where possible, the RAG should aim to prioritise and set a timeline for any identified items, having regard for resourcing.
6. In considering its priorities, the RAG may also wish to note the summary of management priorities supported by the FFWG provided in Table 1 (some of which align with the RAG's priorities) and their progress to date.
7. Having regard for the outcomes of this meeting (including the assessment and management requirements stipulated in the WTO conditions), the RAG may recommend an alternate list of priorities.
8. As far as practical AFMA proposes that a work plan be developed in-session.

Date and venue for future meetings

9. In developing its work plan, the RAG may consider the summary of key due dates for the finfish fishery outlined in Table 2.
10. The next RAG meeting is currently proposed for 18 November 2021 in Cairns.

Table 1. Comments relating to any progress against each management priority considered by the FFRAG on 4-5 November and FFWG on 26 November 2020. Priorities are listed chronologically and not in order of importance.

Priority		FFRAG 4-5 Nov 2020	FFWG 26 Nov 2020 comments	Progress to date and comments
1	Progress the development of a harvest strategy	Subject to funding this will require additional workshops with members and broader industry stakeholders including the FFRAG.	Supported as a priority and noted that clear guidance from AFMA to prospective funding applicants on expected deliverables is needed. It was noted that the RAG and Working Group have been developing a harvest strategy approach for Spanish mackerel over the last four years and arguably there are no immediate risks for coral trout given the low fishing effort. However, the Working Group recognised that it is best practice to develop agreed harvest strategies to provide certainty to stakeholders on the information requirements and decision rules for setting TACs in the fishery. This certainty enables more informed business decisions and importantly supports industry and community leaders in building broader stakeholder support for improving data for the Fishery. To ensure a clear return on investment, members agreed that it was essential that a future project build on work already completed to develop a harvest strategy for the fishery. In this regard all potential applicants were encouraged to contact AFMA to discuss proposals prior to submission.	<p>In progress. FFRAG 9 are to note an update from QDAF on the development of the East Coast Spanish Mackerel Fishery harvest strategy, and the current QLD Reef Line Fishery harvest strategy: 2020-2025. This will allow the RAG to note any relevant considerations in developing a harvest strategy for the Torres Strait finfish fishery.</p> <p>FFRAG 10, Agenda item 4.1 has been scheduled for the RAG to discuss the progression of a harvest strategy.</p>
2	Supporting possible changes to the Western Line Closure	The RAG noted a number of risks and considerations with lifting the northern part of the closure and supported a suggestion that a targeted round of consultation occurs in Gudumalulgal to discuss the three options to support opening the reef line fishery in this area:	Supported as a priority noting that as a long-standing issue, but that good progress has been made more recently to understand the views of Torres Strait Islanders throughout the region and to develop risk-based management options. It was noted that advice needed to be made clear on allowable fishing methods.	In progress. AFMA has not progressed this item due to the limited availability of stakeholders and 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 successful opening. AFMA had to reprioritise some of our other

Priority		FFRAG 4-5 Nov 2020	FFWG 26 Nov 2020 comments	Progress to date and comments
		<ol style="list-style-type: none"> 1. Opening with data collection and monitoring 2. Survey before opening 3. Adaptive management 		<p>fisheries work during the first half of 2021.</p> <p>A proposed plan for reviewing the closure will be tabled at the FFRAG meeting on 14-15 October 2021.</p>
3	Update the daily fishing logbook (TSF01) in line with recommendations from the FFRAG.	The RAG supported the logbook changes recommended by AFMA to various aspects of the TSF01 logbook to IMPROVE Sunset sector catch and effort data and support spatial reporting by the TIB sector.	The WG noted the importance of “data priorities for the fishery and information needed to support the development of a more accurate stock assessment that could be relied upon to adjust the TAC and therefore have greater confidence around the future harvest levels.” These priorities which were noted included “ <i>improvements to the accuracy of logbook reporting (effort, species ‘split’).</i> ”	Ongoing. AFMA has not progressed the recommended changes due to resourcing and will be looking to action them in 2022.
4	Supporting the PZJA’s consideration of quota unit allocation options	N/A	The Working Group noted the PZJA decision and rationale. That being to consider quota unit allocation options for the Finfish Fishery alongside the review it must undertake for the Traditional Inhabitant quota unit allocation in Tropical Rock Lobster Fishery. The AFMA member advised that having clearly defined catch entitlements (i.e. quota units) will be important to support the transfer of the sunset leasing arrangements from TSRA to nongovernment entity/ies. Members noted that the PZJA has not yet allocated quota in the Finfish Fishery despite there being a plan of management in place to do so. The AFMA member advised that, following Australian Government buyout of licences held by non-traditional inhabitants in 2008 and therefore potential effort, the PZJA agreed that it was no longer a priority to introduce quota management. Some Traditional Inhabitant members raised strong concerns that a quota allocation process could start to divide their people and cause in-fighting. In their view it should be a matter for the new Zenadth Kes Fishing	Ongoing.

Priority		FFRAG 4-5 Nov 2020	FFWG 26 Nov 2020 comments	Progress to date and comments
			Company (the entity) to consider whether to pursue such an option. The Working Group noted the sensitivities around allocation and whilst there was support to involve the new entity as a means of involving stakeholders, members noted AFMA member advice that the nature and extent of any involvement would be subject to the role of the entity. Details on this are to be released by TSRA once the entity is established	
5	Formalising total allowable catches for the Finfish fishery	N/A	Supported as a priority noting the Working Group's previous consideration and support for ensuring the TAC is binding on all sectors. The Working Group noted that, in the absence of having quota management under the management plan, current arrangements do not limit catches by the Traditional Inhabitant sector. Having an enforceable TAC was noted as a necessary part of carefully managing catches in the fishery.	Ongoing. AFMA to progress the review of an enforceable TAC
7	Potential application of VMS on tenders	FFRAG provided advice on the potential scientific benefits from using VMS data to address data needs in the fishery at meeting 6 (27-28 November 2019). AFMA will continue to prepare information, including implementation costs across all licence holders to support further consideration of this initiative.	The Working Group did not consider this a high priority at this time, however, supported further information being tabled on the pros and cons on having VMS on tenders (boats that work in conjunction with a primary boat). Some Traditional Inhabitant members did not support having VMS on TIB boats but supported the measure applying to the sunset sector noting concerns with sunset boats breaching the 10nm closures around eastern communities. The AFMA member noted that the FFRAG had previously considered the use of VMS as an option for addressing the spatial data needs. The AFMA member further advised that whilst VMS is generally considered to be a cost-effective compliance tool, there was still much analysis to be done by AFMA on matters such as implementation costs across all licence holders to support further consideration of this initiative. AFMA maintains this as a lower priority, subject to resourcing.	Ongoing

Table 2. Key dates for the Finfish Fishery for 2021 and 2022.

Key date	Activity
18 November 2021	FFRAG10 RBC meeting <ul style="list-style-type: none"> Review updated Spanish mackerel stock assessment. Spanish mackerel - Recommended Biological Catch for 2022-23 Season. Coral trout - Recommended Biological Catch for 2022-23 Season. Review shark management best practice (WTO condition). Progress harvest strategy. Priorities for the RAG
23 November 2021	Annual WTO report due to the Department of Agriculture, Water and the Environment
24 November 2021	Finfish Working Group meeting <ul style="list-style-type: none"> Spanish Mackerel Total Allowable Catch Advice for the 2022-23 Season Coral Trout Total Allowable Catch Advice for the 2022-23 Season Review Spanish mackerel & grey mackerel size limits Review shark management best practice (WTO condition) Progress harvest strategy Policy Guidance for Carrier Licences Torres Strait Finfish Fishery management priorities
January 2022 (date TBA)	PZJA Meeting to decide next season's total allowable catches
February – March 2022	Industry consultation round – AFMA will aim to visit all Communities in the Torres Strait region and the Northern Peninsula Area.
1 July 2022	Torres Strait Finfish Fishery 2022-23 Season opens
September 2022 (date TBA)	RAG/WG advice on annual and five-year research priorities.
DATE TBC	FFRAG 11 Data Meeting <ul style="list-style-type: none"> Review data for Spanish mackerel stock assessment. Progress harvest strategy Priorities for the RAG
October 2022 (date TBC)	FFRAG 12 RBC Meeting <ul style="list-style-type: none"> Review updated Spanish mackerel stock assessment. Spanish mackerel - Recommended Biological Catch for 2023-24 Season. Coral trout - Recommended Biological Catch for 2023-24 Season. Progress harvest strategy Priorities for the RAG

November 2022 (date TBC)	<p>FFWG Meeting</p> <ul style="list-style-type: none">• Spanish Mackerel Total Allowable Catch Advice for the 2023-24 Season• Coral Trout Total Allowable Catch Advice for the 2023-24 Season• Progress harvest strategy• Torres Strait Finfish Fishery management priorities
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TORRES STRAIT FINFISH FISHERY RESOURCE ASSESSMENT GROUP	Meeting 9 14 - 15 October 2021
OTHER BUSINESS	Agenda Item 7 For DISCUSSION

RECOMMENDATION

1. That RAG members **NOMINATE** and **DISCUSS** any additional items of business for the meeting.