Australian Government
Australian Fisheries Management Authority

Meeting of the Tropical Tuna Resource Assessment Group (TTRAG)

TTRAG 39

03 OCTOBER 2023

TROPICAL TUNA RESOURCE ASSESSMENT GROUP (TTRAG)

Chair: Dr Ian Knuckey
Date: 03 October 2023
Meeting: 39
Venue: video conference
Attendance:
All members attended the meeting virtually, except those identified by the interim appointed Chair, Dr Ian Knuckey.

Members	**Invited Participants**	**Observers**
Dr James Larcombe, Science Member	Mr Terry Romaro[1], Industry	Ms Laura Tremblay - Boyer, CSIRO
Dr Ashley Williams, Science Member	Mr Robert Wood, AFMA	Mr Phil Ravanello, Industry
Mr Pavo Walker, Industry Member		Ms Angela Cao, ABARES
Mr Gary Heilmann, Industry Member		
Dr Julian Pepperell, Science/Recreational Fisheries Member		
Mr Robert Curtotti, Economic Member		
Ms Kate Martin, AFMA Member		

Apologies:
Mr David Ellis, industry invited participant
Dr Rich Hillary, Science Member
Ms Selina Stoute, AFMA
Ms Cathy Dichmont, Chair
Mr Lachlan Farquhar, Executive Officer, AFMA

[1] Joined the meeting 1:58pm

Agenda item 1 - Preliminaries

1.1 Welcome and Apologies

The thirty ninth meeting of the Tropical Tuna Resource Assessment Group (TTRAG 39) was opened at 09:00am on 03 October 2023 by the interim appointed Chair, Dr Ian Knuckey. The Chair welcomed members and observers to the meeting and:

a) made an Acknowledgement of Country;

b) noted the following apologies for the meeting from Mr David Ellis, a regular industry invited participant, Dr Rich Hillary, Science Member, Ms Selina Stoute, AFMA and Ms Cathy Dichmont, Chair and Mr Lachlan Farquhar AFMA executive officer, who will no longer be undertaking executive officer duties, due to being successful in another position and that Mr Robert Wood, AFMA is the interim Executive Officer; and

c) advised members the meeting would be recorded to assist with the preparation of the meeting record. The recording will be deleted once the record is finalised.

1.2 Declarations of interest

The standing declaration of interests was reviewed by RAG members and RAG members provided updates as necessary following last TTRAG meeting (meeting 38). The updated declarations of interest are at **Attachment 1.2**.

The RAG agreed that industry members and the industry invited participants held potential conflicts of interest with *Agenda Items 4 –ETBF Broadbill Swordfish (RBCC), Agenda item 5, Striped Marlin constant catch – indicators, Agenda Item 6 - TAC advice for ETBF indicator species; Agenda item 7 – TAC advice for WTBF indicator species.* The RAG also agreed that the scientists who partook in the research Items under *Agenda Item 9 - TTRAG Priorities and Meeting Schedule,* also held potential conflicts of interest.

These members were asked to leave the room while the RAG considered the nature of the conflict and appropriate action to be taken when the agenda item is discussed. The remaining RAG members agreed that we needed the expertise of the industry members in discussions of these agenda item but they would be excluded from the meeting when the TAC recommendations on the abovementioned items were being made, and notified of the recommendation when they had returned to the meeting.

1.3 Adoption of agenda

The RAG adopted the agenda with no amendments (**Attachment 1.3)**. Throughout the meeting the order of agenda items was revisited to ensure presenters had sufficient time for breaks and to meet the availability of invited presenters.

1.4 Actions arising from previous meetings

The RAG noted the status of actions items. AFMA sought guidance from the RAG whether Table 2: Recommended project priorities '*Scientific advice for management of Tropical Tuna and Billfish Fisheries'* and should be removed from actions arising and be managed within the project itself. TTRAG recommended to remove Table 2 project priorities '*Scientific advice for management of Tropical Tuna and Billfish Fisheries*' from actions arising and agreed for the priorities to be managed within the project itself. The status of actions arising together with RAG advice on the ongoing relevance of certain items, can be found at **Attachment 1.4.**

1.5 Out of session correspondence

The RAG noted the out of session correspondence between TTRAG 38 and TTRAG39 as detailed in the table below.

Date	Description
28/07/2023	Four items distributed to the RAG: 1. Annual Research Priorities – TTRAG members were asked to prioritise the 2024/25 research items out of session. 2. Five-year strategic fishery research plan – Following recommendations from TTRAG 38, July 2023 to include Indigenous interests with the sub-heading social aspects. TTRAG members were asked to review and provide comment on the amended version of fio59ive-year fishery research plan. 3. Scoping document – Close kin mark recapture – stock structure broadbill swordfish. 4. Sub draft minutes – Agenda item 8 – Annual Research Priorities.
10/08/2023	Update to RAG member on the annual research prioritisation and to close out comments or questions received by RAG members during the comment period.
14/08/2023	Time zone inconsistencies between data sets action item TTRAG 35 (July 2022); AFMA and CSIRO to investigate the differences and potential inconsistencies in set times, including auto-time adjustments from what is being recorded in electronic logs entries and the AFMA database. *The time data supplied from the FLOG database is stored as EST time but marked as Zulu (Z) in the descriptor table. When ADC (elogs) was first introduced in 2020 the time zone been collected and stored was UTC (Zulu), it is still collected in UTC but in February 2022 a change was made in that we changed it to store as local time in FLOG as it had in the past. The descriptor on the Time Zone wasn't changed from being marked as Zulu (Z) back to Local/EST.* *This is only affecting times stored within the FLOG datasets, the warehouse is not affected by this issue which means internally ran reports, data supplied for a direct request is not affected as the vast majority of the reports run are using warehouse data. The data affected is in the backups of all databases supplied to CSIRO and ABARES, who have been made aware of the issue.*
15/08/2023	Review and comment ETBF Climate and Ecosystems Status Report Following recommendations made at TTRAG 38, July meeting, CSIRO have updated the draft Climate and Ecosystem Status Report for the ETBF. Accordingly, TTRAG was asked to review, and ensure the report includes relevant information to consider as part of the RAG advice for the 2024 TACC setting. The draft report will be presented at TTRAG 39.
06/09/2023	AFMA Research Committee call for research proposals for potential AFMA funding in 2024-25. AFMA is seeking submission of full proposals by Wednesday, 25 October 2023 to research.secretary@afma.gov.au.
14/09/2023	Finalised TTRAG 38 Meeting Record. Members were provided a summary of record amendments made following submitted recommendations. AFMA subsequently published final record on AFMA's website.

Agenda item 2 Member updates

2.1 Industry, recreational fishing and scientific member update

The RAG noted the following update from the recreational fishing member:

- The recreational fishing season off the East Coast, saw sightings of yellowfin tuna and good-sized southern bluefin tuna, particularly off the coast of Sydney and down the South Coast. The presence of these fish was encouraging, as they had been relatively scarce in recent years. There were also reports of striped marlin catches off Port Macquarie, including some small blue marlin, which had made a return to the fishery.
- There has been an absence of juvenile black marlin off the coast of Townsville and Cairns area, often an important indicator of the fishery's strength. However, it was noted the absence juvenile black marlin was not entirely unusual, as historical data indicated similar occurrences.
- A Mako shark tournament off Sydney had noted the catch of blue sharks and tiger sharks, which had not been commercially seen in large numbers lately.
- At the start of the heavy tackle season on the northern Great Barrier Reef in mid-September, it was mentioned that charter boats were fully booked and reporting promising fishing.
- Concerns have been raised in the recreational fishing community regarding the potential impact of wind farms off Port Stephens, which could affect fishing grounds and fish behaviour, potentially leading to exclusions of recreational and commercial fishing in the future.

The RAG noted the following updates from the industry members:

- There has been a strong southern bluefin tuna season this year with over a thousand tonnes caught on the east coast up as far north as Sydney, also noting a gradual inclusion of tropical tuna species mixing in, particularly juvenile yellowfin.
- There has been a shift towards targeting swordfish since COVID, leading to increased effort and industry optimism about the increase of swordfish catches. It was noted prior to the pandemic, the high cost of squid bait had made fishing financially challenging but now some boats are returning to the use of the higher quality traditional Illex squid bait and has had a positive impact on fishing operations.
- Profitability in the industry had remained a significant challenge due to soaring costs for fuel, crew, and bait. Industry emphasised the ongoing struggle to balance costs with catch rates and highlighted the lack of fish price increase despite industry inflation.
- China has reduced its demand for tuna, leading many boats to shift their focus to targeting swordfish. This shift in the fishery might be due to colder water temperatures earlier in the year. It was noted challenges with albacore pricing, as small albacore under 10 kg had a low cannery price, leading to their discarding rather than retention.
- Swordfish prices in the United States had been low due to favourable fishing conditions on the East Coast of the US and competition from South American markets, resulting in a soft market overall for swordfish.

2.2 AFMA Management and international meetings update

TTRAG noted there were no AFMA management updates following TTRAG 38 (July, 2023) and that the international meeting outcomes would be provided under *Agenda Item 3 – Review of Fishery Indicators.*

Agenda item 3 Review of Fishery Indicators –

i) ETBF Climate change and ecosystems status report:

The RAG noted the ETBF climate change and ecosystems status report by the AFMA Member and the presentation on the revised climate driver's document. The RAG recalled that AFMA is developing a framework to support the integration of available information on climate impacts and risk into TAC advice. The framework is currently under development, and in the meantime, the AFMA Commission expects that climate impacts and vulnerability be considered by RAGs and MACs in developing recommendations and advice.

The ETBF climate change status report provided the RAG with supplementary guidance when considering TACs for the ETBF in 2024. The RAG noted that the following climate impact predictions relevant to the ETBF for 2024:

- That it is anticipated that ETBF tuna fishing will experience normal shifts in distribution and abundance with the El Niño-Southern Oscillation (ENSO) cycle (i.e. La Niña and El Niño).
- El Niño is typically associated with higher catches in some of key target species.
- Further warming to sea surface temperatures in central and Eastern Pacific likely and sea surface temperatures above average off Victoria and Tasmania, and Queensland to a lesser extent, during August.

The Report at Climate and Ecosystem Status Report for the Eastern Tuna and Billfish Fishery June 2023 **(Attachment 3.1)** and presentation at **(Attachment 3.1a).**

ii) ETBF Economic indicators:

The RAG noted the presentation by the Economics member, Mr Robert Curtotti on the most recent data pertaining to the economic conditions of the fishery. The latest indicators include Gross Value of Production (GVP), Gross Domestic Product (GDP), Net Economic Returns (NER), catch composition, fuel and bait prices, exchange rates and overall fishery Economic Condition Index (ECI), which includes Southern Bluefin Tuna (SBT). Mr Curtotti noted that there were no major findings in the economic outlook and that the industry's input aligned with the results and that the composition and level of catch was approximately similar in 2021-22 to 2022-23.

Mr Curtotti advised the RAG, that ABARES revised ECI approach is has been supported by new data that provides a more reliable way to estimate NER in the fishery. New NER results from ABARES survey program has continued to validate the approach. The significance of the ECI and the importance of keeping it up to date with accurate data was emphasised.

The RAG noted the following within the fishery:

- Economic conditions improved in 2020-21, largely a result of lower input costs, including fuel and bait. However, in 2021-22 and 2022-23 worsened as a result of rising fuel costs and lower than average Catch Per Unit Effort (CPUE) index deviation.
- Exchange rates have had close to a neutral effect on ECI in 2021-22 and 2022-23.

- It was highlighted that the availability of SBT to ETBF fishers has improved the economic conditions in the fishery.

Additionally, insights into the economic performance of specific species within the fishery:

- Yellowfin Tuna: ECI for yellowfin tuna have tended to be above average over recent years including for 2022-23. This was attributed to CPUE index deviation improvements, GVP improvements and particularly reduction on real fish price deviation.
- Bigeye Tuna: ECI for bigeye tuna has been below average for the most recent six years with a distinct downward trend sine 2020-21. This could be particularly due to an increase in CPUE index deviation.
- Swordfish: ECI for swordfish for 2022-23 is below average, following a period of around average levels since 2018-19, this is primarily due to variations in CPUE index deviation. However, there were some positive signs in the current season that could potentially boost economic conditions in the future.
- Albacore: ECI fell below the average in 2022-23 following a period of above average performance over the previous several years.
- Striped Marlin: ECI for striped marlin has been below average since 2018-19 and remain so in 2022-23. While not a primary target species, it still played a role in the overall economic performance of the fishery.
- Southern Bluefin Tuna (SBT): SBT have a significant impact on economic conditions. When including SBT in the calculations, economic conditions improved, primarily due to increased GVP and catch attributed to SBT. The presence of SBT had a positive influence on the fishery's overall economic performance.

Summary:

- Overall, the results from the report depicted similar economic operating conditions to the previous year with below average ECI reported for 2022-23. The key factors are rising fuel and bait costs and stagnant fish prices, continuing to present challenges for the industry. This notion was further reinforced by industry stressing the fishery was facing economic challenges. These challenges have primarily stemmed from the relentless increase in fuel and crewing expenses, with no substantial corresponding rise in fish prices. Notably, these are broader than ETBF and have been identified as a national concern affecting fisheries beyond this region.
- The economic member thanked the ETBF industry for their participation in the economic surveys and concluded by emphasising the importance of their participation in these surveys to validate and quantify the fishery's economic performance.

iii) ETBF indictors & southwest Pacific annual catch data summaries:

The RAG noted the presentation by Ms Laura Tremblay-Boyer on a high-level summary regarding stock status indicators using ETBF data for each of the species with standardised CPUE abundance indices presented from the most recent analysis in July 2023. Additionally, a presentation from Dr Ashley Williams, on the proportion of catch taken by the ETBF relative to total catch within key regions of the southwest Pacific Ocean and annual catch statistics showing catch by fishing nation. Additionally, the stock assessment results of the WCPFC 2023 stock assessments for yellowfin tuna and bigeye tuna.

The RAG noted:

- The layout of regions that fed into the WCPFC stock assessments. The regions of interest included Region 1 for broadbill swordfish and striped marlin, Region 5 for Albacore, big eye, and yellowfin

tuna, and the Australian New Zealand (ANZ) region for the five target species. These regions were defined based on the structure of stock assessment for the species of interest.

- Catch contributions were calculated by requesting catches by species for these regions from the SPC to obtain the most detailed data. To calculate ETBF contributions, they considered the percentage of Australia's longline commercial catch to the total catch in the region for each species.
- For each target species, the proportion of longline catch and all gear catch taken by the ETBF longline fleet was calculated for Region 1, Region 5 and the ANZ region. The following statistics were taken for Australia's catch proportions (all gears) of WCPFC catch in 2022 for the stock assessment areas and can be found at **(Attachment 3.3)**.
- A summary of status indicators for ETBF target species including catch trends, size trends, and CPUE trends for five key species **(Attachment 3.3a).**
- An industry member highlighted that during the 2023/24 season, the albacore market remained suppressed and over supplied, resulting in low prices for the catch. Consequently, operators resorted to discarding the catch rather than retaining it, along with albacore targeting avoidance. The RAG noted this may have implications for the nominal CPUE going forward.
- The Chair relayed comments received by industry member Mr David Ellis who was unable to attend regarding the need to review regarding reviewing how the TACC for yellowfin tuna maybe adjusted during times of high availability in the ETBF. It was noted that these comments related to future options and not TTRAG's TAC recommendation for the 2024 fishing season. There is a need for the RAG to consider greater flexibility and the potential change in the TACC approaches for YFT. The RAG noted that this was discussed at TTRAG 38 (July, 2023) and AFMA and the project team will explore options to recognise a YFT pulse event and possible Harvest Control Rule (HCR) that could apply in response as part of the project '*Scientific advice for management of Tropical Tuna and Billfish Fisheries'*.

iv) Results of the WCPFC 2023 stock assessment for yellowfin tuna and bigeye tuna stock assessment

Ms Laura Tremblay-Boyer provided a verbal update on the 19th regular session of the Scientific Committee (SC) of the Western and Central Pacific Fisheries Commission (WCPFC), August 2023. SC19 presented the results of the 2023 yellowfin tuna and bigeye stock assessments.

The RAG noted that

- the science service provider had made improvements to the yellowfin tuna and bigeye tuna assessments based on the recommendations from the 2022 peer review assessments. The improvements included estimating growth rather than fixing growth and estimating natural mortality by age.
- Yellowfin tuna assessment reduced the spatial complexity from 9 regions to 5 regions to reduce the uncertainty and complexity in the model. Bigeye tuna retained the same 9 region structure as part of the assessment.

<u>Summary</u>

- The yellowfin stock remains as not overfished nor subject to overfishing. The median depletion using additional data from 2018 - 2021 was 0.47 and F_{MSY} median is 0.50. The median depletion levels in the 2018 assessment were 0.58.
- The bigeye stock remains as not overfished nor subject to overfishing. The median depletion using data up to 2018 - 2021 was 0.35 F_{MSY} median is 0.59. The median depletion levels in the 2018 assessment were 0.41.
- Both stock assessments were accepted by the scientific committee.

Agenda item 4 ETBF Broadbill Swordfish RBCC – Modified Harvest Strategy

Ms Laura Tremblay-Boyer provided an overview of the swordfish harvest strategy presented the results of the application of the modified swordfish harvest strategy **(Attachment 4)**.

Swordfish Harvest Strategy overview

- The AFMA Commission adopted the Harvest Strategy (HS) in 2020, for broadbill swordfish following a MSE under the direction of the Tropical Tuna Resource Assessment Group (TTRAG) and the Tropical Tuna Management Advisory Committee (TTMAC) (Hillary, 2020). The HS generates a Recommended Biological Commercial Catch RBCC from a scalar applied to recent TAC based on the ratio between recent (4 years average) CPUE compared to target period (2015-2015). The RBCC changes are not allowed to exceed more than 10% either direction (up or down).

Modified Swordfish Harvest Strategy

In 2022, a modification to the broadbill swordfish HS was developed to account for unprecedented low levels of catch well below the Total Allowable Catch (TAC) over recent years due to the COVID pandemic (Hillary, 2022). It was and approved by the TTRAG, TTMAC and AFMA Commission.

If the harvest strategy suggests a decrease to the TAC during the extreme under-catch period (tested to end in 2024) are as follows:

- If current catches are further below the Recommended Biological Commercial Catch (RBCC) than the RBCC is below the current TAC, no change is recommended;
- If current catches are not further below the RBCC than the RBCC is below the TAC, the residual difference is discounted from the TAC reduction; and
- If the RBCC is below current catches, then the full TAC decrease is applied. - If the harvest strategy suggests an increase in the TAC during the extreme under-catch period, no alterations are made, and a TAC increase is applied.

Summary

The modified ETBF harvest strategy for Swordfish, modified in 2022, was used to recommend the RBCC setting of the 2024 TACC **(Attachment 4).** No further exceptional circumstances were identified by TTRAG 39.

Agenda item 5 Striped marlin constant catch – indicators

The RAG was provided with an overview from AFMA member on the process for the TACC for striped marlin with requirement to review annual agreed indicators. The striped marlin constant catch harvest strategy was assessed through MSE (Management Strategy Evaluation for Striped Marlin) and adopted by the RAG in July 2021.

The RAG considered the following agreed annual indicators:

i. The most recent WCPFC stock assessment of south western Pacific striped marlin,
ii. Any changes in targeting practice
iii. Any increased take of TACC on a regular basis
iv. Industry desire to increase catch

The RAG noted the following:

i. TTRAG considered the most recent WCPFC stock assessment of south western Pacific striped marlin, which was last assessed in 2019, and noted there has not been a new stock assessment.
ii. Industry members noted there have been no changes in targeting practices. The 2022 catch of striped marlin (283 t) is above both the five-year and ten-year average catch in the ETBF of 239 t and 257 t respectively. Catches of striped marlin in the ETBF have been declining gradually over time since a peak of 730 t in 2001 and increased sharply in 2022. The increase of catches for striped marlin have mirrored changes in overall catches in the ETBF. The RAG noted that striped marlin catches could increase, if yellowfin tuna catches increase.
iii. Presently there is no change in industry's desire to increase catch.

TTRAG members did not consider there to be conditions that would trigger a review of the constant catch HS and TACC recommendation derived from the annual indicators. Non-conflicted TTRAG recommended a TACC of 351t for the 2024 fishing season.

Agenda item 6 TAC advice for ETBF indicators species – yellowfin, bigeye tuna and albacore

TTRAG discussed available information on ETBF Species: yellowfin tuna, bigeye tuna, south pacific albacore, striped marlin, broadbill swordfish. They considered the most recent ETBF fisheries data summaries, HS outputs, indicators, to provide final TACC recommendations to the MAC and AFMA Commission for each species. TTRAG's 2024 TACC recommendations are provided at **Attachment 6.**

Agenda item 7 TAC advice for WTBF target species – yellowfin tuna, bigeye tuna, striped marlin and swordfish

TTRAG discussed available information on WTBF Species: yellowfin tuna, bigeye tuna, south pacific albacore, striped marlin, broadbill swordfish. They considered the most recent WTBF fisheries data summaries, HS outputs, indicators, to provide final TACC recommendations to the MAC and AFMA Commission for each species. TTRAG's 2024 TACC recommendations are provided at **Attachment 7.**

Agenda item 8 TTRAG priorities and meeting schedule

The RAG discussed, and provided advice on, key RAG priorities for the short to medium term. The RAG supported the draft list of priorities tabled by AFMA and provided additional guidance as necessary for some items **(Table 1)**. To ensure ongoing review of priorities the RAG agreed for TTRAG priorities to be a standing agenda item for the March RAG meeting.

Table 1

Date	meeting	Priorities
March 2024	TTRAG 40	Review current and future data needs: EM/Logbook congruence study recommendations, reviews (CPUE standardisation), risk assessments (ERA) and future harvest strategies, the data needs in additional fields for e-log i.e. whale depredation, seabird mitigation requirements, WCPFC recommended fields, economic survey missing fields and programs for collecting that data should be reviewed.
		Present results from Modified Harvest Strategy beyond 2025 to include an additional two years.

		Review of CPUE standardisation analysis and prioritisation work as part of future data priorities
		Swordfish harvest strategy and indicator review (advised by RAG and Project team)
		Review and consider draft ERA results for ETBF and WTBF
		Presentation from the recreational fishing sector TTMAC members on the objectives and operational environment regarding recreational fishing sectors for striped marlin.
		Presentation from the University of sunshine coast – FRDC project – honours student depredation toothed whale interactions.
		WCPFC management procedure framework – south pacific albacore
		IOTC Commission updates: Technical Committee on Allocation – 16 October 2023 Working Party on Tropical Tunas Meeting – 30 October 2023 Session of the scientific committee – 4 December 2023 IOTC Commission Meeting
		Presentation on the Bigeye management procedure IOTC
		WCPFC Commission meeting – December 2023
July 2024	TTRAG 41	Consider and provide advice following the scientific analysis of Coral Sea Zone Hook Trial
		Review indicators tunas or 'breakout rules' (yellowfin tuna, bigeye tuna and albacore). Catch, weight and size class.
		Review priority analysis undertaken by the project team for the swordfish harvest strategy review: - MSE testing general scenarios - Include updated information on migration rates - Accounting for cyclical trends in abundance - Explore HCR options that might best account for cyclical trends in abundance that is becoming more apparent from the data. - Accounting for undercatch - Explore options for account for undercatches of the TAC - 10% change limit rule - Explore options to ensure equivalency in rate of overall change in TAC reductions and increases. - Climate change adaptation - Project team to meet with Beth Fulton (CSIRO) to understand drivers for predicted changes in abundance and develop potential robustness tests for MSE (growth, migration, productivity, recruitment) - Review target reference years - Based on latest stock assessment results determine catch rate proxy for the previously agreed MEY proxy for the fishery (assumed to be B_{48})

		- Constant TAC over multiple seasons - Explore possible constant catch TAC scenarios up to three years.
		Priority analysis in reviewing the process for recommending TACC for the five target species ETBF. – Explore options to move to 3 yearly consideration or multiyear TAC of all indicators (includes CPUE standardisation for all species) In support of a potential 3-yearly approach, explore possible 'breakout rules' and suite of annual fishery statistics to be considered by the RAG. The annual review will ensure any data issues are resolve in a timely manner and RAG's understand of fishery trends remains current. – AFMA and Project team to explore options to recognise a YFT pulse event and possible HCR that could apply in response. Noting mostly likely indicator will be cumulative catch within season.
		Seabird interaction review
		Pending annual research statement outcomes – to review results of the scoping analysis close-kin mark recapture stock structure - swordfish
Proposed intersessional meetings		AFMA coordinate a small working group out of session to determine to scope improving our understanding of eddie oceanography through temperature depth recorders to assist in further defining fishing strategies.
		AFMA and Tuna Australia to convene a climate adaptation stakeholder workshop
		Electronic Monitoring workshop – identifying enhancement to electronic monitoring and 'e' related data needs.
		Pulse Event TTRAG 37 (March meeting) noted that the need for specific RAG advice will be informed by ongoing discussions between AFMA and industry to identify possible management options to better maximise returns from pulse abundance events. Once preferred options have been identified the RAG can then advice on the likely ecological impacts.
		Swordfish harvest strategy and indicator review (TBA by RAG and Project team)

Agenda Item 9 Other Business

There was no other Business identified for the meeting.

Agenda Item 10 Next Meeting

The RAG was invited to agree on a date for the next meeting. The RAG agreed for to arrange future meeting dates out of session.

Attachment 1.2

Table 2. TTRAG member, invited participants and observer's declarations of interests.

Position	Membership	Declared Interests
Dr Ian Knuckey	Interim appointed Chair.	Has a consulting company with interests in electronic reporting in the tuna fisheries, and is a member on several other AFMA Committees. Is working on a recreational and indigenous capacity building project with DAWE.
Ms Kate Martin	AFMA Member	Employee of AFMA, which includes a salary. Is the Manager of the tropical tuna fisheries. No pecuniary interest in tropical tuna fisheries.
Mr Robert Wood	Interim Executive Officer	Employee of AFMA, which includes a salary. Is the Fisheries Management Officer of the tropical tuna fisheries. No pecuniary interest in tropical tuna fisheries.
Ms Laura Tremblay Boyer	Scientific Invited Participant	Employee of CSIRO, no pecuniary interest in Australian tropical tuna fisheries. Is the PI for the Management Strategy Evaluation (MSE) project for the tropical tuna and billfish species.
Dr Julian Pepperell	Scientific Member	Independent fisheries research consultant and representative of the recreational fishing sector. Is involved in projects including monitoring and research on pelagic fish landed at game fishing tournaments, analysis of gamefish tagging data and assessing current data and alternate data collection methods relating to recreational catches of tropical tuna and billfishes.
Dr James Larcombe	Scientific Member	Employee of ABARES, involved in fisheries research, primarily through engagement with the Western Central Pacific Fisheries Commission. Has no pecuniary interest in the Australian Tropical Tuna Fisheries.
Dr Ashley Williams	Scientific Member	Employee of CSIRO, no pecuniary interest in Australian tropical tuna fisheries. Is the PI for the project - *Scientific advice for management of Tropical Tuna and Billfish Fisheries*
Mr Phil Ravanello	Observer	Program Manager of industry association Tuna Australia which includes a salary paid by industry. Attending to provide industry update on behalf of David Ellis, Tuna Australia. Steering committee on the following projects: - FRDC Project 2020-041. Improving the effectiveness, efficiency and safety of mitigation tools for protected species interactions in the Eastern Tuna and Billfish Fishery - FRDC Project 2021-078. Improving the management of wildlife interactions in pelagic longline fisheries - FRDC Project 2021-063. Future Proofing: Integrating community quota, product supply, product innovation and market diversification in Australia's Tropical Tuna Industry.
Mr Pavo Walker	Industry Member	Owner of several ETBF boat SFRs and holds a Coral Sea permit and minor line permit.

Mr Gary Heilmann	Industry Member	Industry member, director of a processing company, no longer holds ETBF boat or quota SFRs.
Mr Terry Romaro	Industry Invited Participant	Director of a company that owns Eastern Tuna and Billfish Fishery (ETBF) boat statutory fishing rights (SFRs), minor line SFRs, ETBF longline SFRs, Western Tuna and Billfish Fishery (WTBF) boat SFRs, WTBF longline SFRs, Western Skipjack Tuna Fishery (WSTF) purse seine permit, Small Pelagic Fishery (SPF) purse seine, mid-water trawl SFRs, and SPF quota SFRs. Shareholder of a company that owns shares in a proposal to fish with foreign longliners in the WTBF. Industry member on Southern Bluefin Tuna (SBT) and Tropical Tuna MAC, Invited participant for TTRAG, and industry representative at the Commission for the Conservation of SBT (CCSBT) & IOTC. Invited participant for squidRAG and squid SFR holder. Director of a company who owns a fish processing facility in Port Lincoln, & a Director of Tuna Australia.
Mr Robert Curtotti	Economics Member	Employee of ABARES, involved in fisheries economic research related to the Eastern Tuna and Billfish Fishery. Has no pecuniary interest in the Australian tropical tuna fisheries.
Ms Angela Cao	Economic Member (observer)	Employee of ABARES, involved in fisheries economic research related to the Eastern Tuna and Billfish Fishery. Has no pecuniary interest in the Australian tropical tuna fisheries

Attachment 1.3

Tropical Tuna Resource Assessment Group

Meeting 39 03 October 2023

Videoconference

Tuesday 03 October

Tuesday 0900 – 1700 hrs (AEST)

1. Preliminaries

1.1 Welcome and apologies

1.2 Declaration of interests

1.3 Adoption of agenda

1.4 Actions arising from previous meetings *(suggest by exception only)*

1.5 Out of session correspondence *(suggest being taken as read)*

2. Updates *(suggest by exception only)*

2.1 Industry, recreational fishing and scientific member update

2.2 AFMA Management update

3. Review of Fishery Indicators

TTRAG will be invited to review the latest data and indicators for each target species and will be provided results of the WCPFC 2023 stock assessments for yellowfin tuna and bigeye tuna. These inputs will be used to provide TAC advice for the ETBF and WTBF for the 2024 season.

3.1 ETBF Climate change status report (AFMA)

3.2 ETBF Economic indicators – (ABARES)

3.3 Southwest Pacific Data – A summary of the spatial and temporal trends in total annual catch (CSIRO)

3.4 ETBF indicators summaries – (CSIRO)

3.5 Results of the WCPFC 2023 stock assessment for yellowfin tuna and bigeye tuna stock assessment (CSIRO/ABARES)

4. ETBF Broadbill Swordfish RBCC - Modified Harvest Strategy (CSIRO)

TTRAG will be invited to provide TAC advice for swordfish for the 2024 season derived through the application of the modified swordfish harvest strategy.

5. Striped Marlin constant catch - indicators (AFMA)

TTRAG will be invited to review the most recent indicators and provide TAC advice for striped marlin for the 2024 season.

6. TAC advice for ETBF indicator species – yellowfin tuna, bigeye tuna and albacore tuna.

TTRAG will be invited to provide TAC advice for ETBF indicators species for the 2024 season.

7. TAC advice for WTBF target species – yellowfin tuna, bigeye tuna, striped marlin and swordfish

TTRAG will be invited to review the latest data and indicators for each target species and will be provided an update on the IOTC stock assessment for bigeye tuna. Having regard for these inputs, TTRAG will be invited to provide TAC advice for WTBF quota species for the 2024 season.

9. TTRAG Priorities and Meeting Schedule

The RAG will be asked to provide advice on key RAG priorities for the short to medium term. Having agreed priorities and a corresponding work plan aims to achieve a more efficient RAG process.

10. Other Business

Members will be invited to raise any other business agreed by the Chair. Note there is no meeting paper for this item.

11. Next Meeting

The RAG will be invited to agree on date and venue for the next meeting. Note there is no meeting paper.

Australian Government
Australian Fisheries Management Authority

Attachment 1.4

Table 3. Actions Items as at TTRAG 39

Number	Action	Meeting Raised	Responsibility	Status at TTRAG 39
1.	ABARES to pursue options to take account of Southern Bluefin Tuna in the catch figures and calculations of GVP and NER for the ETBF and include Southern Bluefin Tuna in future ETBF economic indicators for TTRAG considerations.	TTRAG 33	ABARES / Economics Member	**IN PROGRESS:** Economics Member Mr Robert Curtotti to provide update at TTRAG 39.
2.	AFMA to investigate, if possible, whether bait changes have been experienced by NZ and the Spanish.	TTRAG 33	AFMA	**NOT YET ACTIONED**: AFMA has assessed this as a lower priority, due competing priorities and timings. This will remain as an action item for AFMA going forward and further investigation to be undertaken.
3.	TTRAG to be provided an update in the new year on the Management Procedure for big eye tuna.	TTRAG 35	ABARES/AFMA	**NOT YET ACTIONED:** AFMA has not been able to present Management Procedure for bigeye tuna, due to competing timeframes for agenda items. AFMA is aiming to present the action item in the new year.
4.	AFMA and CSIRO to investigate the differences and potential inconsistencies in set times, including auto-time adjustments from what is being recorded in electronic logs entries and the AFMA database.	TTRAG 35	AFMA/CSIRO	**COMPLETE:** AFMA has investigated the inconsistencies in set times relating to the AFMA database. Update sent to the RAG on 14 August 2023.
5.	TTRAG to revisit the regions used in considerations of TACC for ETBF target species to ensure they are consistent with the needs of the RAG.	TTRAG 36	TTRAG	**COMPLETE:** TTRAG discussed the regions of interest map boundaries are used to summarise the proportion of catch taken by the ETBF relative to the total catch in the southwest Pacific

				Ocean. TTRAG recommended re-labelling the TTRAG's southwest Pacific region to remove any misunderstanding when discussing the region boundaries between the WCPO stock assessment and the TTRAG region boundaries. The RAG agreed to re-label and refer the southwest Pacific region as **ANZ region**.
6.	ABARES to examine congruence between logbook and CDR data in the ETBF over time to determine if there is a need to alter the calculation of CPUE to ensure a consistent factor for GVP calculations.	TTRAG 36	ABARES / Economics Member	**IN PROGRESS:** Economics Member Robert Curtotti to provide update at TTRAG 39.
7.	CSIRO to provide a graph detailing the approximate catch rate of Broadbill Swordfish in relation to mean hook density per kilometre of mainline in the ETBF.	TTRAG 37	CSIRO	**COMPLETE:** Graph presented by CSIRO under Agenda Item 4.3 at TTRAG38.
8.	CSIRO to make TTRAG's recommended amendments to the climate and Ecosystems status report for ETBF and AFMA to provide the update status report out -of – session for comment.	TTRAG 38	CSIRO	**COMPLETE:** CSIRO provided an updated report to AFMA in August 2023. Member comments were incorporated. The status report will be used as a tool to support the RAG's consideration of climate impacts when providing future TAC advice.
9.	AFMA to outsource analysis of the Coral Sea hook trial data and present findings to the TTRAG mid-2024	TTRAG 38	AFMA	**IN PROGRESS:** AFMA has received an initial project scope from CSIRO to undertake the Coral Sea trial analysis. AFMA to yet to provide comments to CSIRO on the scoping document.
10.	AFMA to explore whether reporting mixed bait species proportions is included in e-logs and to advise TTRAG.	TTRAG 38	AFMA	**COMPLETE:** AFMA confirmed this is not currently an option available to fishers, however the licencing team at AFMA can initiate the change to the e-logs to make this option available. TTRAG to discuss in March TTRAG to determine future data needs.
11.	AFMA to coordinate a small working group out of session to determine to scope improving our understanding of eddie	TTRAG 38	AFMA	**IN PROGRESS:** Was assessed as part of the 2024/25 annual research cycle. However, AFMA was unable to coordinate a small working group prior to AFMA research committee meeting

	oceanography through temperature depth recorders to assist in further defining fishing strategies and whether temperature and depth recorders projects can concurrently run or remain separate.			timings. This will remain a priority for the RAG as part of 2025/26 annual research cycle.
12.	AFMA coordinate a small working group out of session to determine to scope the stock structure analysis and determine if it can align or complement the WCPFC project swordfish abundance project.	TTRAG 38	AFMA	**COMPLETE:** CSIRO provided a research scoping for close-kin mark recapture design study to detect broadbill swordfish stock structure to assess the scoping, feasibility and logistics of different sampling needs based on consultation with TTRAG and fishing industry and determine sampling program i.e. Provide scientific advice and support to AFMA and TTRAG on CKMR simulation model to assess sampling needs (number of individuals per year, number of years, location of samples) to detect stock structure for broadbill swordfish in the southern Western Central Pacific Ocean. TTRAG agreed to out of session (August 9th, 2023) that this project be prioritised as the annual research funding cycle 2024/25 and be presented to the AFMA Research Committee.

Table 4. Action Items relating to CPUE as of TTRAG 39

Number	Item	Meeting Raised	Responsibility	TTRAG comments
1.	The RAG recommended using revised data each year and accepting minor changes for the catch summary tables. Any change greater than 1% will be flagged and brought to the attention of the RAG for discussion and advice.	TTRAG 38	CSIRO	**NOT YET ACTIONED**
2.	TTRAG discuss and provide advice at its meeting in March 2024, on priority need to undertake simulation testing of the CPUE standardisation. The RAG identified the following four CPUE refinement priorities: Priority refinement (1-3), further discussion needed for priority 4 simulation testing of CPUE. 1. Continue the implementation of metiers approach 2. Move from area-based approach to explicit spatial approach 3. Improve inclusion of oceanography covariates eg. Eddies 4. Simulation test of the CPUE standardisation-To be discussed in March TTRAG during research gaps.	TTRAG 38	CSIRO, TTRAG	**NOT YET ACTIONED:** TTRAG to discuss in March TTRAG to inform future data priorities.

3.	Tuna Australia and CSIRO to investigate potential erroneous logbook reporting regarding 45 hooks between floats. Tuna Australia to follow up with operator if error is identified.	TTRAG 38	CSIRO, Tuna Australia	**ONGOING:** Tuna Australia contacted all ETBF operators regarding 45 hooks per basket. However, have not received any responses to the query. AFMA identify boat is recording 45 hooks between floats into e-logs and liaise with Tuna Australia, if required.
4.	CSIRO will look to explore potential changes in fishing practices (particularly with the start of set location) associated with the introduction of Marine Parks, and determine potential implications for CPUE standardisations.	TTRAG 23	CSIRO	**ONGOING:** At TTRAG 37 (March meeting 2023), the RAG agreed to keep this as an ongoing action item, due to work being undertaken with CPUE standardisation and noted this agenda item may inform future data priorities.
5.	TTRAG to consider development of Time Temperature Depth Recorder (TDR) based research and/or data collection in the ETBF to better understand and account for (in CPUE analyses) the relationship between fishing strategies (including vessel log speed, shooter speed and dropper lengths etc) and fishing depth.	TTRAG 23	CSIRO, Ian Knuckey, AFMA	**ONGOING:** At TTRAG 37 (March meeting 2023), the RAG agreed to keep this as an ongoing action item, due to work being undertaken with CPUE standardisation and noted this agenda item may inform future data priorities.
6.	AFMA to examine VMS data to check and verify sets reported on logbooks as having mainline lengths greater than 100km.	TTRAG 24	CSIRO, AFMA	**ONGOING:** At TTRAG 37 (March meeting 2023), CSIRO presented distributions of variables used in the CPUE standardisation to identify appropriate thresholds for outliers/erroneous entries.
7.	TTRAG 29 discussed how e-logs may allow better collection of gear information through the ability to prepopulate fields that do not regularly change, and the need for the fleet to form good reporting habits at the start of the elog transition relating to additional potential fields, specifically, those required by WCPFC logbooks and ROP, fields relevant to collecting data on depredation, and shape of mainline set.	TTRAG 29	CSIRO, AFMA	**ONGOING:** At TTRAG 37 (March meeting 2023), the RAG agreed to keep this as an ongoing action item, due to work being undertaken with CPUE standardisation and noted this agenda item may inform future data priorities.

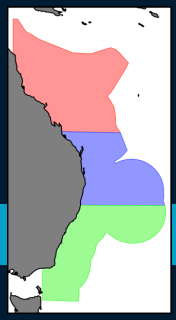
8.	AFMA to work with Tuna Australia to develop operationally feasible options to capture discard sizes for swordfish. i.e. (E-log comment section, tick box for fish between 10-20kg, head only, small, medium or large).	TTRAG 34	AFMA/Tuna Australia	**ONGOING**: AFMA sought advice from the RAG, the RAG agreed to keep this as an ongoing action item, due to work currently being undertaken with CPUE standardisation and noted this agenda may inform future data priorities.

Climate & Ecosystem Status Report

Eastern Tuna and Billfish Fishery

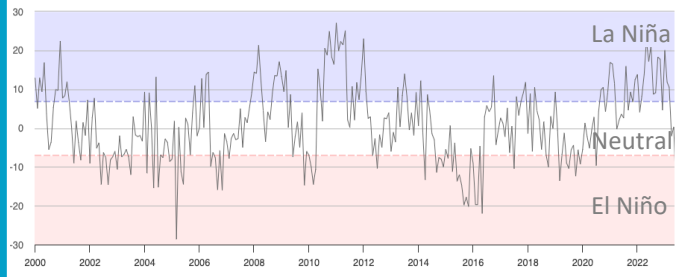
June 2023

Attachment 3.1



Historical Period

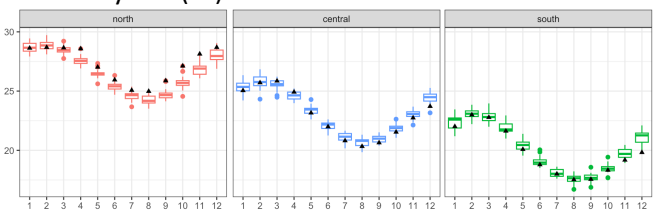
Climate Drivers



Monthly Southern Oscillation Index[1] (link).

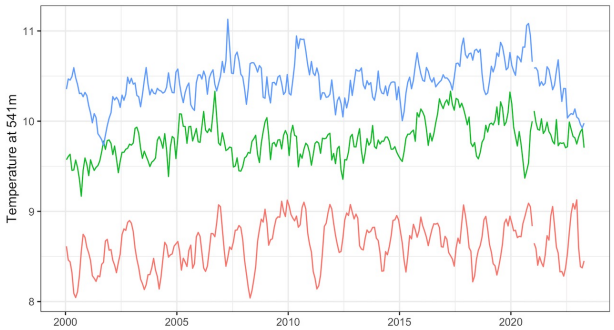
Sea Surface Temperature

Monthly SST (°C) from 2000-2022:



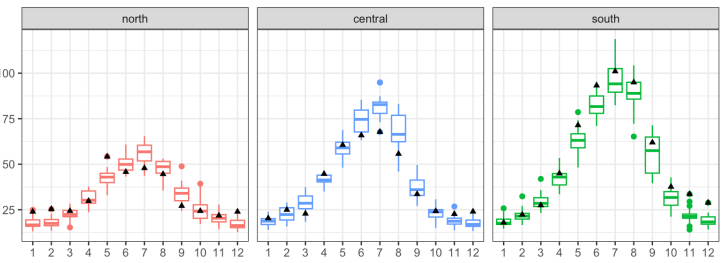
Seasonal SST dynamics for each region, with black triangles show the most recent monthly SST (July 2022-June 2023). SST last year was warmer than average in the North, but cooler than average in Central and South regions. This may support higher recruitment.

Subsurface Temperature



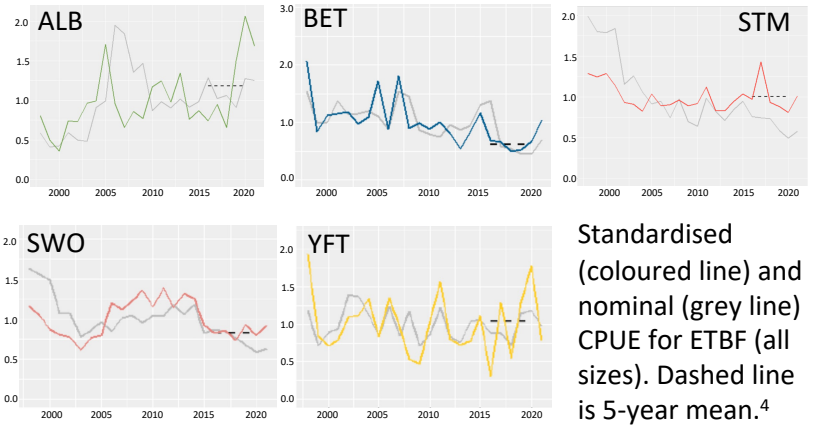
Temperature at 500 m indicates sub-surface ocean structure. All regions have warmed over time, but more so in the Central and South regions[3].

Monthly Mixed Layer Depth (MLD; m) from 2000-2022:



MLD indicates the depth of surface mixing and can impact the distribution of top predators. MLD can be deeper in the South & Central regions but varies seasonally. Black triangles show the most recent monthly MLD (Jun 2022-May2023).

Ecosystem and Fishery



Standardised (coloured line) and nominal (grey line) CPUE for ETBF (all sizes). Dashed line is 5-year mean.[4]

Observations

- Catches higher during El Niño.
- Recreational fishing sector noted a recruitment event is occurring due to juvenile species being caught.
- Bigeye is usually fished at different depths especially before El Niño.
- High sea temperatures during La Niña thought to be good conditions for spawning.

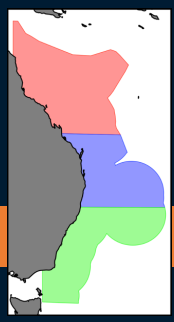
TTRAG 39 - Agenda item 3 Attachement 3.1a Climate Report ETBF 2023

Sources: BOM[1] NOAA[2] CMEMS[3] CSIRO[4] AFMA[5]

Climate & Ecosystem Status Report

Eastern Tuna and Billfish Fishery

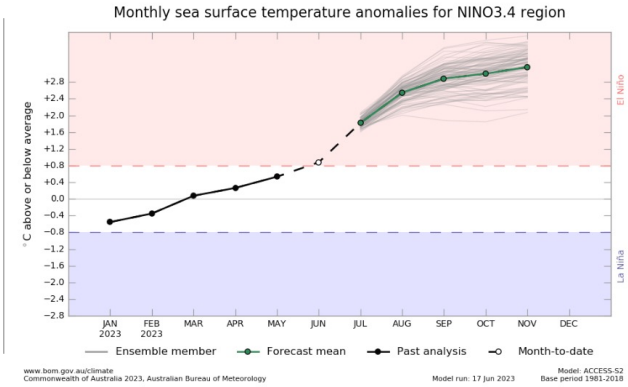
June 2023



Future Outlook for 2023

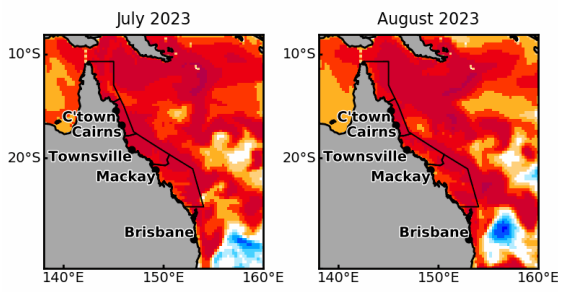
Climate Drivers

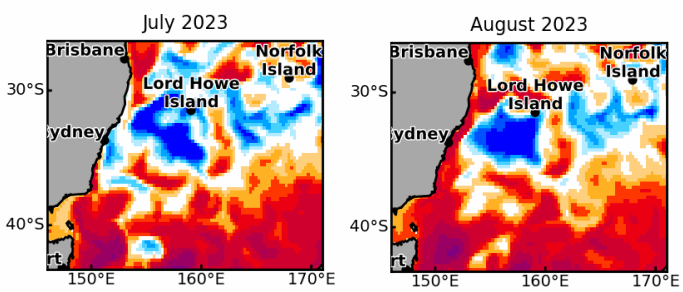
Currently transitioning to El Niño[1] (link)



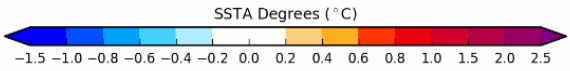
El Niño is predicted[1] (link). These conditions can favour higher catches for YFT, BET, ALB, & STM in the Western Central Pacific[4]

Temperature for the region



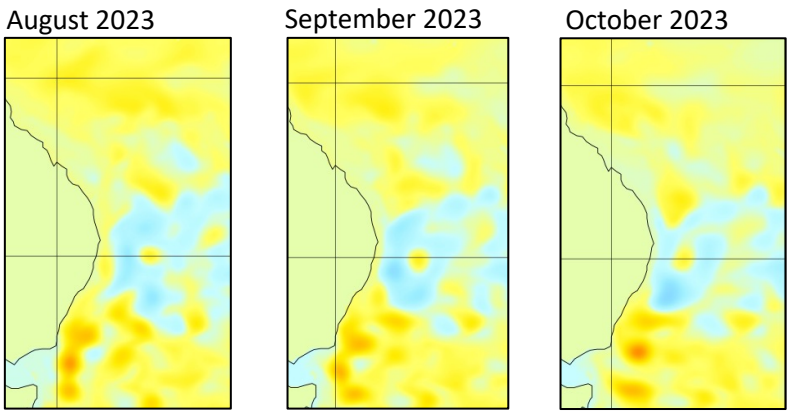


Forecasts of SST anomalies for July and August indicate warmer conditions off QLD and cooler conditions seen off NSW[1] (link).



Base period 1981-2018

Sea Surface Height Forecasts



Forecasts of sea surface height show how regional ocean dynamics may change over the next 3 months[1]. Sea surface Height anomalies can indicate the location of eddies.

Sources: BOM[1] NOAA[2] CMEMS[3] CSIRO[4] AFMA[5]

contact details: steph.brodie@csiro.au

Attachment 3.1a

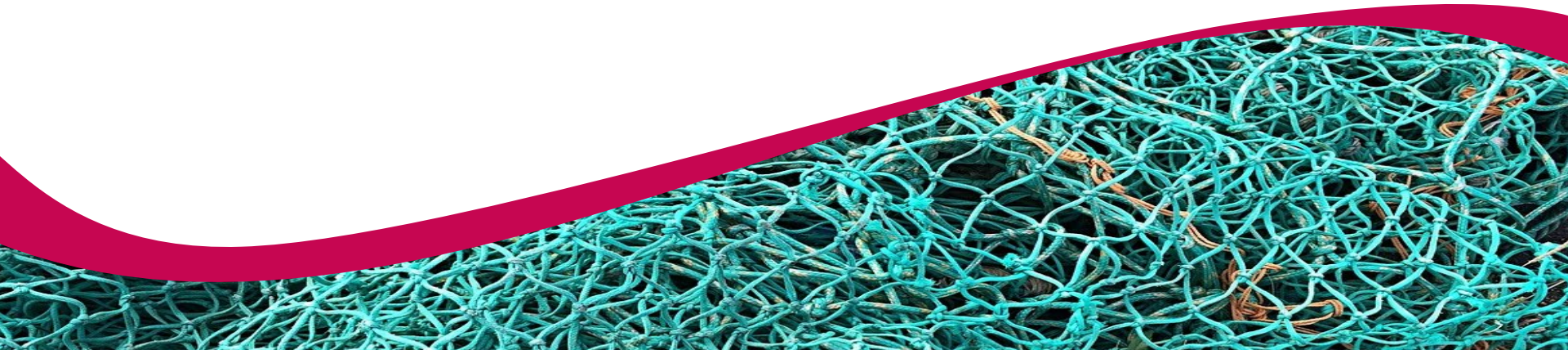
Australian Government

Australian Fisheries Management Authority

Climate Change Update

Tropical Tuna RAG

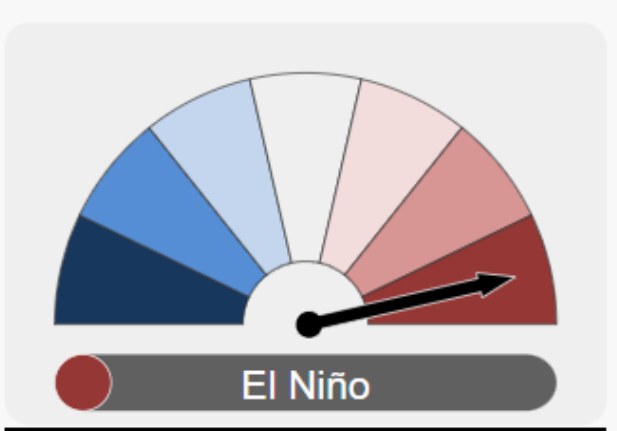
October 2023

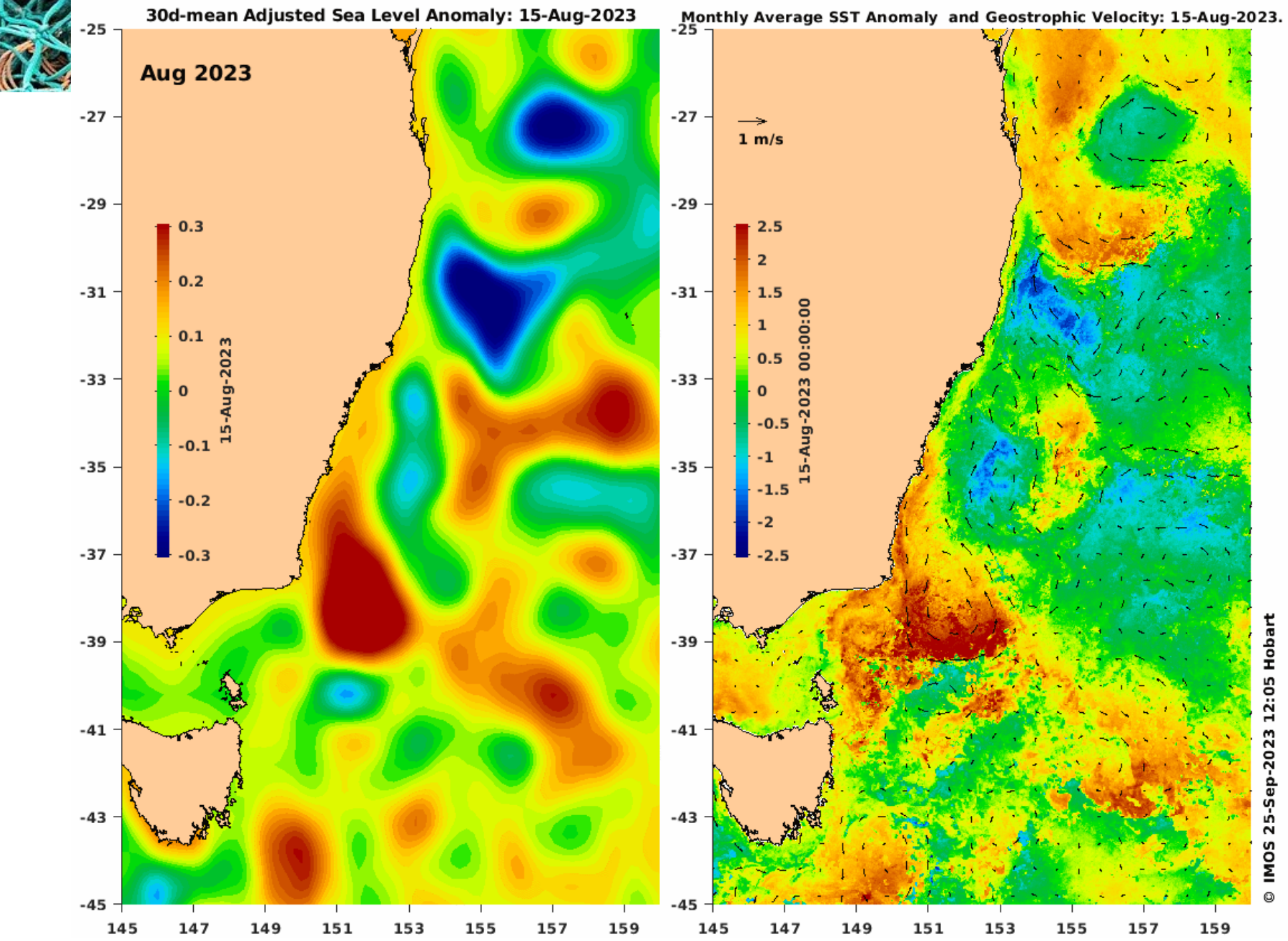


Climate drivers update

- El nino + Positive IOD (Indian Ocean Dipole) underway

  = Warmer and drier conditions predicted for much of Australia over next 3 months
- Further warming to sea surface temperatures in central and Eastern Pacific likely
- Sea surface temperatures above average off Vic and Tas, and QLD to a lesser extent, during August



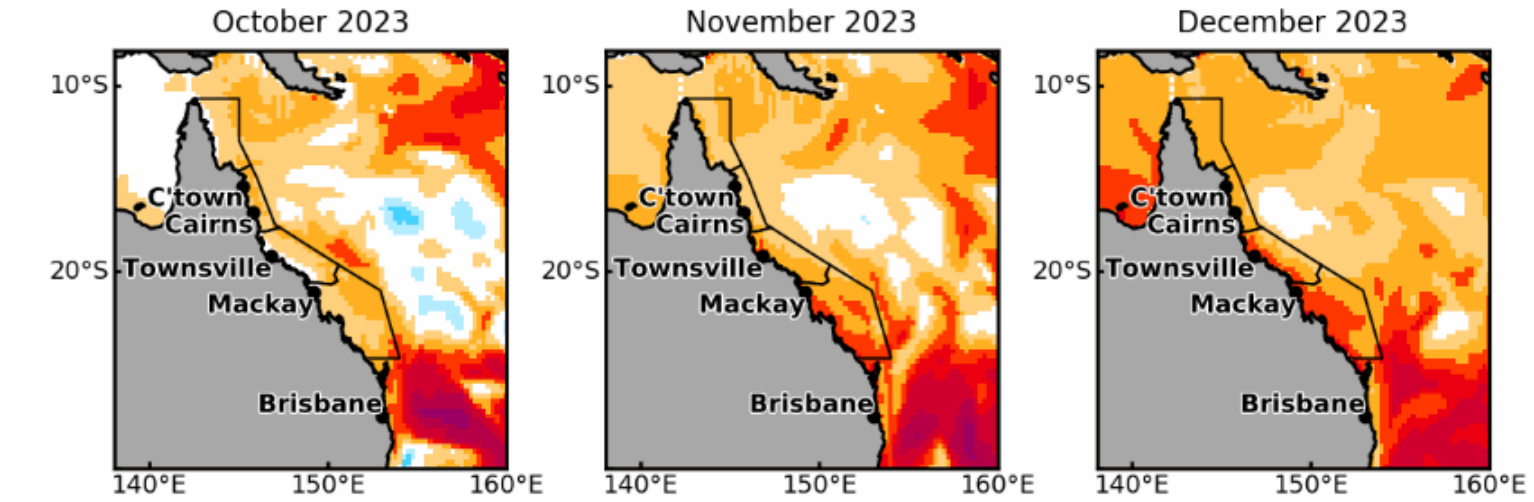


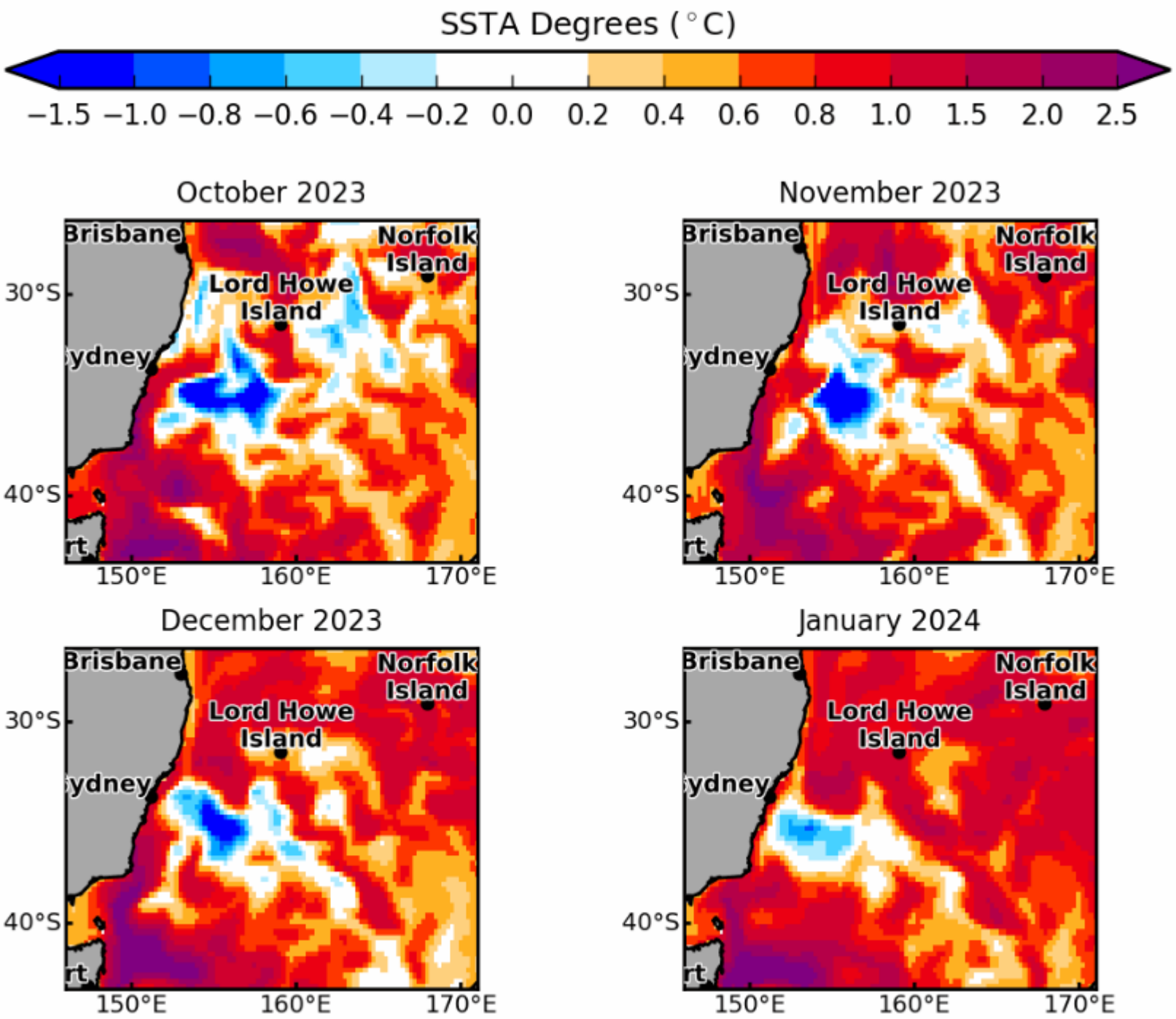
https://oceancurrent.aodn.org.au/monthlymeans.php#

Sea surface temperature forecasts

Sea surface temperature anomaly forecasts (BOM)

- Up to 6 month forecasts
- Updated regularly (Note: less certain beyond the next 2-3 months)
- http://www.bom.gov.au/oceanography/oceantemp/sst-outlook-map.shtml




SSTA Degrees (°C)
−1.5 −1.0 −0.8 −0.6 −0.4 −0.2 0.0 0.2 0.4 0.6 0.8 1.0 1.5 2.0 2.5
October 2023
November 2023
December 2023
January 2024
Brisbane
Norfolk Island
Lord Howe Island
ydney
30°S
40°S
150°E
160°E
170°E

Attachment 3.2a

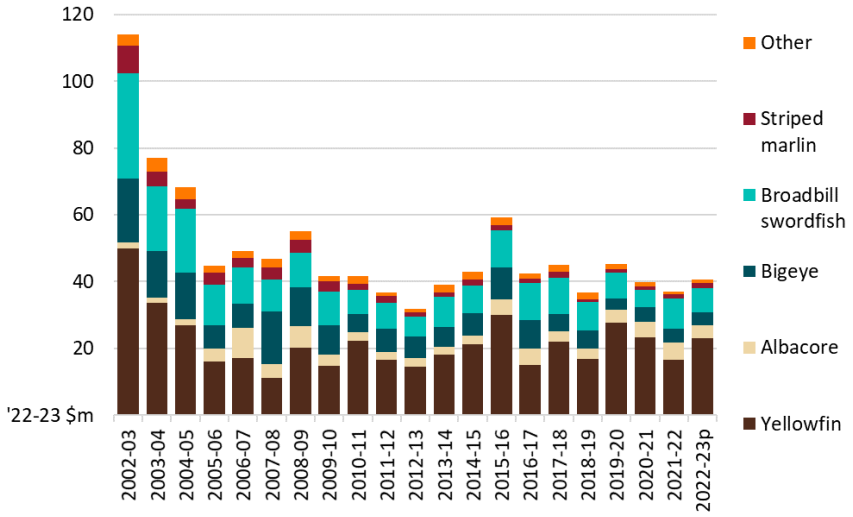
Australian Government
Department of Agriculture, Fisheries and Forestry
ABARES

Economic conditions in the Eastern Tuna and Billfish Fishery

Meeting paper for Tropical Tuna Resource Assessment Group meeting, held 3rd October 2023

Economic conditions in the Eastern Tuna and Billfish Fishery
Annual indicators

Gross value of production



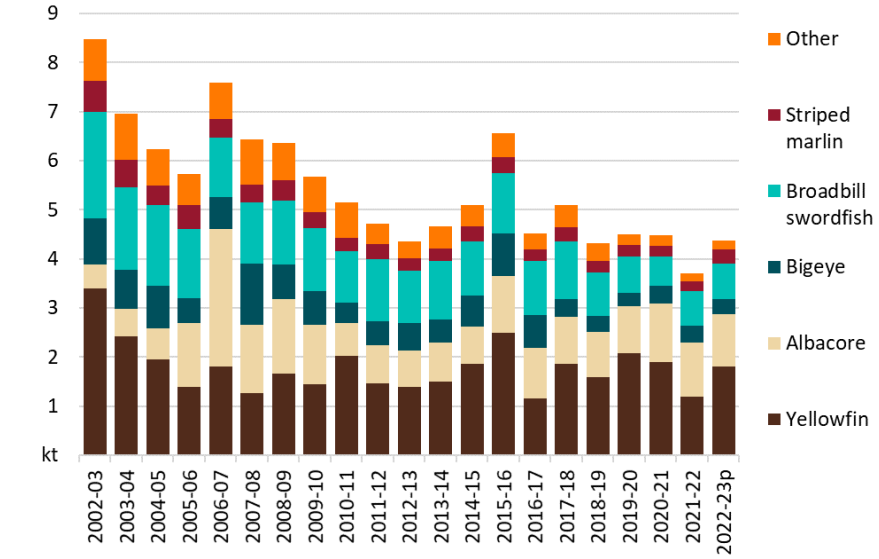
Source: ABARES.
Note: p preliminary
GVP for 2022-23 is preliminary. Final GVPs will be available for the 2022-23 financial year later in 2023. Catch data is from AFMA.

Gross value of production (GVP) in the ETBF decreased between 2002–03 and 2012–13 from $114.4 million to $31.9 million in real terms (2022–23 dollars), reflecting lower landed catch and falling average prices. Average prices are likely to have been influenced by movements in the Japanese Yen and Australian dollar exchange rate.

Between 2012–13 and 2015–16, GVP increased to an 11-year high of $59.1 million in 2015–16 in real terms (2022–23 dollars). This increase resulted from higher landed catch and rising prices of key targeted species (particularly yellowfin tuna).

The decrease in GVP between 2015–16 and 2022–23 largely resulted from lower bigeye tuna, Broadbill swordfish and Yellowfin tuna production value.

Catch



Source: AFMA.

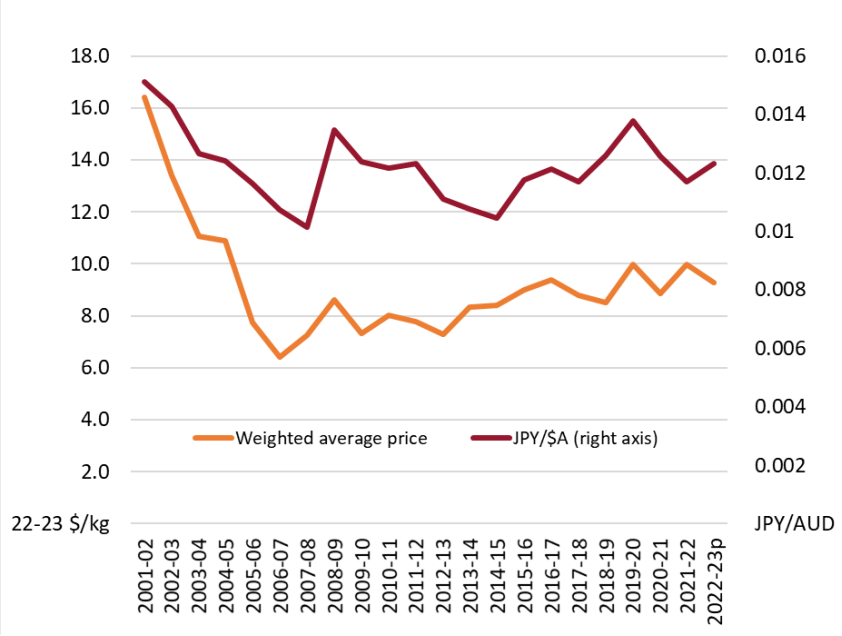
Catch in the ETBF has trended downwards between 2002–03 and 2022–23, with peaks during those years in 2002–03, 2006–07 and 2015–16.

Since 2002–03 the number of active vessels (and fishing effort to a lesser extent) decreased significantly, likely because of a decline in economic conditions in the fishery and the removal of vessels through the Securing Our Fishing Future structural adjustment package (Patterson et al 2020). Declining prices and rising input costs during this period may have also reduced fishing effort and catch.

Between 2012–13 and 2015–16 landed catch increased by 50% to 6,572 tonnes and has remained well below this level since 2015–16.

Economic conditions in the Eastern Tuna and Billfish Fishery
Annual indicators

Weighted average price of landed catch tracks the JPY/AUD exchange rate

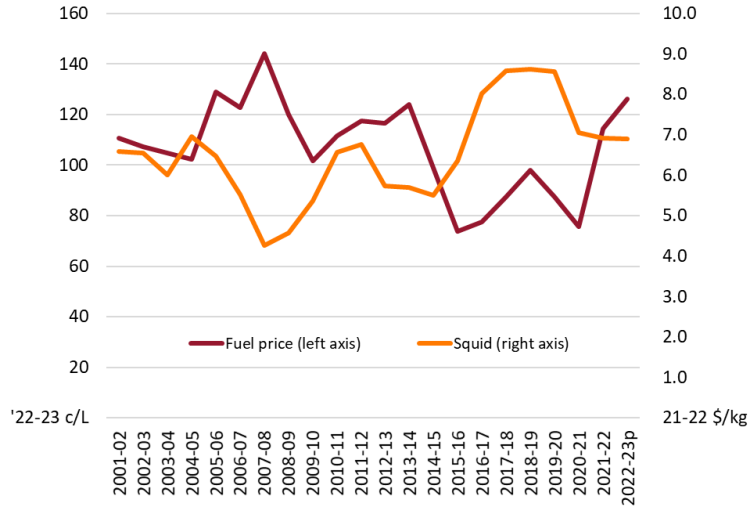


Source: ABARES, RBA.

The weighted average price of fish caught in the ETBF fell significantly in the early 2000s, largely a result of the appreciation of the Australian dollar against the Japanese Yen. Japan was Australia's major export market for yellowfin tuna, and bigeye tuna during this period.

The weighted average price of fish caught in the ETBF trended upwards from 2006–07. There is a strong correlation of the Australian dollar against the Japanese Yen and the weighted average price movement.

Input prices – fuel and squid



Note: Fuel price is diesel (ex. GST and excise).
Source: ABARES.

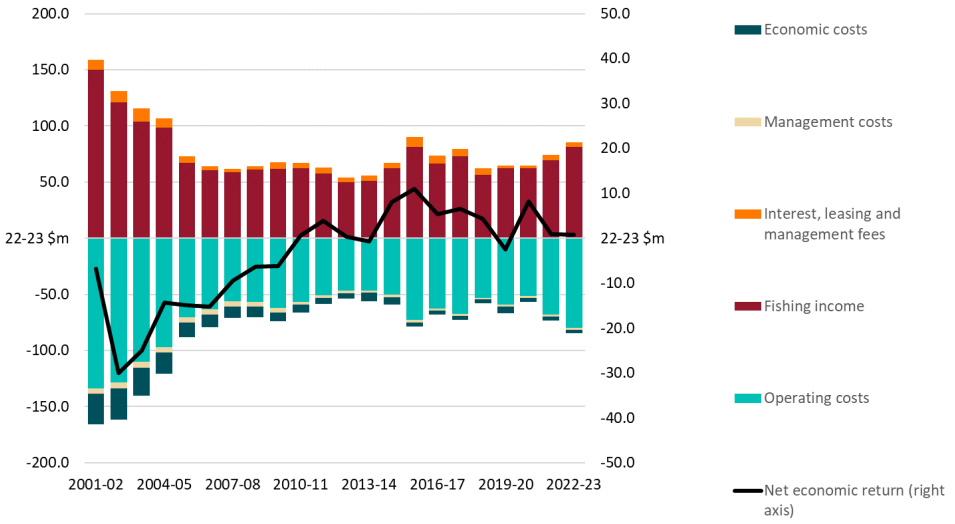
The price of fuel and squid in real terms (2022−23 dollars) have varied significantly between 2000–01 and 2022−23.

The average real price of fuel peaked in 2007−08, 2013–14 and 2022-23. Real fuel prices have trended upwards since 2015−16 and were at historically high levels through 2022–23.

The average real price of squid imports (a proxy for bait price) peaked in 2017–18 at more than double the average price in 2007−08. According to the FAO (2019), squid prices have risen on tight world supplies which are not expected to ease in the short term. Squid prices declined in 2020-21, but remained high in 2021–22 and 2022–23 in real terms compared to the early 2000s period.

Economic conditions in the Eastern Tuna and Billfish Fishery
Annual indicators

Economic performance (ABARES surveys)



Notes: 2017–18 and 2018–19, and 2021-22 and 2022-23 represent non-survey-based estimates. Economic costs include owner and family labour, opportunity cost of capital and economic depreciation.
Source: Dylewski et. al. 2023 (forthcoming).

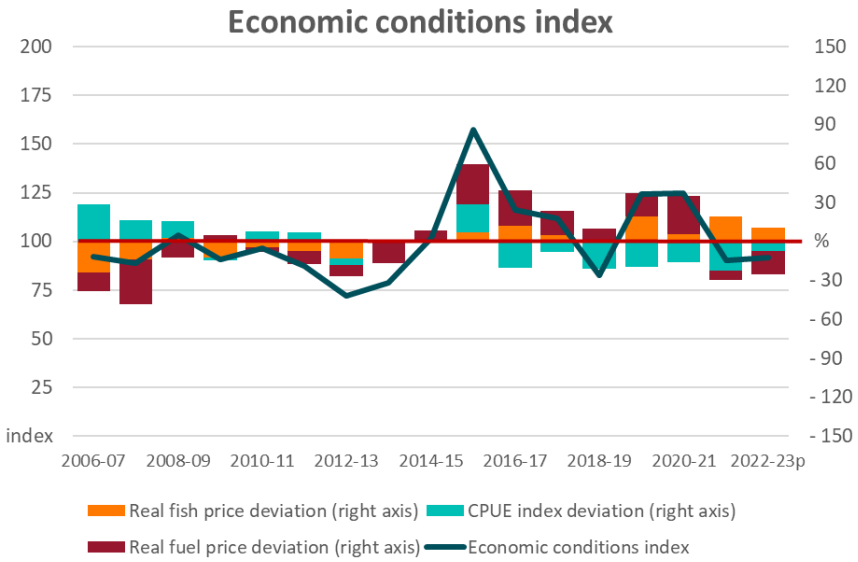
Net economic returns (NER) generated in the ETBF are measured by ABARES surveys. NER in real terms (2022−23 dollars) trended upwards from 2002–03. NER were negative between 2002–03 and 2009–10. In 2010–11 the fishery achieved positive real NER, driven primarily by reduced operating costs, and peaked at $11.0 million in 2015–16.

From 2016–17 real NER in the ETBF has followed a generally declining trend, dipping to negative $2.6 million in 2019–20.

Preliminary non-survey-based estimates indicate real NER averaging $0.8 million 2021–22 and 2022–23. These low levels of NER are attributed to higher input costs experienced in these years.

Economic conditions in the Eastern Tuna and Billfish Fishery
Annual indicators

Economic conditions index (weighted)



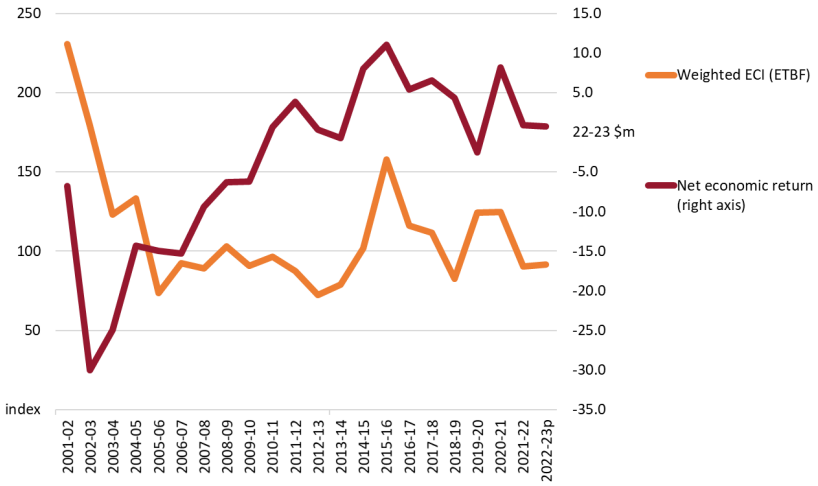
Notes: CPUE is catch-per-unit effort. 2006–07 to 2022–23 average = 100 for all indices. Economic conditions index reflects three component indices. Deviation (right axis) represents percentage difference of each component index from long-term average. ECI and deviations in real fish price and real fuel price are calculated using weighted GVP of yellowfin tuna, bigeye tuna, albacore, swordfish and striped marlin.
Source: ABARES adapted from FFA 2018.

The ECI reflects that the ETBF is a multi-species fishery. Nominal GVP weights of the 5 key commercial species in the ETBF were used to calculate ECI and deviations in its component indices from the long-term (2005–06 to 2022–23) average.

Using the weighted ECI approach, in 2022−23 the ECI remains at around a level of 90.0 indicating below average economic operating conditions. This outcome is attributed to elevated input costs in an environment of steady fish prices, and declining catch per unit effort.

During early 2023-24 fuel prices are likely to continue to limit economic conditions in the fishery. It is unclear to what extent price improvements or catch rates can offset the downward pressure on the index in this period from higher fuel prices. It is also unclear if current high fuel prices will persist into 2024.

Economic conditions index (weighted) and NER



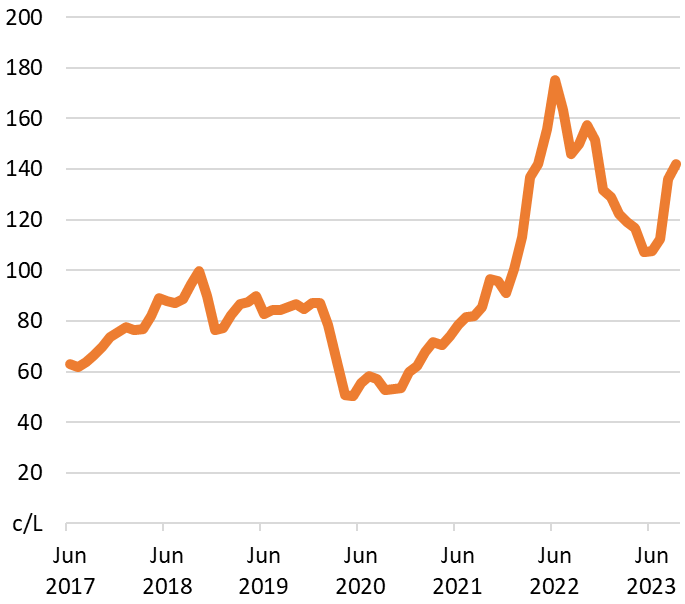
Notes: 2006–07 to 2022–23 average = 100 for economic conditions index, which is calculated using weighted GVP of yellowfin tuna, bigeye tuna, albacore, swordfish and striped marlin.
Source: ABARES adapted from FFA 2018.

The weighted ECI approach has the potential to be a leading indicator of NER. Weighted ECI and NER are highly correlated: 60% since 2012–13.

Economic conditions in the Eastern Tuna and Billfish Fishery
Monthly indicators

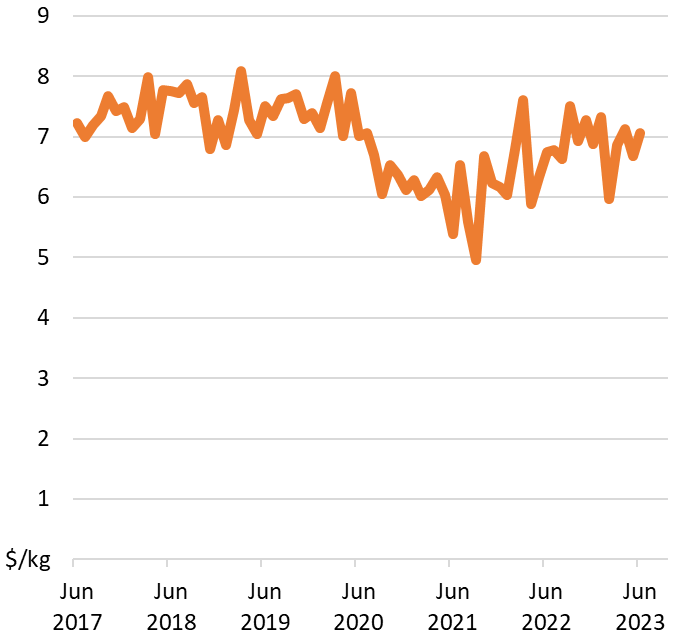
Input prices

Fuel



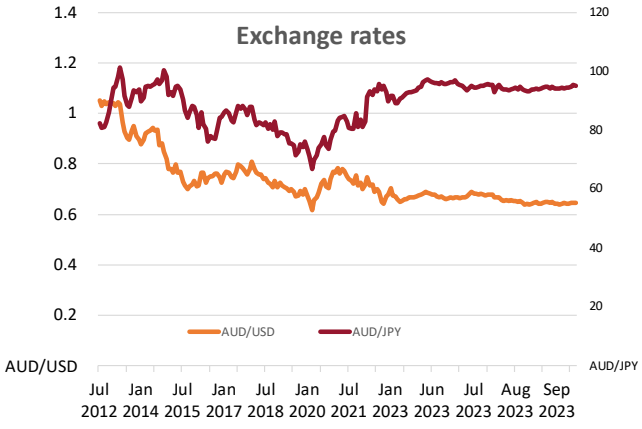
Notes: Nominal dollars. Fuel price (diesel) excludes GST and excise.
Source: ABARES.

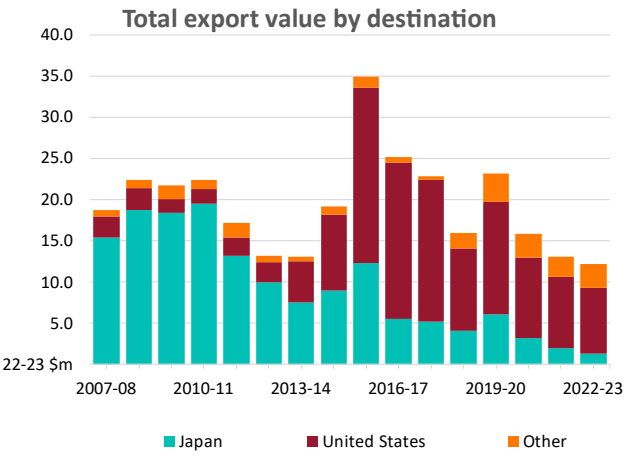
Bait price proxy (squid import price)



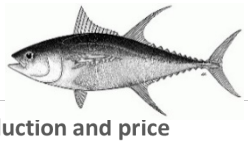
Note: Nominal dollars. Source: ABS, ABARES.

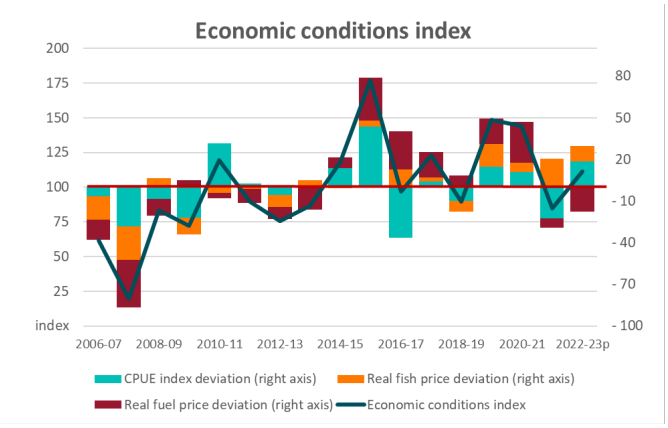
Export markets

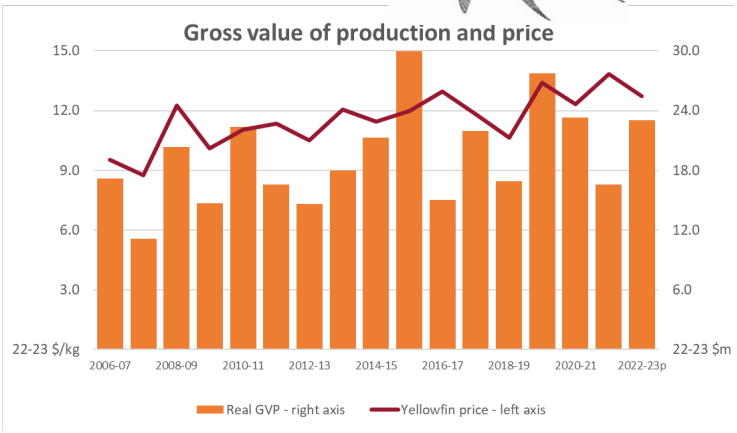


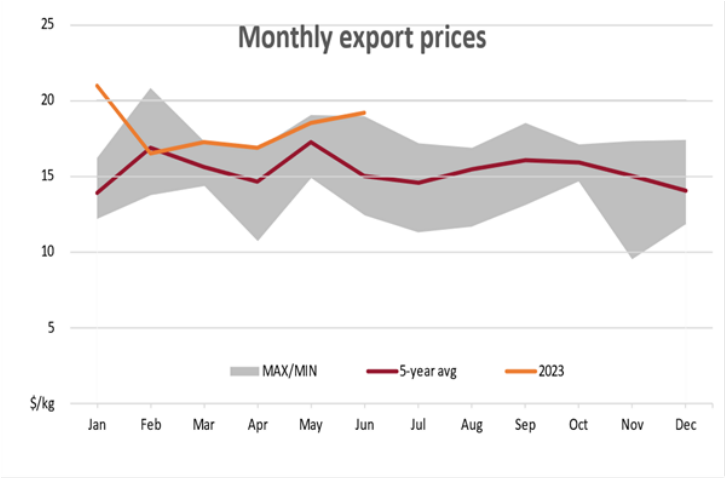


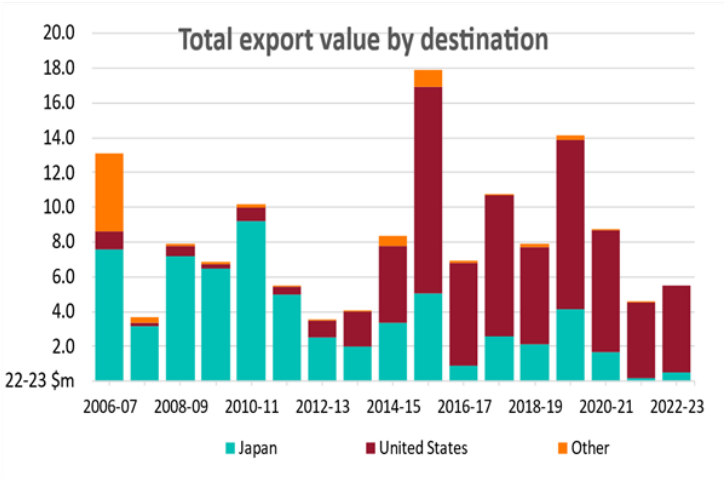
Economic conditions in the Eastern Tuna and Billfish Fishery
Yellowfin tuna





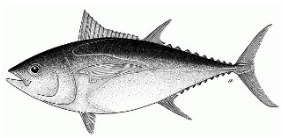


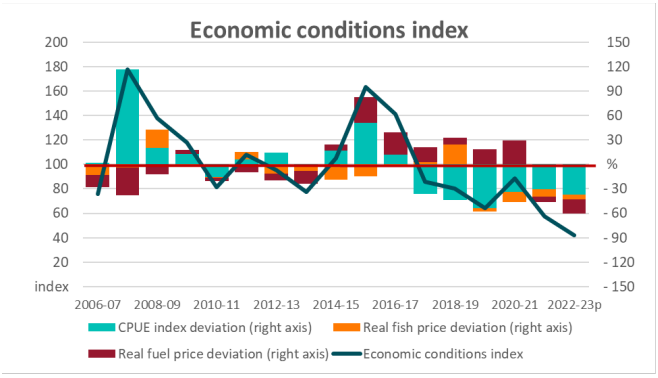


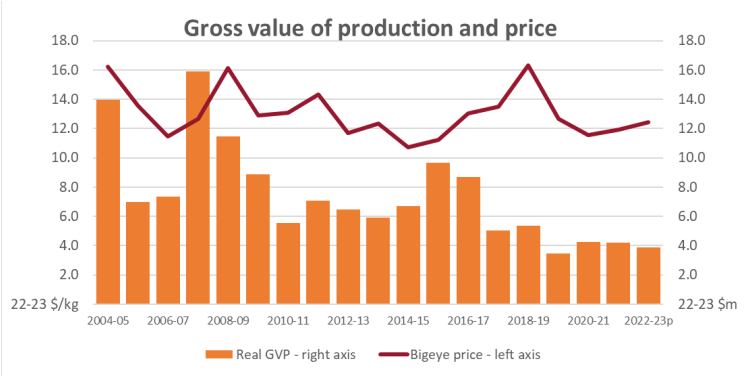


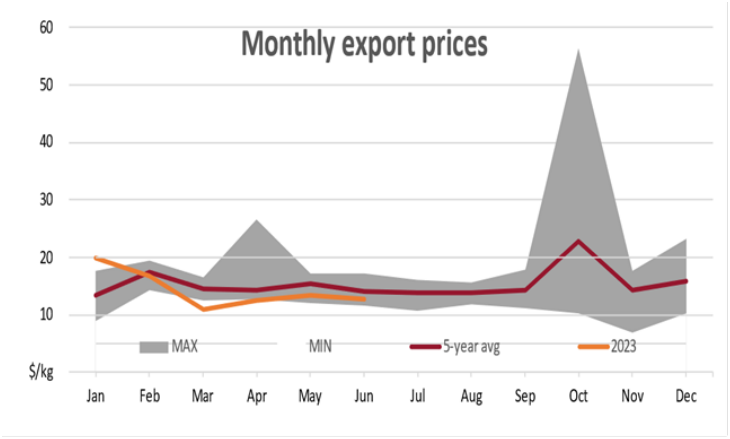
Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Monthly export prices based on fresh or chilled yellowfin tuna exports. Total export value by destination based on all yellowfin tuna exports from Australia. 99% of yellowfin tuna exports are as 'fresh or chilled'.
Sources: ABARES, ABS, FFA.

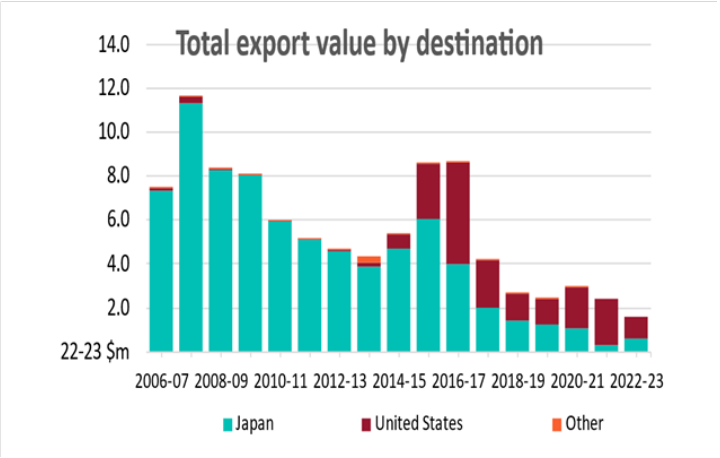
Economic conditions in the Eastern Tuna and Billfish Fishery
Bigeye tuna





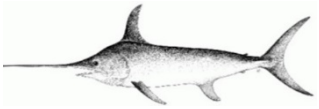


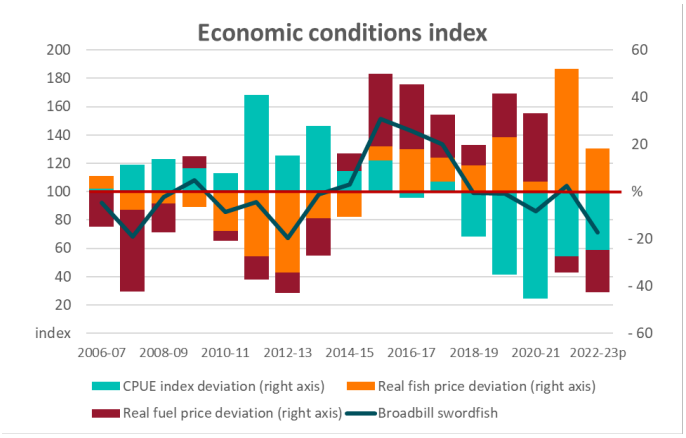


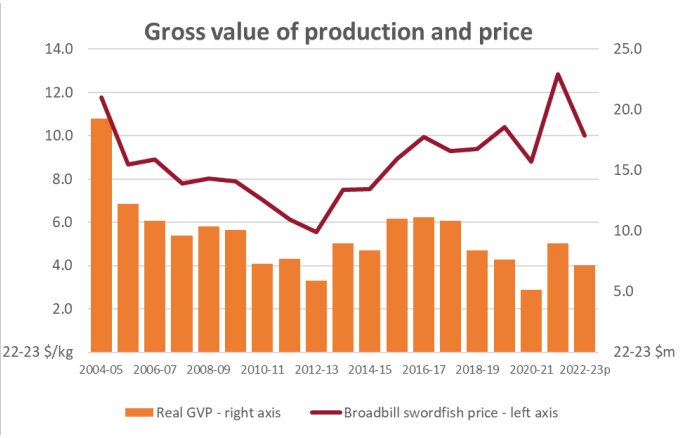


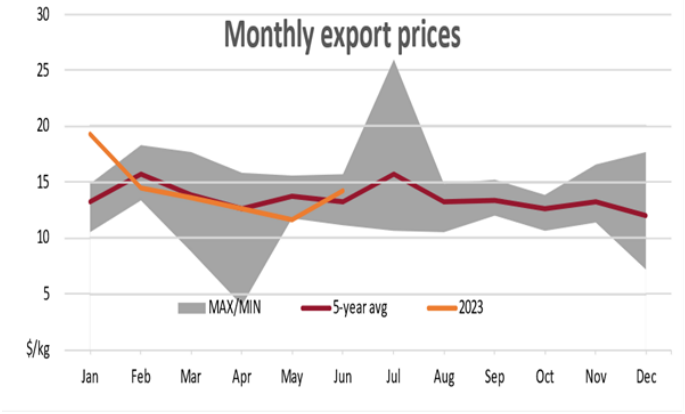
Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Monthly export prices based on fresh or chilled bigeye tuna exports. Total export value by destination based on all bigeye tuna exports from Australia. 99.9% of bigeye tuna exports are as 'fresh or chilled'.
Sources: ABARES, ABS, FFA.

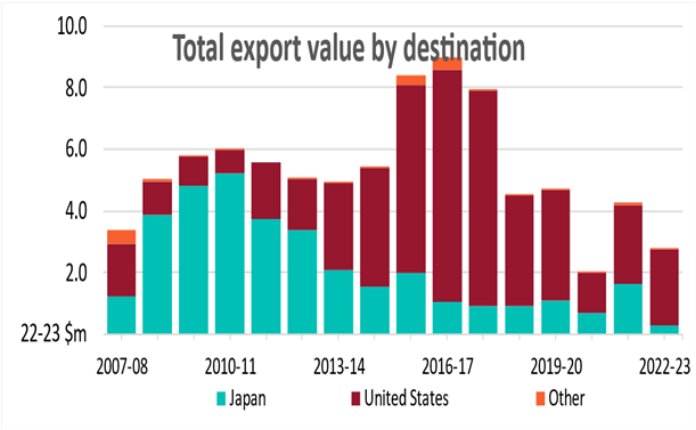
Economic conditions in the Eastern Tuna and Billfish Fishery
Swordfish





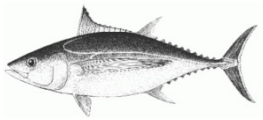


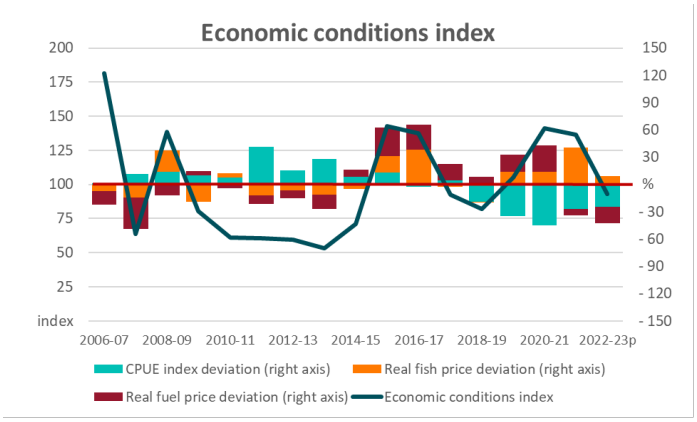


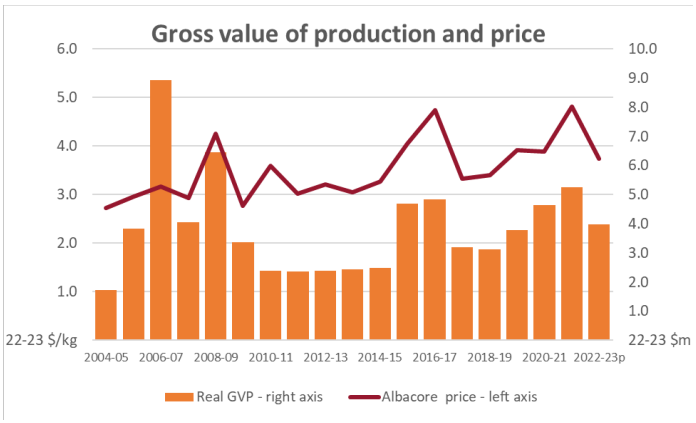


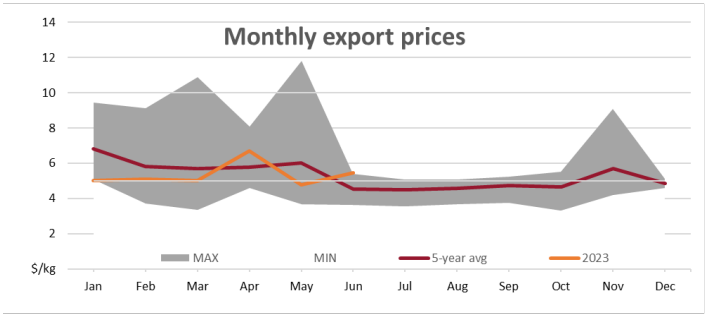
Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Monthly export prices based on fresh or chilled swordfish exports. Total export value by destination based on all swordfish exports from Australia. 99% of swordfish exports are as 'fresh or chilled'.
Sources: ABARES, ABS, FFA.

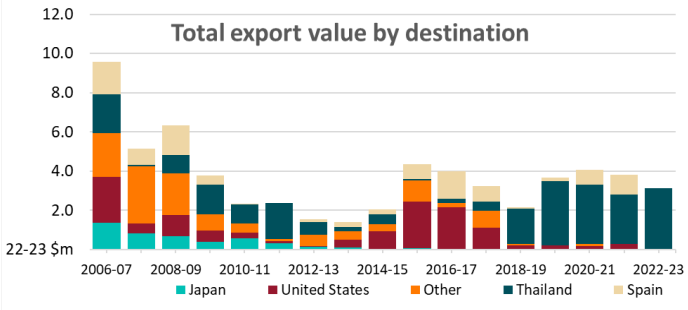
Economic conditions in the Eastern Tuna and Billfish Fishery
Albacore





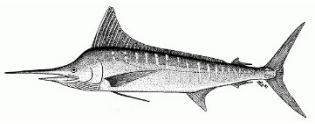


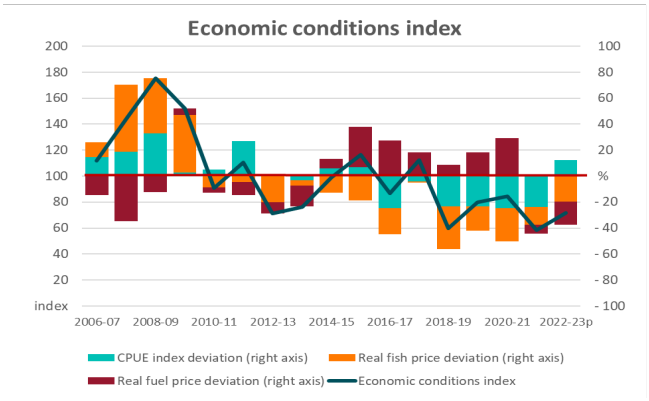


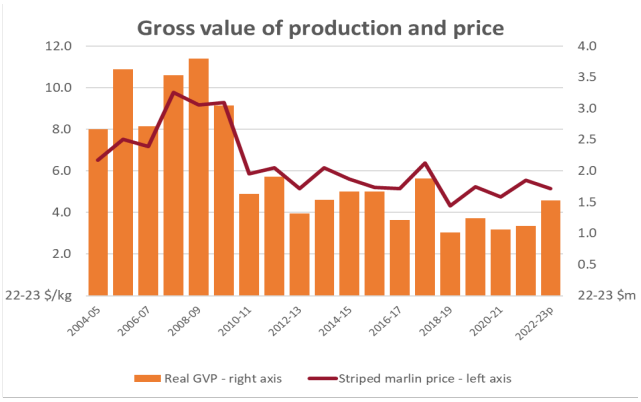


Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Monthly export prices based on all albacore exports. Total export value by destination based on all albacore exports from Australia. Albacore export product form varies and between 2016–17 and 2020–21 on average 78% was exported frozen and 22% was exported as 'fresh or chilled'. In 2020–21 only 5% was exported as 'fresh or chilled'.
Sources: ABARES, ABS, FFA.

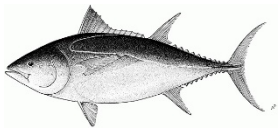
Economic conditions in the Eastern Tuna and Billfish Fishery
Striped Marlin

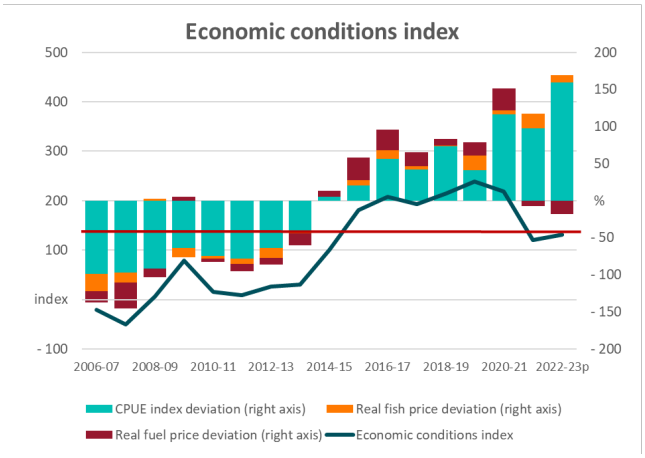


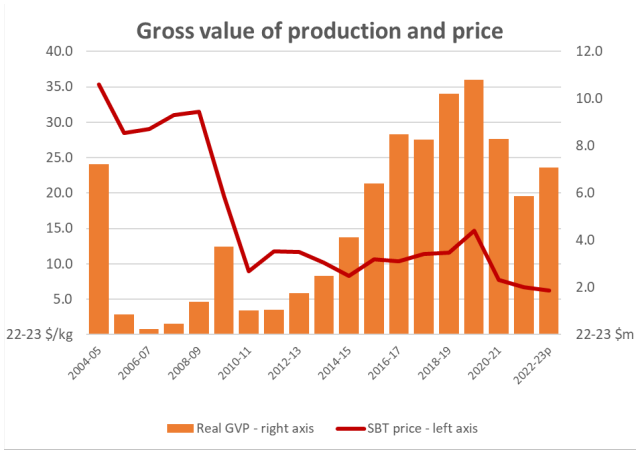




Southern bluefin tuna (excluding SA farm input)



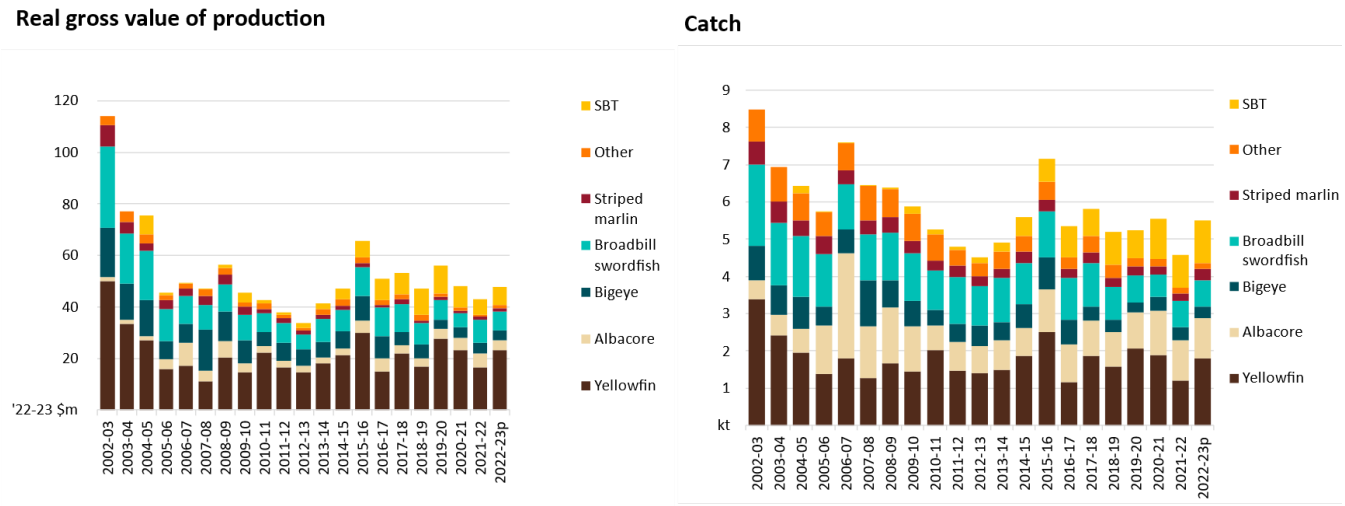




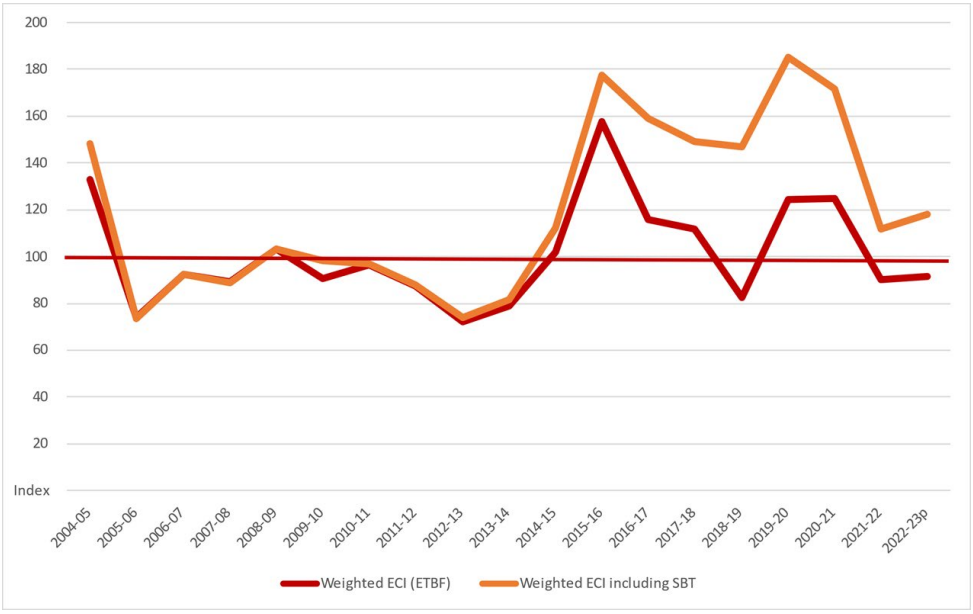
Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Export data not available for striped marlin. Gross value of production data for southern bluefin tuna are for fish landed outside South Australia.
Sources: ABARES, ABS, FFA.

Economic conditions in the Eastern Tuna and Billfish Fishery

GVP and catch of combined ETBF and SBT long line (excluding SA farm input)



Impact on ECI of Southern bluefin tuna (excluding SA farm input)



Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Export data not available for striped marlin. Gross value of production data for southern bluefin tuna are for fish landed outside South Australia.

Sources: ABARES, ABS, FFA.

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Environment
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Annual catch by fleet and fishing method in the southwest Pacific: 2023 update

Laura Tremblay-Boyer and Ashley Williams

26 September 2023

CSIRO Environment
Battery Point, Hobart 7004, Tasmania, Australia.

Citation

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Acknowledgement

We would like to thank Peter Williams (SPC) for his assistance in compiling catch statistics for different regions within the Western and Central Pacific. Nicholas Hill, who authored the previous iteration of this report, provided insights and materials when we conducted the current update.

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Copyright and disclaimer

Important disclaimer

1 Overview

This report updates regional catch statistics for the five target species of the Eastern Tuna and Billfish Fishery (ETBF): South Pacific albacore tuna (ALB; *Thunnus alalunga*), bigeye tuna (BET; *Thunnus obesus*), yellowfin tuna (YFT; *Thunnus albacares*), broadbill swordfish (BBL; *Xiphias gladius*) and striped marlin (STM; *Kajikia audax*). Summaries of the proportion of catch taken by the Eastern Tuna and Billfish Fishery relative to total catch within key regions of the southwest Pacific Ocean are included, as well as annual catch statistics showing catch by fishing nation.

2 Methods

2.1 Regions of interest

Key regions for which regional catch statistics should be reported have been agreed on by the Tropical Tuna Resource Assessment Group (TTRAG), and can vary in relevance depending on the focal species. These regions have been defined to capture both the fishing operations of the ETBF and the general population structure of the ETBF's target species.

Two regions of interest were identified based on the regional configuration of Western and Central Pacific Fisheries Commission (WCPFC) stock assessments conducted for ETBF target species. "Region 1" is based on Region 1 used in the 2021 stock assessment of broadbill swordfish in the south Pacific (Ducharme-Barth et al., 2021), and is bounded by the 0° and 50° S parallels and the 140° E and 165° E meridians (Figure 1). In this stock assessment, this region is the one that contains Australia and its associated longline fisheries (i.e. the ETBF).

"Region 5" was selected based on the past yellowfin tuna and bigeye tuna stock assessments (e.g., Vincent et al. 2020). In those stock assessments, this region comprised both the main area fished by the ETBF fleet and a large proportion of both the Coral and Tasman Seas. In this report, the southern boundary of Region 5 is extended to 50° S in order to encompass all ETBF fishing operations, including those off eastern Tasmania. Of note, the most recent stock assessments for bigeye and yellowfin tuna (Day et al., 2020; Magnusson et al., 2020) used a different regional configuration. For consistency with previous iterations of this report, the boundaries for Region 5 are left here unmodified , i.e., bounded by parallels 10° -50° S and meridians 140° -170° E, and extending eastwards from the east coast of Australia (Figure 1).

Catch statistics for a third, wider spanning region, are also included, with the goal of describing trends in ETBF catches compared to the area encompassing key fisheries from Australia and New Zealand, given overlap in some fisheries. This region moves the eastern boundary of Region 5 to 175° W, aligning this boundary with key parts of the eastern edge of the New Zealand Exclusive Economic Zone. Following discussions at TTRAG, this region is referred to as the Australia - New Zealand region ('ANZ') but note that it was previously referred to as the southwest Pacific (e.g. Hill and Williams, 2022) and the Eastern Extension (e.g., Campbell, 2017). TTRAG agreed to change the label to ANZ to avoid confusion with WCPFC terminology which refers to the southwest Pacific as the area of the WCPFC Convention Area that lies south of the equator.

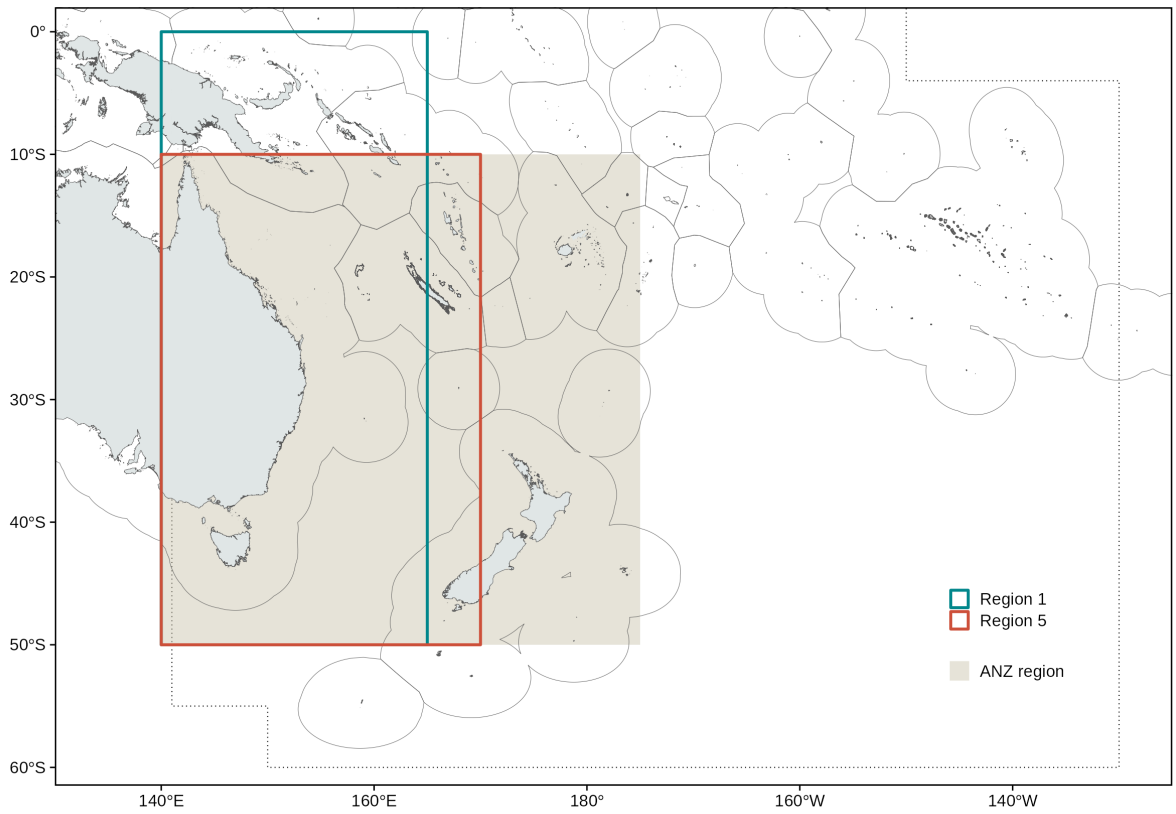

Figure 1: Boundaries of the three regions used when compiling catch statistics in this report. The dottedl line shows the outline of the Western and Central Pacific Fisheries Convention Area; Exclusive Economic Zones are shown in grey.

2.2 Catch data

The catch data used in this analysis were supplied by the Pacific Community (SPC), the Scientific Service Provider to the WCPFC. The data were received on 9 August 2023. Catch, in metric tonnes, was disaggregated by year, fishing method (longline, purse seine, pole and line, and troll) and fishing fleet. A comparison of the Australian catch component in the data supplied by SPC with the Australian catch data provided by AFMA has been provided in earlier iterations of this report (Campbell, 2017; Campbell, 2018). These comparisons have consistently indicated several differences in estimates of ETBF catch. The reasons for these discrepancies remain uncertain but are currently being investigated. Due to these discrepancies, and for consistency with the catch estimates for other fleets, the following analysis uses SPC-provided data to characterise ETBF catches (assumed to be equal to longline catches for the Australian fleet).

Of note, the last year in the SPC-supplied time-series (2022) are considered provisional given the time it takes for countries to collate the catch data pertaining to all fleets under their jurisdiction, and the time taken for SPC to check the data supplied to them for errors or other issues such as double reporting. For longline fisheries, countries have until April of the following year to provide complete versions of their catch and effort data. As such, it is not uncommon for SPC to make corrections or updates to historical data as new data are acquired, or if errors or new information are identified in the error checking process.

For all species but striped marlin, catch statistics are used without further modifications from

the WCPFC extract. For striped marlin, an attempt is also made to account for recreational catches given it is a principal target species for recreational gamefishers in both Australia and New Zealand. While the majority of striped marlin are tagged and released, some are also landed and weighed. Estimates of the annual recreational catch of both tagged and landed fish were obtained from data sources as outlined in Pepperell and Campbell (2021). Estimates were obtained for the number and measured weight of landed and released striped marlin. The accuracy of all datasets remains unknown and does not account for catches of striped marlin taken by non-club anglers. To provide an estimate of the combined mortality of striped marlin due to recreational fishing in each country, the total landed catch and 20% of the tag and release catch (assuming 80% survival) was calculated. Estimates of the total weight for both landed and tagged fish in each year were based on multiplying the number of fish in each category by an estimate of the associated mean weight of fish within each category. As no recreational data was available for 2019-2022, the recreational catch for both Australia and New Zealand for these years was set equal to the average of the catch taken over the last four years for which catch statistics were available (2015-2018). The same protocol was also used for several other years when data was missing. Also, the recreational catch data were initially compiled based on a financial year. However, as most catches are generally taken between January and June, this aligns reasonably well with the calendar year period on which the commercial data are based, so the financial year catches are assigned to the later calendar year in the time period.

Catch statistics are reported for longline and all gear categories, where all gears includes longline, purse seine, pole and line, and troll.

2.3 Computation of catch proportions

For each target species, the proportion of longline catch and all gear catch taken by the ETBF longline fleet was calculated for Region 1, Region 5 and the ANZ region.

The information for striped marlin is provided with and without the recreational catches included in the catch total at the region level (i.e., the recreational catches are added to the region total, not the catches taken by the ETBF).

2.4 Catch summaries by flag

The annual catch by fleet is shown for Region 5 for the three tuna species (south Pacific albacore, bigeye, and yellowfin tuna) and for Region 1 for the two billfish species (broadbill swordfish and striped marlin). Countries contributing less than 2.5% of the total catch are grouped into a ‘Others‘ category.

3 Results

3.1 Regional trends across species

3.1.1 Region 1

Table 1: ETBF contribution (%) to longline and all gear catch by species in Region 1. 'Incl. rec' includes striped marlin recreational catch for Australia and New Zealand in the regional catches.

	Longline					All gears					Incl. rec
Year	ALB	BBL	BET	STM	YFT	ALB	BBL	BET	STM	YFT	STM
2006	19.3	78.8	13.7	72.0	17.5	19.3	78.8	1.8	72.0	1.2	62.0
2007	14.5	82.9	23.4	69.5	10.6	14.5	82.9	2.8	69.5	0.8	55.6
2008	11.9	81.8	23.5	67.8	11.5	11.9	81.8	3.3	67.8	0.7	58.2
2009	9.9	73.7	13.4	57.6	7.3	9.9	73.7	2.1	57.6	0.7	47.1
2010	4.0	60.1	12.8	39.7	7.4	4.0	60.1	1.5	39.7	0.6	33.8
2011	6.0	49.9	7.7	44.5	10.8	6.0	49.9	1.4	44.5	0.9	38.6
2012	4.8	54.1	16.4	45.3	7.7	4.8	54.1	2.6	45.3	0.7	36.7
2013	4.3	56.8	18.2	52.0	11.6	4.3	56.8	1.6	52.0	0.5	40.8
2014	3.1	64.7	9.1	51.5	8.7	3.1	64.7	2.6	51.5	1.0	43.2
2015	6.4	65.0	13.9	64.7	10.6	6.4	65.0	5.4	64.7	2.0	53.0
2016	10.2	68.4	27.0	59.7	11.7	10.2	68.4	5.3	59.7	0.9	41.2
2017	6.6	70.0	12.7	65.6	10.2	6.6	70.0	2.7	65.6	0.8	54.1
2018	7.6	63.3	9.0	68.6	8.8	7.5	63.3	3.1	68.6	1.1	52.7
2019	7.8	64.2	8.1	61.9	11.6	7.8	64.2	2.7	61.9	1.7	47.0
2020	10.3	65.9	17.9	57.1	18.8	10.3	65.9	2.6	57.1	0.9	41.2
2021	9.8	64.1	16.3	55.2	13.4	9.3	64.1	2.3	55.2	0.8	40.5
2022	7.3	75.8	12.0	55.8	8.5	7.3	75.8	1.6	55.8	0.7	44.2
Mean	8.5	67.0	15.0	58.1	11.0	8.4	67.0	2.7	58.1	0.9	46.5
Mean 2013–2022	7.3	65.8	14.4	59.2	11.4	7.3	65.8	3.0	59.2	1.1	45.8
Mean 2018–2022	8.6	66.7	12.6	59.7	12.2	8.5	66.7	2.5	59.7	1.0	45.1

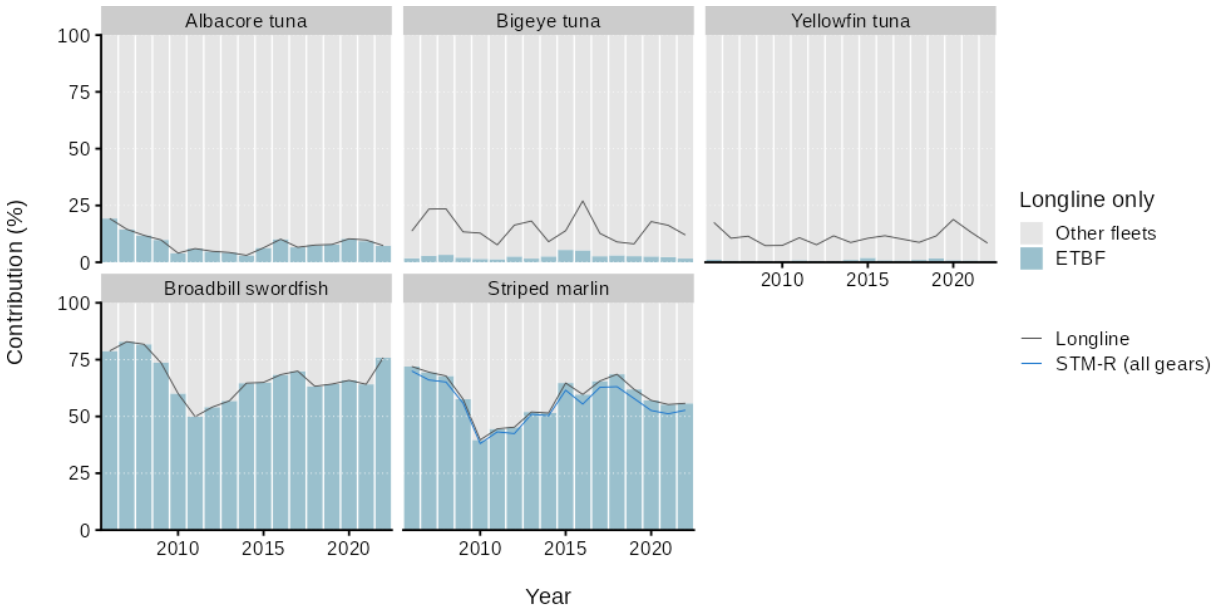

Figure 2: ETBF contribution (%) to all gear (bar) and longline (line) catch in weight by species in Region 1. STM-R includes recreational striped marlin catches.

3.1.2 Region 5

Table 2: ETBF contribution (%) to longline and all gear catch by species in Region 5. 'Incl. rec' includes striped marlin recreational catch for Australia and New Zealand in the regional catches.

	Longline					All gears					Incl. rec
Year	ALB	BBL	BET	STM	YFT	ALB	BBL	BET	STM	YFT	STM
2006	13.2	80.6	23.1	69.9	21.0	13.0	80.6	22.1	69.9	17.0	60.8
2007	12.1	83.6	36.1	61.9	15.7	11.9	83.6	28.0	61.9	9.1	50.7
2008	6.2	73.0	30.0	51.6	14.6	5.9	73.0	25.0	51.6	6.8	45.8
2009	8.8	81.2	28.3	59.3	13.0	8.8	81.2	22.7	59.3	8.5	48.2
2010	2.8	62.7	14.5	38.6	9.1	2.8	62.7	13.1	38.6	7.3	33.1
2011	4.7	64.5	14.7	43.9	16.7	4.5	64.5	12.5	43.9	12.1	38.2
2012	3.1	64.5	26.4	44.8	13.2	3.1	64.5	25.0	44.8	10.5	36.4
2013	3.2	62.7	24.3	51.1	18.9	3.2	62.7	21.8	51.1	9.7	40.3
2014	2.7	67.1	19.5	50.4	16.0	2.7	67.1	18.2	50.4	13.7	42.5
2015	5.0	65.3	31.6	63.4	17.5	5.0	65.3	30.1	63.4	15.4	52.1
2016	9.2	55.3	40.2	57.5	20.8	9.0	55.3	37.6	57.5	11.2	40.2
2017	5.7	62.6	26.7	66.3	17.9	5.7	62.6	21.2	66.3	8.7	54.6
2018	5.4	55.0	25.0	67.9	18.1	5.3	55.0	21.9	67.9	13.6	52.3
2019	6.6	51.4	19.4	60.9	21.6	6.5	51.4	18.2	60.9	20.4	46.4
2020	8.3	39.2	24.1	54.8	24.5	8.1	39.2	21.3	54.8	13.6	40.0
2021	8.8	46.1	29.4	53.4	22.0	8.1	46.1	25.3	53.4	14.5	39.5
2022	5.9	73.5	24.9	53.0	14.4	5.6	73.5	23.4	53.0	12.8	42.4
Mean	6.6	64.0	25.8	55.8	17.3	6.4	64.0	22.8	55.8	12.0	44.9
Mean 2013–2022	6.1	57.8	26.5	57.9	19.2	5.9	57.8	23.9	57.9	13.4	45.0
Mean 2018–2022	7.0	53.0	24.6	58.0	20.1	6.7	53.0	22.0	58.0	15.0	44.1

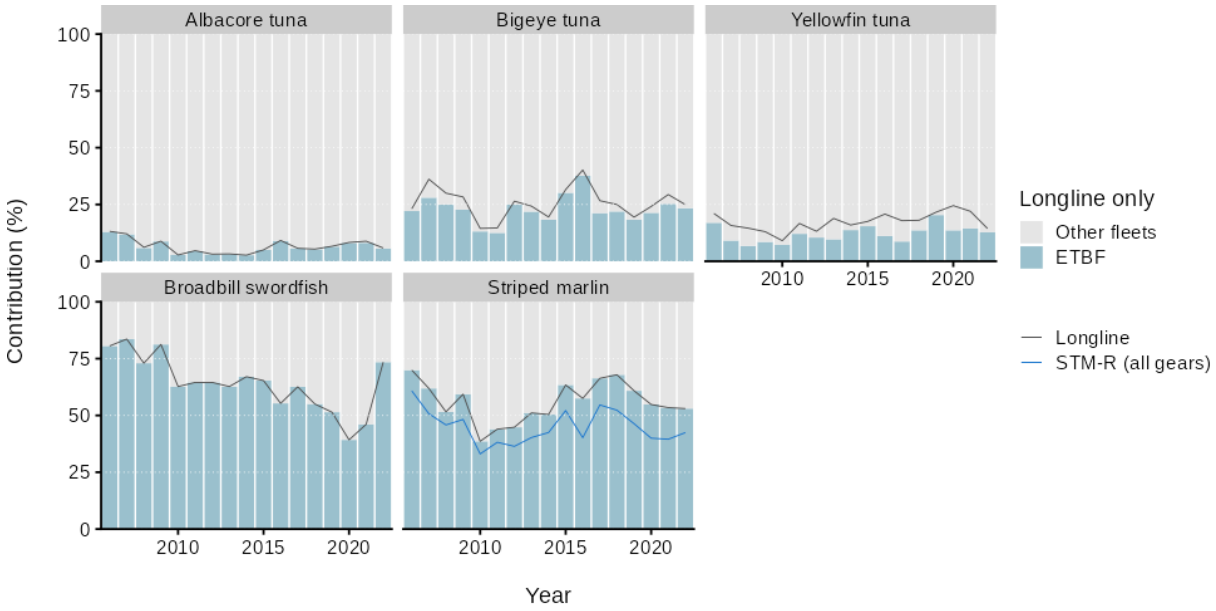

Figure 3: ETBF contribution (%) to all gear (bar) and longline (line) catch in weight by species in Region 5. STM-R includes recreational striped marlin catches.

3.1.3 Australia-New Zealand region

Table 3: ETBF contribution (%) to longline and all gear catch by species in Australia-New Zealand region. 'Incl. rec' includes striped marlin recreational catch for Australia and New Zealand in the regional catches.

	Longline					All gears					Incl. rec
Year	ALB	BBL	BET	STM	YFT	ALB	BBL	BET	STM	YFT	STM
2006	6.9	52.3	15.2	60.5	15.7	6.6	52.3	14.4	60.5	13.1	53.6
2007	6.1	50.4	21.1	47.8	11.0	5.8	50.4	18.0	47.8	7.3	40.9
2008	2.8	50.8	19.0	36.8	10.0	2.6	50.8	16.3	36.8	5.5	33.8
2009	2.8	37.9	11.8	38.7	7.3	2.7	37.9	10.4	38.7	5.6	33.6
2010	1.4	34.9	9.9	32.8	6.7	1.4	34.9	8.8	32.8	5.6	28.7
2011	2.3	29.9	8.3	34.9	12.0	2.1	29.9	7.3	34.9	9.2	31.2
2012	1.7	28.4	14.5	34.1	9.6	1.5	28.4	14.0	34.1	7.9	29.0
2013	2.0	28.6	13.6	42.8	13.1	1.8	28.6	12.6	42.8	7.8	34.9
2014	1.8	33.5	12.7	41.3	10.9	1.7	33.5	11.8	41.3	9.7	35.9
2015	2.6	23.6	18.7	49.9	12.3	2.4	23.6	17.3	49.9	10.7	42.6
2016	4.0	32.3	21.0	42.6	12.2	3.7	32.3	17.9	42.6	7.6	32.3
2017	1.9	37.8	11.1	52.9	8.6	1.8	37.8	9.9	52.9	5.6	45.2
2018	2.2	36.6	11.9	46.3	11.3	2.1	36.6	10.9	46.3	9.2	38.5
2019	2.9	38.4	10.1	49.8	13.9	2.7	38.4	9.7	49.8	13.2	39.6
2020	4.2	27.1	11.8	44.6	12.3	3.8	27.1	10.8	44.6	8.6	34.3
2021	4.5	27.9	15.2	37.5	13.3	3.8	27.9	13.7	37.5	10.0	30.1
2022	2.9	43.2	13.7	43.8	10.1	2.6	43.2	12.9	43.8	9.2	36.3
Mean	3.1	36.1	14.1	43.4	11.2	2.9	36.1	12.7	43.4	8.6	36.5
Mean 2013–2022	2.9	32.9	14.0	45.1	11.8	2.6	32.9	12.7	45.1	9.2	37.0
Mean 2018–2022	3.3	34.6	12.6	44.4	12.2	3.0	34.6	11.6	44.4	10.0	35.7

Figure 4: ETBF contribution (%) to all gear (bar) and longline (line) catch in weight by species in Australia-New Zealand region. STM-R includes recreational striped marlin catches.

3.2 Regional trends by species

3.2.1 Albacore tuna

Table 4: Longline and all gear catch of albacore tuna by region and contribution (%) by the ETBF.

	Longline catch (t)			ETBF (%)			Total catch (t)			ETBF (%)		
Year	R1	R5	ANZ	R1	R5	ANZ	R1	R5	ANZ	R1	R5	ANZ
2006	13 536.7	19 811.6	37 583.5	19.3	13.2	6.9	13 536.7	20 145.5	39 626.5	19.3	13.0	6.6
2007	12 577.8	15 148.7	30 047.0	14.5	12.1	6.1	12 577.8	15 433.8	31 783.0	14.5	11.9	5.8
2008	9 128.1	17 596.6	38 176.7	11.9	6.2	2.8	9 128.1	18 375.9	41 528.7	11.9	5.9	2.6
2009	13 632.2	15 196.1	47 256.5	9.9	8.8	2.8	13 632.2	15 358.0	49 088.9	9.9	8.8	2.7
2010	18 022.2	26 096.6	51 368.8	4.0	2.8	1.4	18 022.2	26 172.2	53 200.8	4.0	2.8	1.4
2011	10 605.2	13 677.7	28 030.8	6.0	4.7	2.3	10 614.2	14 061.0	30 823.0	6.0	4.5	2.1
2012	11 498.0	17 688.6	33 283.4	4.8	3.1	1.7	11 513.0	18 146.1	36 025.4	4.8	3.1	1.5
2013	14 647.4	19 470.6	32 118.1	4.3	3.2	2.0	14 655.6	19 675.2	34 962.3	4.3	3.2	1.8
2014	18 331.5	20 748.6	31 970.4	3.1	2.7	1.8	18 331.5	20 863.9	33 907.4	3.1	2.7	1.7
2015	11 489.6	14 589.2	27 990.5	6.4	5.0	2.6	11 489.8	14 652.0	30 415.7	6.4	5.0	2.4
2016	8 477.3	9 393.5	21 542.2	10.2	9.2	4.0	8 484.0	9 575.4	23 517.9	10.2	9.0	3.7
2017	11 882.1	13 737.2	42 296.2	6.6	5.7	1.9	11 884.3	13 799.7	44 257.9	6.6	5.7	1.8
2018	9 177.1	12 956.8	31 159.4	7.6	5.4	2.2	9 216.1	13 085.7	33 469.8	7.5	5.3	2.1
2019	9 694.8	11 515.7	25 979.9	7.8	6.6	2.9	9 719.9	11 720.9	28 325.0	7.8	6.5	2.7
2020	10 699.2	13 344.2	26 414.8	10.3	8.3	4.2	10 705.2	13 680.8	29 245.9	10.3	8.1	3.8
2021	10 596.4	11 771.7	23 221.6	9.8	8.8	4.5	11 151.7	12 780.5	27 111.7	9.3	8.1	3.8
2022	13 522.2	16 933.1	33 954.9	7.3	5.9	2.9	13 569.7	17 576.4	38 149.0	7.3	5.6	2.6
Mean	12 206.9	15 863.3	33 082.0	8.5	6.6	3.1	12 248.9	16 182.5	35 614.1	8.4	6.4	2.9
Mean 2013–2022	11 851.8	14 446.1	29 664.8	7.3	6.1	2.9	11 920.8	14 741.1	32 336.3	7.3	5.9	2.6
Mean 2018–2022	10 737.9	13 304.3	28 146.1	8.6	7.0	3.3	10 872.5	13 768.8	31 260.3	8.5	6.7	3.0

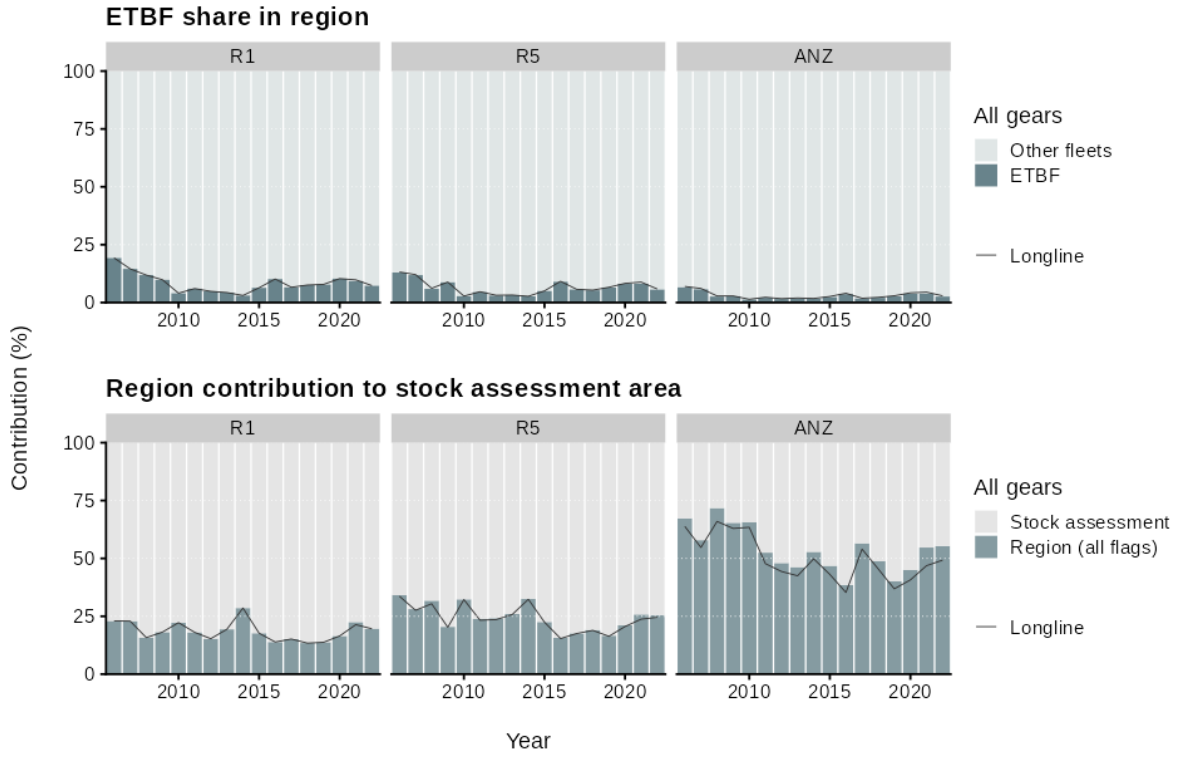

Figure 5: Contribution (%) of ETBF albacore tuna catch in weight to longline (solid line) and all gears (bar) catch in each region (top). Contribution (%) of the catch in weight taken in each region (all countries) to longline (solid line) and all gears (bar) catch in the stock assessment area for the species (bottom).

3.2.2 Bigeye tuna

Table 5: Longline and all gear catch of bigeye tuna by region and contribution (%) by the ETBF.

	Longline catch (t)			ETBF (%)			Total catch (t)			ETBF (%)		
Year	R1	R5	ANZ	R1	R5	ANZ	R1	R5	ANZ	R1	R5	ANZ
2006	3 504.6	2 091.7	3 189.7	13.7	23.1	15.2	26 950.8	2 186.3	3 348.7	1.8	22.1	14.4
2007	3 319.5	2 153.3	3 679.4	23.4	36.1	21.1	27 309.8	2 777.9	4 314.8	2.8	28.0	18.0
2008	3 803.4	2 986.1	4 701.2	23.5	30.0	19.0	27 360.2	3 579.1	5 484.6	3.3	25.0	16.3
2009	3 805.4	1 800.7	4 338.7	13.4	28.3	11.8	24 731.2	2 248.3	4 907.4	2.1	22.7	10.4
2010	3 397.0	3 017.6	4 389.2	12.8	14.5	9.9	29 245.3	3 322.1	4 951.7	1.5	13.1	8.8
2011	4 723.4	2 470.5	4 353.9	7.7	14.7	8.3	26 702.3	2 897.0	4 947.9	1.4	12.5	7.3
2012	2 849.9	1 762.2	3 223.9	16.4	26.4	14.5	18 133.7	1 862.8	3 330.3	2.6	25.0	14.0
2013	2 254.6	1 687.5	3 019.6	18.2	24.3	13.6	25 182.3	1 873.7	3 250.2	1.6	21.8	12.6
2014	4 502.4	2 095.0	3 221.2	9.1	19.5	12.7	15 708.0	2 237.1	3 452.7	2.6	18.2	11.8
2015	4 870.5	2 144.8	3 622.3	13.9	31.6	18.7	12 433.9	2 247.2	3 912.6	5.4	30.1	17.3
2016	2 765.4	1 858.7	3 553.8	27.0	40.2	21.0	14 174.8	1 986.1	4 180.2	5.3	37.6	17.9
2017	2 941.4	1 405.6	3 371.4	12.7	26.7	11.1	14 014.0	1 768.3	3 791.8	2.7	21.2	9.9
2018	3 497.6	1 255.3	2 623.6	9.0	25.0	11.9	10 239.7	1 429.9	2 888.4	3.1	21.9	10.9
2019	3 042.5	1 267.8	2 435.3	8.1	19.4	10.1	9 111.2	1 350.0	2 541.9	2.7	18.2	9.7
2020	1 574.8	1 170.9	2 386.5	17.9	24.1	11.8	10 931.7	1 323.4	2 619.0	2.6	21.3	10.8
2021	2 214.1	1 226.2	2 373.4	16.3	29.4	15.2	15 379.3	1 425.1	2 624.7	2.3	25.3	13.7
2022	2 732.7	1 316.6	2 394.4	12.0	24.9	13.7	20 036.3	1 406.2	2 538.9	1.6	23.4	12.9
Mean	3 282.3	1 865.3	3 345.7	15.0	25.8	14.1	19 273.2	2 113.0	3 710.9	2.7	22.8	12.7
Mean 2013–2022	3 039.6	1 542.8	2 900.2	14.4	26.5	14.0	14 721.1	1 704.7	3 180.1	3.0	23.9	12.7
Mean 2018–2022	2 612.3	1 247.4	2 442.7	12.6	24.6	12.6	13 139.6	1 386.9	2 642.6	2.5	22.0	11.6

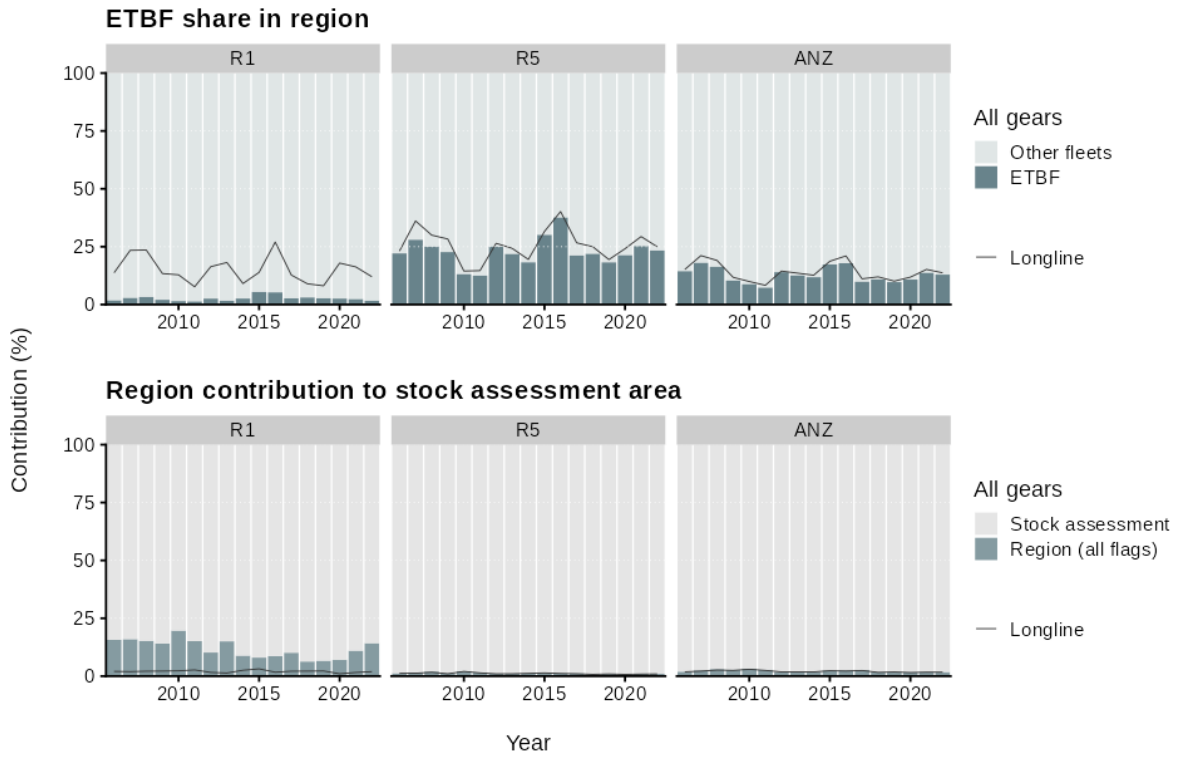

Figure 6: Contribution (%) of ETBF bigeye tuna catch in weight to longline (solid line) and all gears (bar) catch in each region (top). Contribution (%) of the catch in weight taken in each region (all countries) to longline (solid line) and all gears (bar) catch in the stock assessment area for the species (bottom).

3.2.3 Yellowfin tuna

Table 6: Longline and all gear catch of yellowfin tuna by region and contribution (%) by the ETBF.

	Longline catch (t)			ETBF (%)			Total catch (t)			ETBF (%)		
Year	R1	R5	ANZ	R1	R5	ANZ	R1	R5	ANZ	R1	R5	ANZ
2006	10 406.7	8 682.8	11 633.7	17.5	21.0	15.7	157 524.8	10 781.4	13 936.0	1.2	17.0	13.1
2007	11 635.2	7 826.3	11 157.0	10.6	15.7	11.0	163 174.3	13 525.3	16 889.9	0.8	9.1	7.3
2008	12 673.5	9 968.6	14 497.3	11.5	14.6	10.0	210 791.3	21 495.3	26 523.0	0.7	6.8	5.5
2009	16 172.2	9 094.5	16 149.2	7.3	13.0	7.3	172 521.0	13 899.7	21 323.5	0.7	8.5	5.6
2010	17 669.5	14 457.0	19 405.7	7.4	9.1	6.7	235 372.6	17 970.6	23 221.4	0.6	7.3	5.6
2011	16 649.6	10 798.6	14 969.8	10.8	16.7	12.0	200 626.7	14 880.2	19 622.1	0.9	12.1	9.2
2012	14 222.5	8 291.4	11 441.7	7.7	13.2	9.6	162 862.6	10 476.9	13 856.4	0.7	10.5	7.9
2013	9 331.4	5 755.1	8 313.8	11.6	18.9	13.1	199 153.1	11 220.6	13 936.6	0.5	9.7	7.8
2014	16 714.6	9 117.5	13 372.7	8.7	16.0	10.9	141 295.2	10 586.1	15 068.1	1.0	13.7	9.7
2015	18 173.8	10 942.9	15 548.4	10.6	17.5	12.3	97 919.7	12 426.4	17 946.5	2.0	15.4	10.7
2016	12 788.8	7 195.2	12 277.0	11.7	20.8	12.2	165 762.9	13 398.6	19 544.7	0.9	11.2	7.6
2017	14 557.4	8 331.4	17 381.9	10.2	17.9	8.6	176 110.5	17 097.6	26 681.2	0.8	8.7	5.6
2018	14 591.1	7 082.5	11 320.1	8.8	18.1	11.3	121 433.4	9 383.7	13 858.3	1.1	13.6	9.2
2019	16 311.2	8 750.2	13 645.6	11.6	21.6	13.9	110 891.8	9 294.1	14 359.8	1.7	20.4	13.2
2020	8 804.4	6 776.2	13 503.7	18.8	24.5	12.3	180 450.4	12 181.8	19 229.3	0.9	13.6	8.6
2021	10 460.6	6 378.1	10 571.0	13.4	22.0	13.3	169 871.7	9 692.9	14 061.6	0.8	14.5	10.0
2022	16 549.0	9 702.8	13 886.0	8.5	14.4	10.1	193 231.4	10 906.7	15 278.1	0.7	12.8	9.2
Mean	13 983.0	8 773.6	13 475.0	11.0	17.3	11.2	168 176.1	12 895.2	17 961.0	0.9	12.0	8.6
Mean 2013–2022	13 828.2	8 003.2	12 982.0	11.4	19.2	11.8	155 612.0	11 618.8	16 996.4	1.1	13.4	9.2
Mean 2018–2022	13 343.3	7 738.0	12 585.3	12.2	20.1	12.2	155 175.7	10 291.9	15 357.4	1.0	15.0	10.0

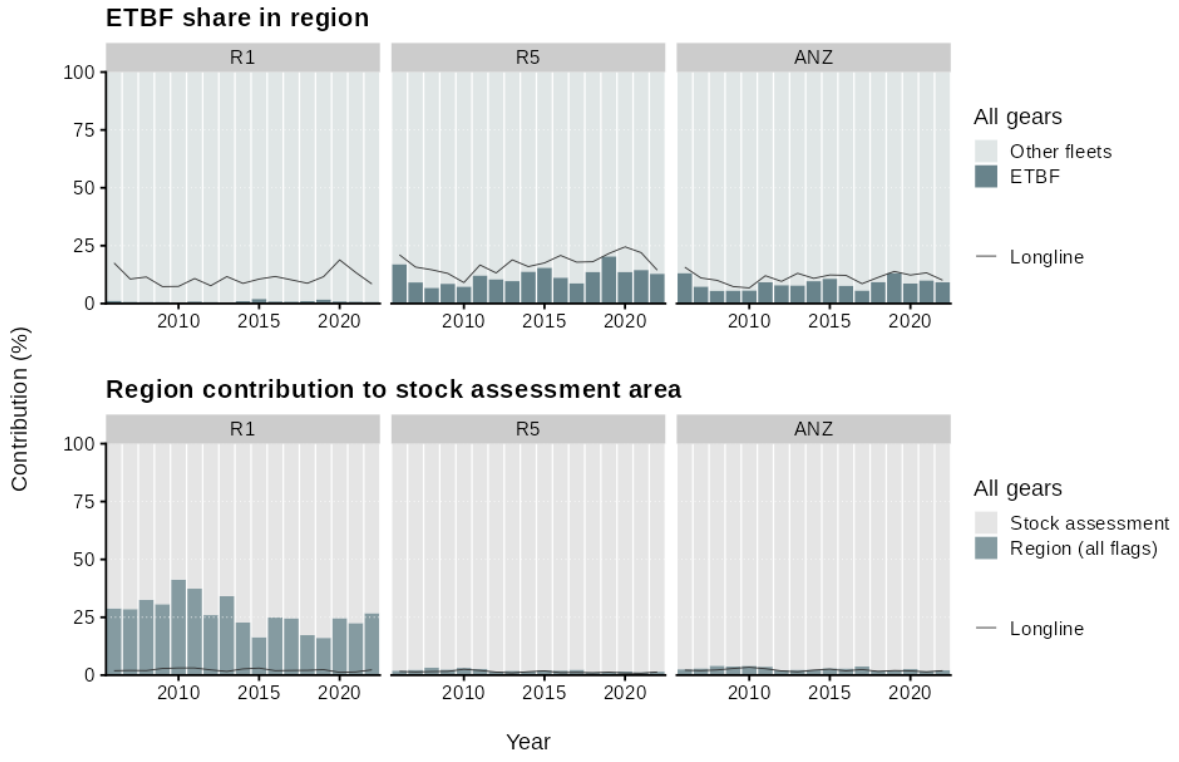

Figure 7: Contribution (%) of ETBF yellowfin tuna catch in weight to longline (solid line) and all gears (bar) catch in each region (top). Contribution (%) of the catch in weight taken in each region (all countries) to longline (solid line) and all gears (bar) catch in the stock assessment area for the species (bottom).

3.2.4 Broadbill swordfish

Table 7: Longline catch of broadbill swordfish by region and contribution (%) by the ETBF. Note, only longline gear is showed given very small catches by other gears.

	Longline catch (t)			ETBF (%)		
Year	R1	R5	ANZ	R1	R5	ANZ
2006	1 333.7	1 424.1	2 193.1	78.8	80.6	52.3
2007	1 360.4	1 382.8	2 292.1	82.9	83.6	50.4
2008	1 542.1	1 727.7	2 484.6	81.8	73.0	50.8
2009	1 514.0	1 392.0	2 980.4	73.7	81.2	37.9
2010	1 535.0	1 502.6	2 696.3	60.1	62.7	34.9
2011	1 835.9	1 419.9	3 068.0	49.9	64.5	29.9
2012	1 880.8	1 576.8	3 578.5	54.1	64.5	28.4
2013	1 579.3	1 431.7	3 141.2	56.8	62.7	28.6
2014	1 597.2	1 540.1	3 081.3	64.7	67.1	33.5
2015	1 474.5	1 466.3	4 054.8	65.0	65.3	23.6
2016	1 439.3	1 791.9	3 066.0	68.4	55.3	32.3
2017	1 522.9	1 702.2	2 816.3	70.0	62.6	37.8
2018	1 440.3	1 656.0	2 488.6	63.3	55.0	36.6
2019	1 273.6	1 590.7	2 130.9	64.2	51.4	38.4
2020	925.1	1 556.1	2 255.6	65.9	39.2	27.1
2021	1 022.6	1 423.6	2 355.2	64.1	46.1	27.9
2022	1 076.3	1 111.0	1 891.1	75.8	73.5	43.2
Mean	1 432.5	1 511.5	2 739.6	67.0	64.0	36.1
Mean 2013–2022	1 335.1	1 527.0	2 728.1	65.8	57.8	32.9
Mean 2018–2022	1 147.6	1 467.5	2 224.3	66.7	53.0	34.6

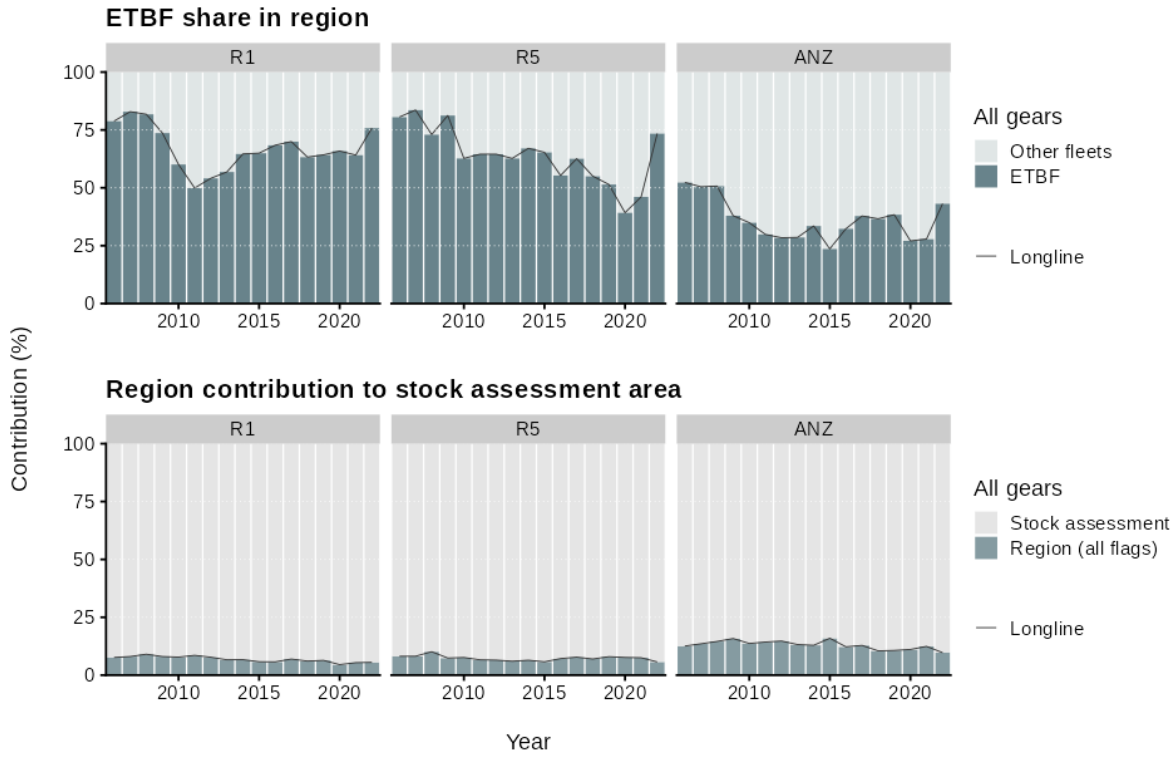

Figure 8: Contribution (%) of ETBF broadbill swordfish catch in weight to longline (solid line) and all gears (bar) catch in each region (top). Contribution (%) of the catch in weight taken in each region (all countries) to longline (solid line) and all gears (bar) catch in the stock assessment area for the species (bottom).

3.2.5 Striped marlin

Table 8: Longline catch of striped marlin by region and contribution (%) by the ETBF. Note, only longline gear is showed given very small catches by other gears.

	Longline catch (t)			ETBF (%)			ETBF (%, incl. rec.)		
Year	R1	R5	ANZ	R1	R5	ANZ	ANZ	R1	R5
2006	677.9	723.7	836.4	72.0	69.9	60.5	53.6	70.0	60.8
2007	477.5	539.7	698.4	69.5	61.9	47.8	40.9	66.0	50.7
2008	558.8	734.9	1 028.8	67.8	51.6	36.8	33.8	65.1	45.8
2009	569.1	555.0	851.2	57.6	59.3	38.7	33.6	55.8	48.2
2010	620.6	641.3	754.3	39.7	38.6	32.8	28.7	38.1	33.1
2011	662.8	671.8	846.0	44.5	43.9	34.9	31.2	43.2	38.2
2012	512.8	518.0	681.5	45.3	44.8	34.1	29.0	42.4	36.4
2013	411.1	417.9	498.9	52.0	51.1	42.8	34.9	51.0	40.3
2014	465.1	475.2	579.3	51.5	50.4	41.3	35.9	50.3	42.5
2015	500.3	510.5	649.3	64.7	63.4	49.9	42.6	61.6	52.1
2016	385.0	400.1	539.6	59.7	57.5	42.6	32.3	55.4	40.2
2017	397.5	392.9	492.5	65.6	66.3	52.9	45.2	62.8	54.6
2018	331.7	335.0	491.1	68.6	67.9	46.3	38.5	63.1	52.3
2019	365.0	371.4	454.0	61.9	60.9	49.8	39.6	57.9	46.4
2020	300.7	313.2	385.1	57.1	54.8	44.6	34.3	52.6	40.0
2021	319.0	329.8	470.4	55.2	53.4	37.5	30.1	51.2	39.5
2022	442.0	465.9	564.6	55.8	53.0	43.8	36.3	52.7	42.4
Mean	470.4	493.9	636.5	58.1	55.8	43.4	36.5	55.3	44.9
Mean 2013–2022	391.7	401.2	512.5	59.2	57.9	45.1	37.0	55.9	45.0
Mean 2018–2022	351.7	363.1	473.0	59.7	58.0	44.4	35.7	55.5	44.1

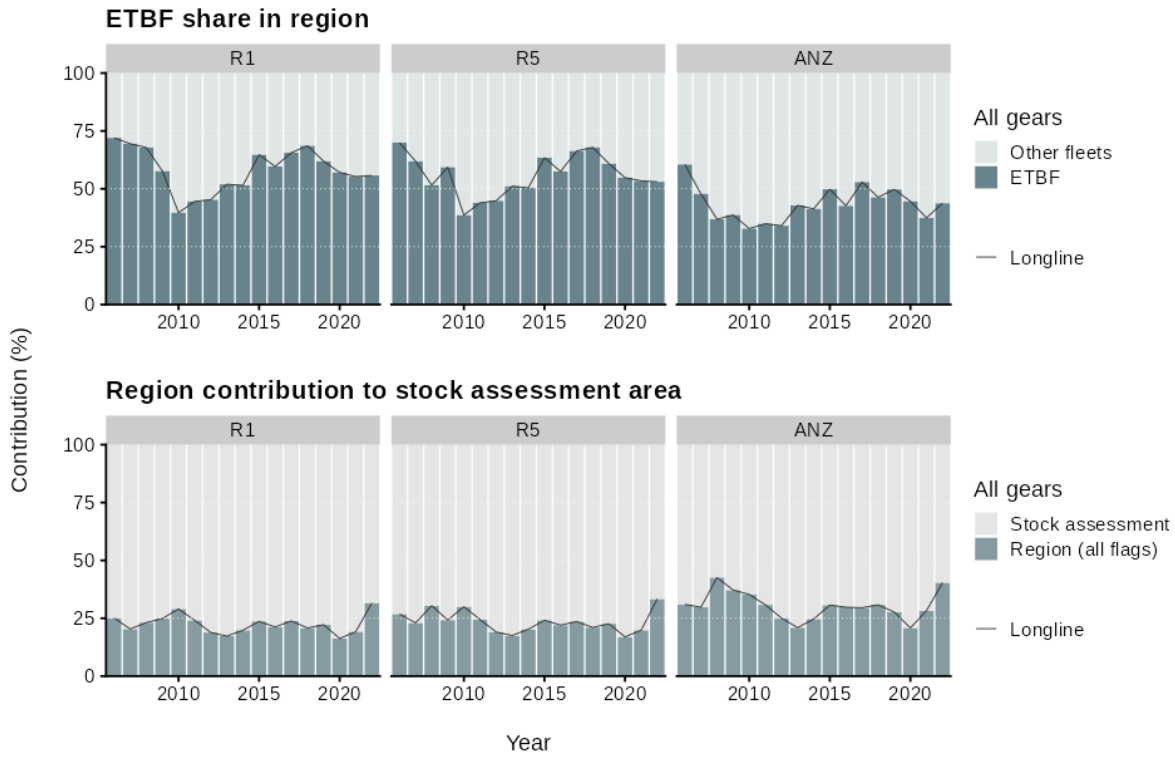

Figure 9: Contribution (%) of ETBF striped marlin catch in weight to longline (solid line) and all gears (bar) catch in each region (top). Contribution (%) of the catch in weight taken in each region (all countries) to longline (solid line) and all gears (bar) catch in the stock assessment area for the species (bottom).

3.3 Annual catches by country

3.3.1 Albacore tuna

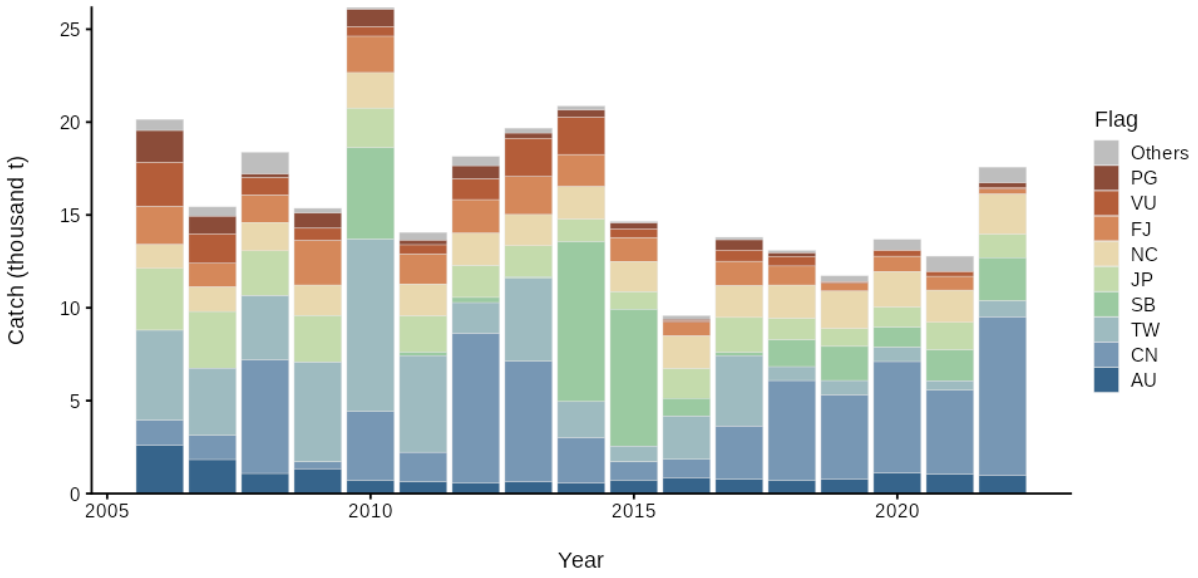

Figure 10: Annual catch of albacore tuna (in thousand tons) by country in Region 5. Countries contributing to less than 2.5% of the total catch are grouped into the ”Others” category.

3.3.2 Bigeye tuna

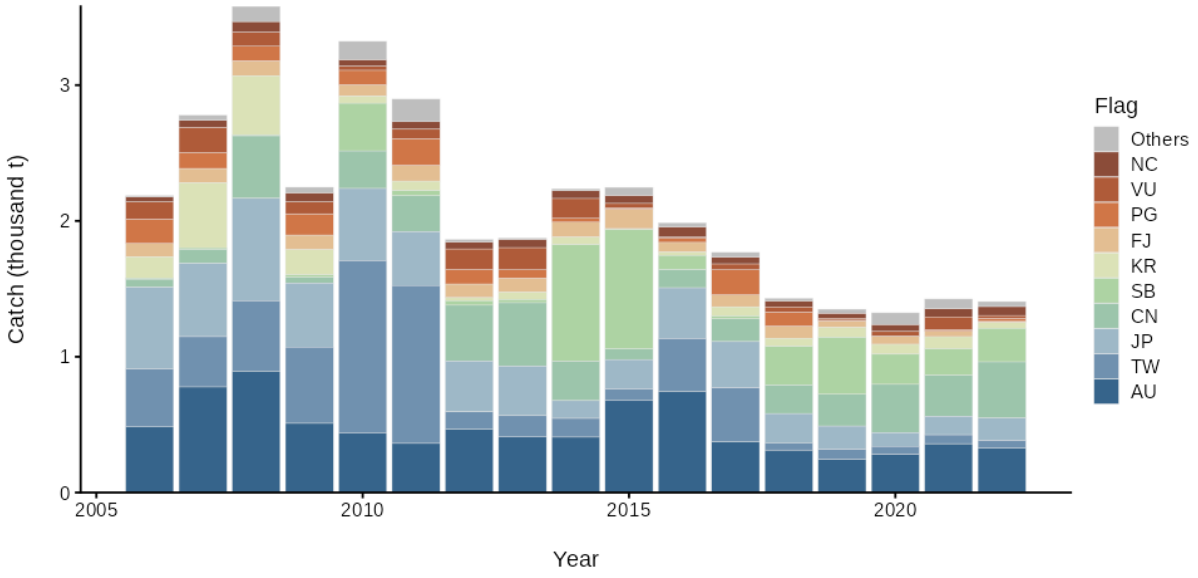

Figure 11: Annual catch of bigeye tuna (in thousand tons) by country in Region 5. Countries contributing to less than 2.5% of the total catch are grouped into the ”Others” category.

3.3.3 Yellowfin tuna

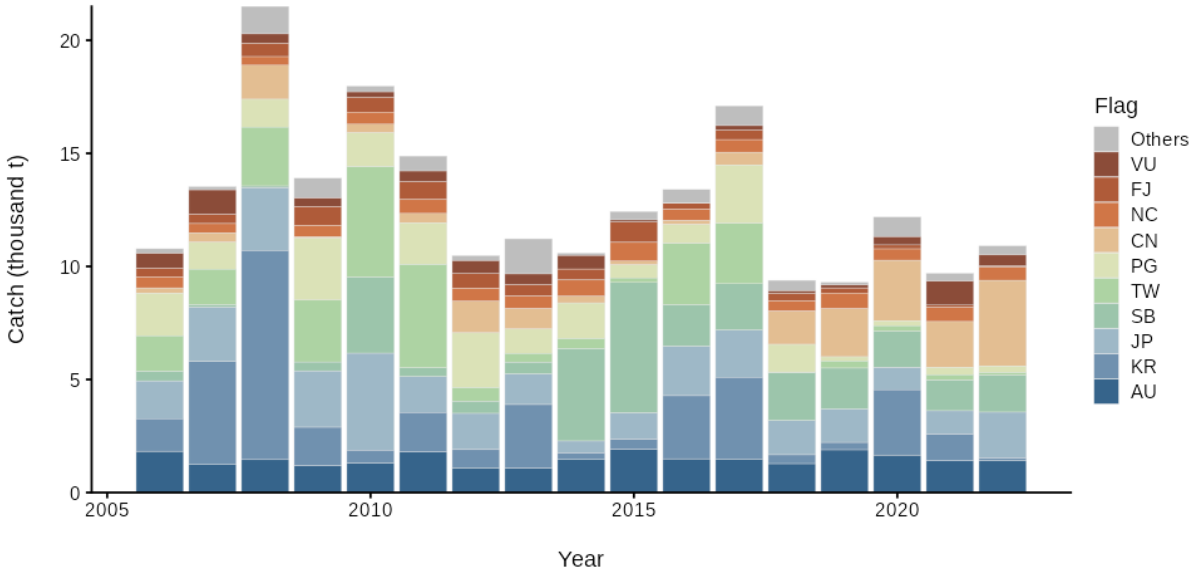

Figure 12: Annual catch of yellowfin tuna (in thousand tons) by country in Region 5. Countries contributing to less than 2.5% of the total catch are grouped into the ”Others” category.

3.3.4 Broadbill swordfish

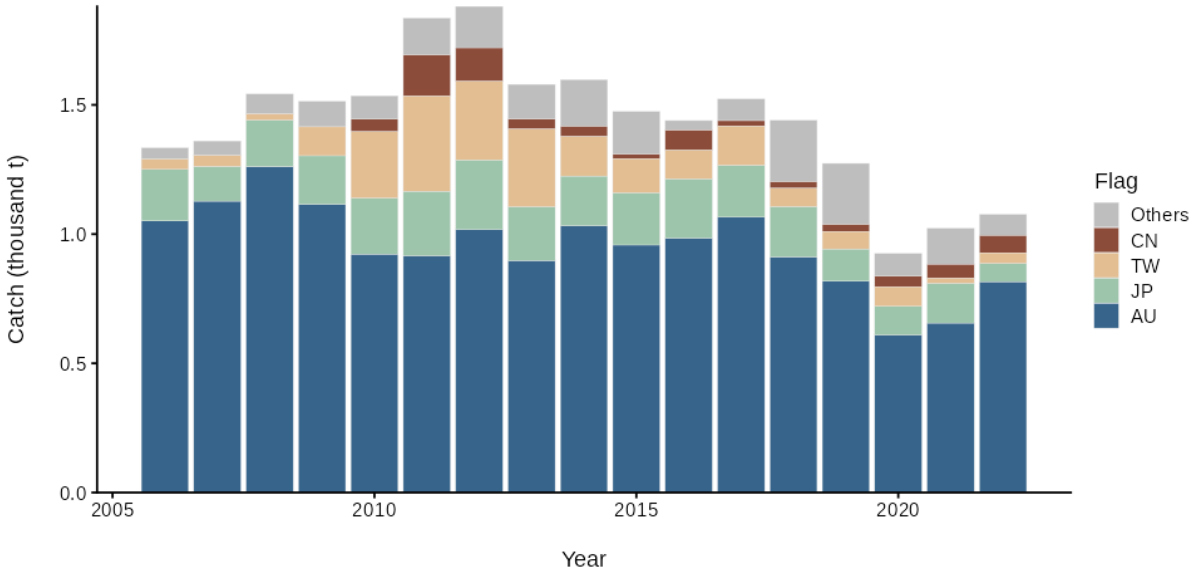

Figure 13: Annual catch of broadbill swordfish (in thousand tons) by country in Region 1. Countries contributing to less than 2.5% of the total catch are grouped into the ”Others” category.

3.3.5 Striped marlin

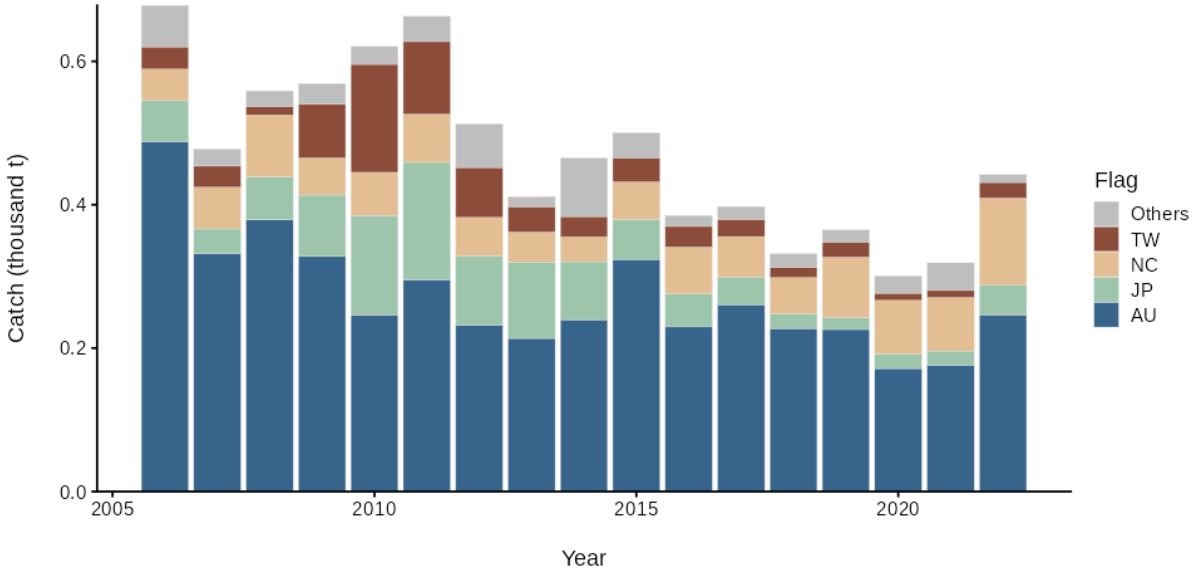

Figure 14: Annual catch of striped marlin (in thousand tons) by country in Region 1. Countries contributing to less than 2.5% of the total catch are grouped into the ”Others” category. Recreational catches from New Zealand and Australia are included in catch statistics.

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Attachment 3.4a

Australia's National
Science Agency

Summary of status and CPUE indicators for ETBF target species

ENVIRONMENT

Ashley J. Williams and Laura Tremblay-Boyer

03 October 2023

Working Paper to the 39th meeting of Tropical Tuna Resource Assessment Group held 3rd October 2023

Citation

Williams AJ and Tremblay-Boyer L (2023) Summary of status and CPUE indicators for ETBF target species. CSIRO Environment, working paper to the 39th meeting of Tropical Tuna Resource Assessment Group held 3rd October 2023, online.

Contents

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1 Introduction

This paper presents a high level summary of stock status for the target species of the Eastern Tuna and Billfish Fishery (ETBF). Stock assessment results are summarised for each species from the various Western and Central Pacific Fisheries Commission (WCPFC) stock assessment papers. A summary of stock status indicators using ETBF data is also provided for each of the species with standardised catch-per-unit-effort (CPUE) abundance indices presented from the most recent analysis. It should be noted that catch data presented below is based on Catch Disposal Records (CDR) where possible, followed by processor and logbook data (Dell et al. 2021). More background information on the ETBF, fisheries across the Western and Central Pacific Ocean (WCPO), and current management arrangements are available in Campbell (2020). Species summarised are:

- South Pacific albacore tuna (*Thunnus alalunga*)
- Bigeye tuna (*Thunnus obesus*)
- Broadbill swordfish (*Xiphias gladius*)
- Striped marlin (*Kajikia audax*)
- Yellowfin tuna (*Thunnus albacares*)

2 Stock status overview

The results of the most recent stock assessments undertaken for each of the principal catch species in the ETBF are shown in Figure 1. Note that the year of the most recent assessment varies across species (i.e., 2023 for yellowfin and bigeye tuna, 2022 for skipjack tuna, 2021 for south Pacific albacore and broadbill swordfish, and 2019 for striped marlin).

The results from these assessments indicate, based on the median values across the uncertainty grid adopted for each species, that for five species (yellowfin tuna, bigeye tuna, south Pacific albacore, skipjack tuna and broadbill swordfish) the stock is not overfished (i.e. $SB_{recent}/SB_{F=0} > 0.2$) nor is overfishing occurring (i.e. $F_{recent}/F_{MSY} < 1$). For striped marlin, however, the stock is at the point of being overfished ($SB_{recent}/SB_{F=0}$~0.20) based on the limit reference point adopted for tunas of 0.2, and close to being subject to overfishing (i.e. $F_{recent}/F_{MSY} = 0.91$).

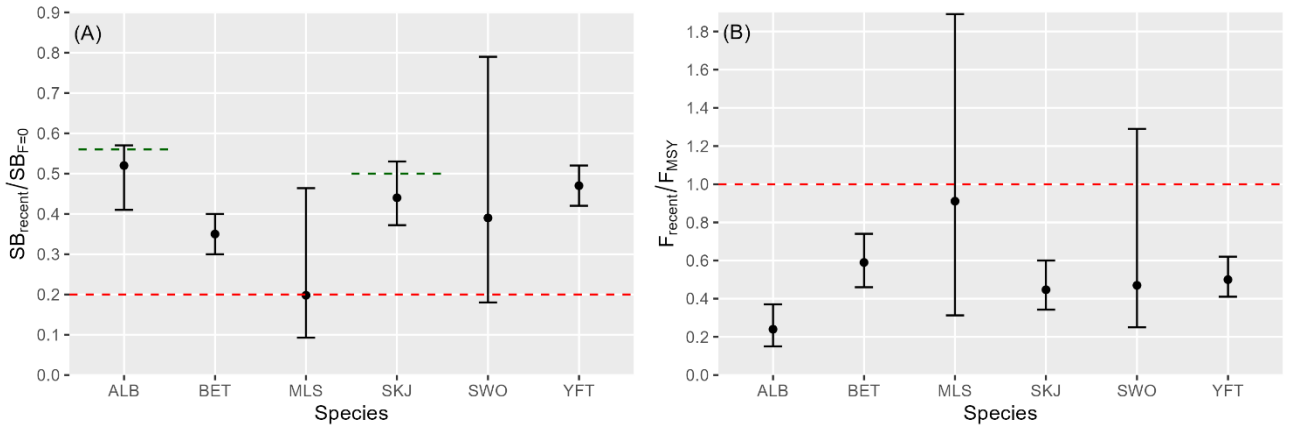

Figure 1. Median value (and 80% probability interval) of (A) the time-dynamic spawning biomass depletion ($SB_{recent}/SB_{F=0}$) and (B) fishing mortality ratio (F_{recent}/F_{MSY}) across the respective uncertainty grid used in the stock assessment for each of the principal tuna and billfish species in the WCPO. In (A) the dotted red line indicates the Limit Reference Point (LRP) adopted by the WCPFC for tunas while the dotted green line indicates the Target Reference Point adopted for skipjack tuna and south Pacific albacore tuna, while in (B) the dotted red line is a generally accepted MSY-based LRP for fishing mortality. ALB = south Pacific albacore, BET = bigeye tuna, MLS = striped marlin, SKJ = skipjack tuna, SWO = broadbill swordfish, YFT = yellowfin tuna.

3 Regions of interest

TTRAG takes into consideration information about the ETBF catch relative to the catch of other fleets in regions adjacent to the ETBF. To do this, “Region 1” is used for the two billfish species and “Region 5” is used for the three tuna species. A third “ANZ region” region is used elsewhere (but not in this paper) for any species. A map of these regions is shown in Figure 2 and a description is as follows:

Region 1

Region 1 is used for the two billfish species. This region, bounded by 0-50^{o}S and 140-165^{o}E, extends eastwards from the east coast of Australia and comprises most of the area fished by the ETBF fleet in recent years. Region 1 is one of the two regions used in stock assessments for broadbill swordfish in the south Pacific (Ducharme-Barth et al. 2021). Note, at present no regional structure is used in the assessment for southwest Pacific striped marlin.

Region 5

Region 5 is based on two of the nine regions used in the 2020 stock assessment models for yellowfin tuna (Vincent et al., 2020) and bigeye tuna (Ducharme-Barth et al., 2020) within the WCPO. These two assessment regions (5 and 9) bounded by 10-40^{o}S, and 140-170^{o}E, extend eastwards from the east coast of Australia and comprise both the main area fished by the ETBF fleet and a large proportion of both the Coral and Tasman Seas. These two regions are combined for the analyses presented here and referred to as Region 5. Also, in order to encompass all ETBF fishing operations, including those off eastern Tasmania, the southern boundary was extended to 50^{o}S. Note, the regions used in the assessment for South Pacific albacore tuna do not align with those used for the two tropical tunas, with region bounded by 0-50^{o}S, and 140-150^{o}W divided into three latitudinal zones with boundaries at 10^{o}S and 25^{o}S.

Australia-New Zealand (ANZ) region

This region represents an extension of the eastern boundary of Region 5 to 175^{o}W, encompassing much of the New Zealand exclusive economic zone and adjacent high seas. This region is not used in the figures reported in this paper but is mainly used in other papers to look at relative regional catches of broadbill swordfish and striped marlin in an extended area where there is uncertainty around stock connectivity with the ETBF. This region is distinct from and smaller than the SW-Pacific regions used in the assessments for the two billfish species.

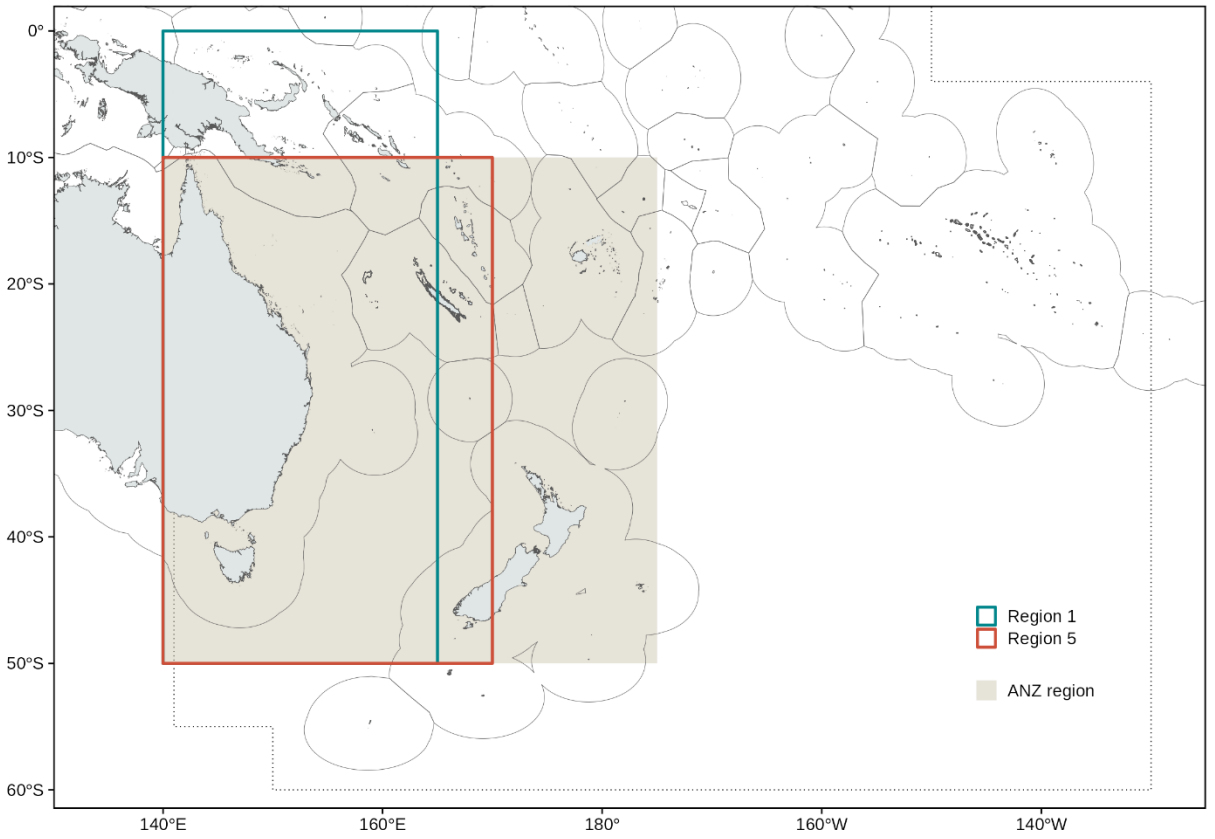

Figure 2. Map showing the boundaries of the three regions used in the analyses described in this paper. The boundaries associated with the exclusive economic zones for the nations within this region are also shown. Region-5 is used for the three tuna species, Region-1 is used for the two billfish species, while the ANZ region is used for all species. The dotted line indicates the boundary of the WCPFC Convention area.

4 Species summaries

4.1 South Pacific albacore tuna

South Pacific albacore tuna (*Thunnus alalunga*) were last assessed and presented at the WCPFC scientific committee meeting in 2021 (Jordán *et al*., 2021). The assessment results were consistent with the 2018 assessment. In summary:

- South Pacific albacore tuna are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2016-2019; $SB_{recent}/SB_{F=0}$) was 0.52 with a range (80% CI) of 0.41–0.57. None of the 72 model runs estimated depletion to be below 0.2.
- South Pacific albacore tuna are not subject to overfishing. The median estimate of recent (2015-2018) fishing mortality relative to F_{MSY} (F_{recent}/F_{MSY}) was 0.24 with a range (80% CI) of 0.15-0.37. None of the 72 model runs estimated recent fishing mortality to be above F_{MSY}.

In the ETBF, the 2022 catch of albacore tuna (1132 t) was above both the five-year (2017-2021) and ten-year (2012-2021) average catch of albacore tuna in the ETBF of 1015 t and 934 t respectively (Figure 3). Catches of albacore tuna in the ETBF have been slowly increasing over the last decade after a sharp decline from a peak in 2006.

The 2022 ETBF catch of albacore tuna represents 6% of the provisional total catch of albacore tuna within Region 5 (10-50^{o}S and 140-170^{o}E). The average contribution is 7% over the previous five years (2017-2021), with a maximum in recent years of 9% in 2016 (Tremblay-Boyer and Williams, 2023a).

The median of processed fish weights has increased slightly over time, with bimodality for some years, including 2021 and 2022, (Figure 4) (Tremblay-Boyer and Williams, 2023b).

The standardised CPUE index of albacore tuna has been highly variable over time. It remains above the recent five-year average in 2022 (Figure 5) (Tremblay-Boyer and Williams, 2023c).

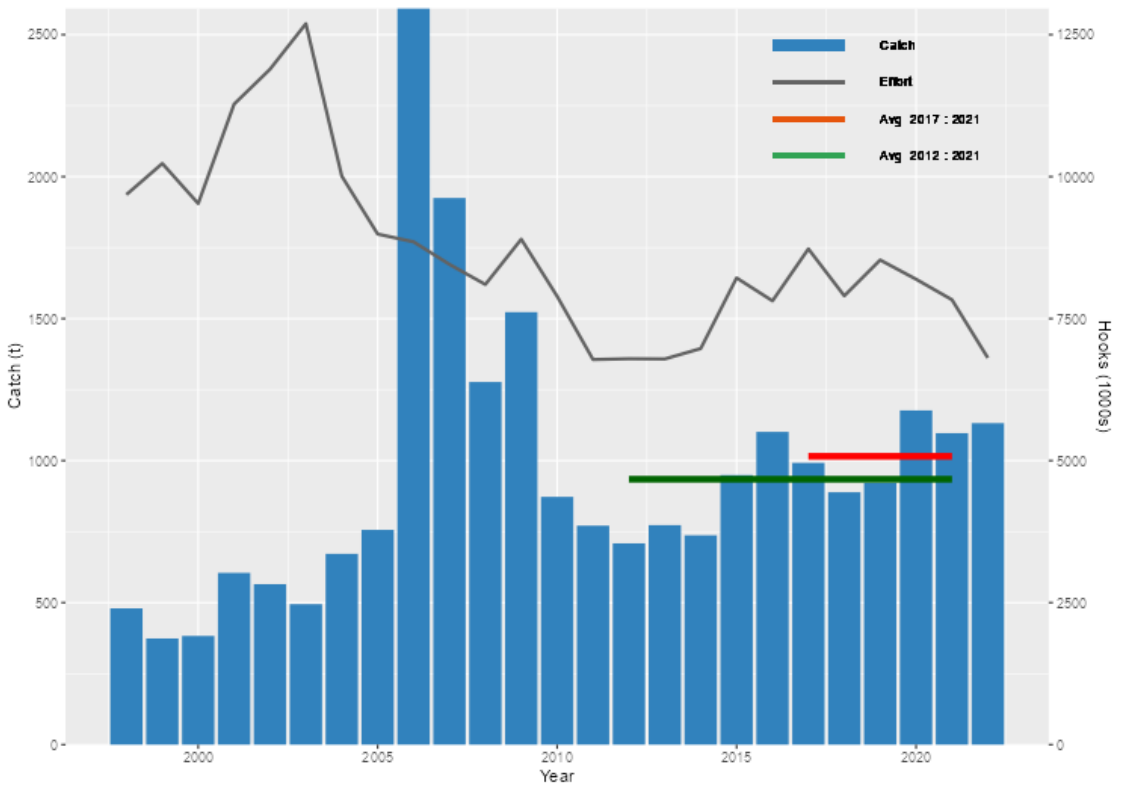

Figure 3 Total albacore tuna catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

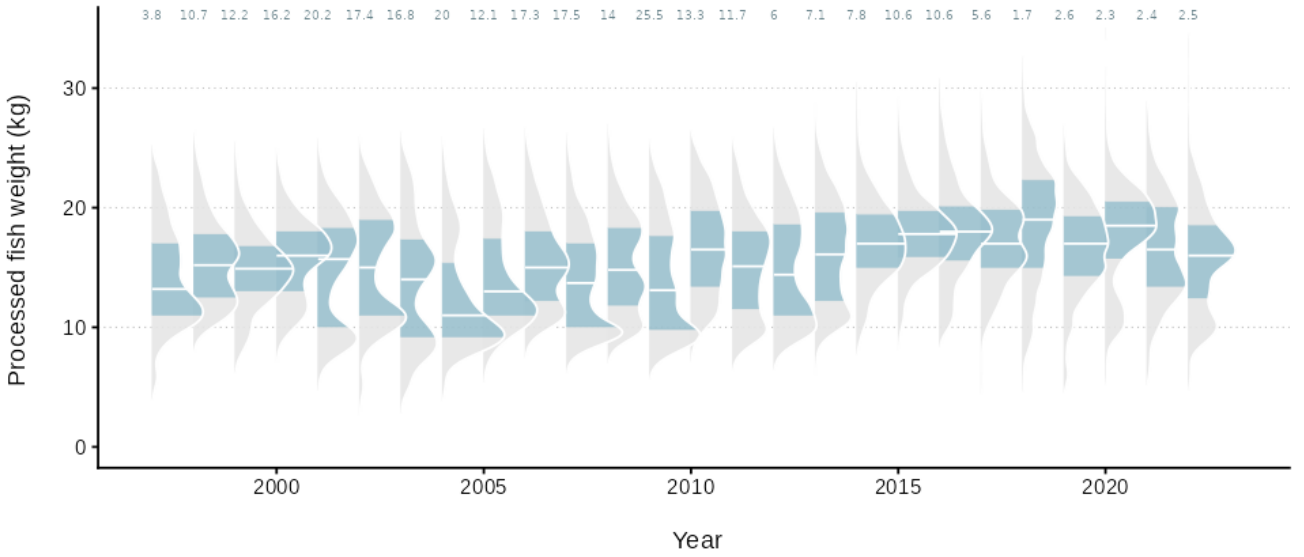

Figure 4 The distribution in processed weights (kg) of albacore tuna caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay-Boyer and Williams, 2023b).

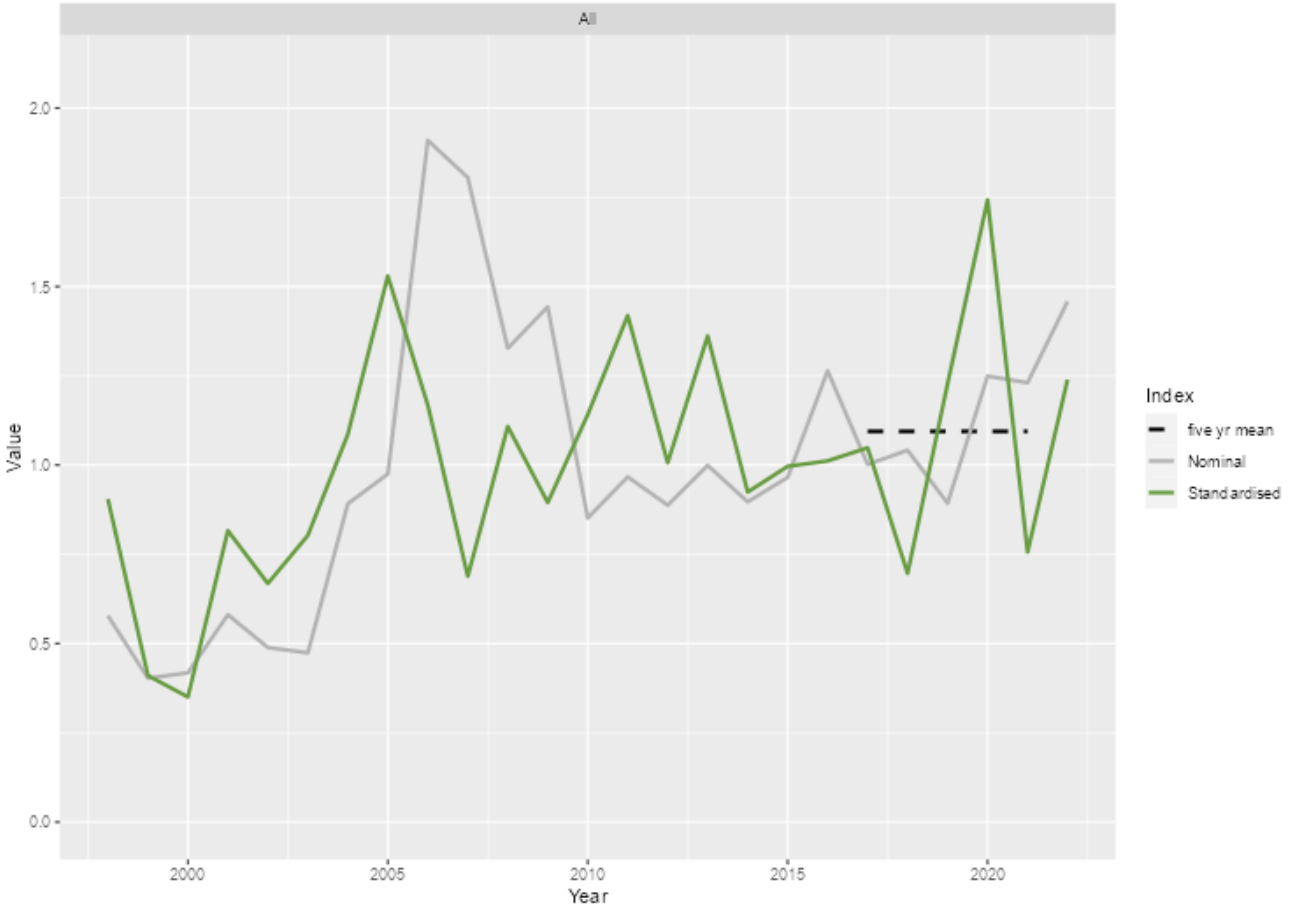

Figure 5 Nominal and standardised CPUE time series for albacore tuna in the ETBF and the recent five-year average (2017-2021) (source: Tremblay-Boyer and Williams, 2023c).

4.2 Bigeye tuna

A new stock assessment for bigeye tuna (*Thunnus obesus*) in the WCPO was conducted in 2023 (Day et al., 2023). Results were similar to the 2020 stock assessment (Ducharme-Barth et al., 2020), except that the stock was estimated to be more depleted (lower depletion level), and fishing mortality was estimated to be lower in the 2023 assessment (Day et al., 2023). Uncertainty in these estimates was also lower in the 2023 assessment. In summary:

- Bigeye tuna are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2018-2021; $SB_{recent}/SB_{F=0}$) was 0.35 with a range (80% CI) of 0.30–0.40. None of the model runs estimated depletion to be below 0.2.
- Bigeye tuna are not subject to overfishing. The median estimate of recent (2017-2020) fishing mortality relative to F_{MSY} (F_{recent}/F_{MSY}) was 0.59 with a range (80% CI) of 0.46-0.74. None of the model runs estimated recent fishing mortality to be above F_{MSY}.

In the ETBF, the 2022 catch of bigeye tuna (346 t) is below both the five-year and ten-year average catch in the ETBF of 360 t and 499 t respectively (Figure 6). Catches of bigeye tuna in the ETBF have declined since a peak in 2016, however catches have shown a slight increase in 2021 and 2022.

The 2022 ETBF catch of bigeye tuna represents 23% of the provisional total catch of bigeye tuna within Region 5 (10-50^{o}S and 140-170^{o}E). The average contribution is 22% over the previous five years (2017-2021), with a maximum of 38% in 2016 (Tremblay-Boyer and Williams, 2023a).

The distribution of processed fish weights of bigeye tuna has been variable across size classes (small, prime, and large), but with no clear directional trends (Figures 7 and 8). There is a bimodal distribution of sizes in several years, potentially indicating progression of cohorts (Tremblay-Boyer and Williams, 2023b).

The standardised CPUE indices for bigeye tuna increased for adults but decreased for recruits in 2022 (Figure 9) (Tremblay-Boyer and Williams, 2023c). Overall, the standardised CPUE index for all sizes declined slightly in 2022. The CPUE indices for adults and all sizes combined were above the recent five-year average in 2022, while the CPUE for recruits was below. Each of the indices have been below average or declining over the last five to ten years and these increases show a return of the index toward the long-term average.

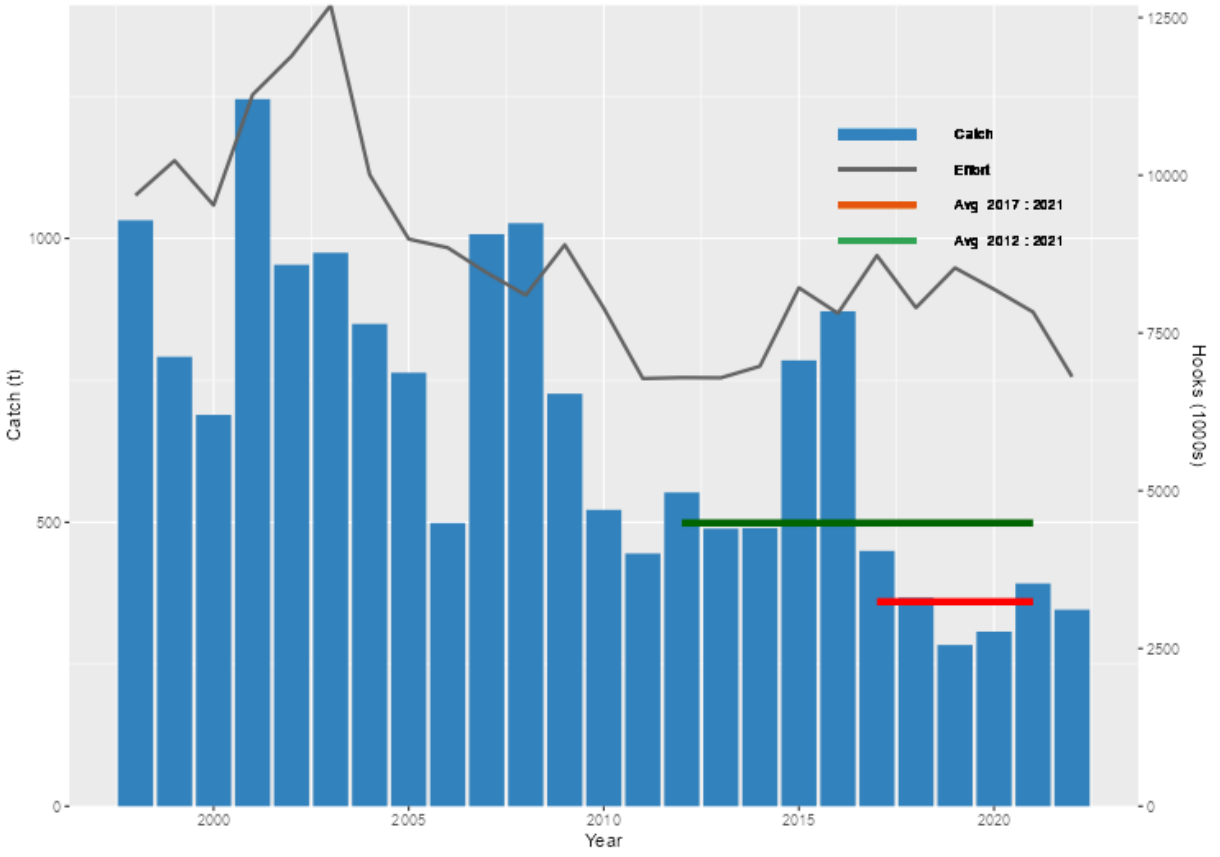

Figure 6 Total bigeye tuna catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

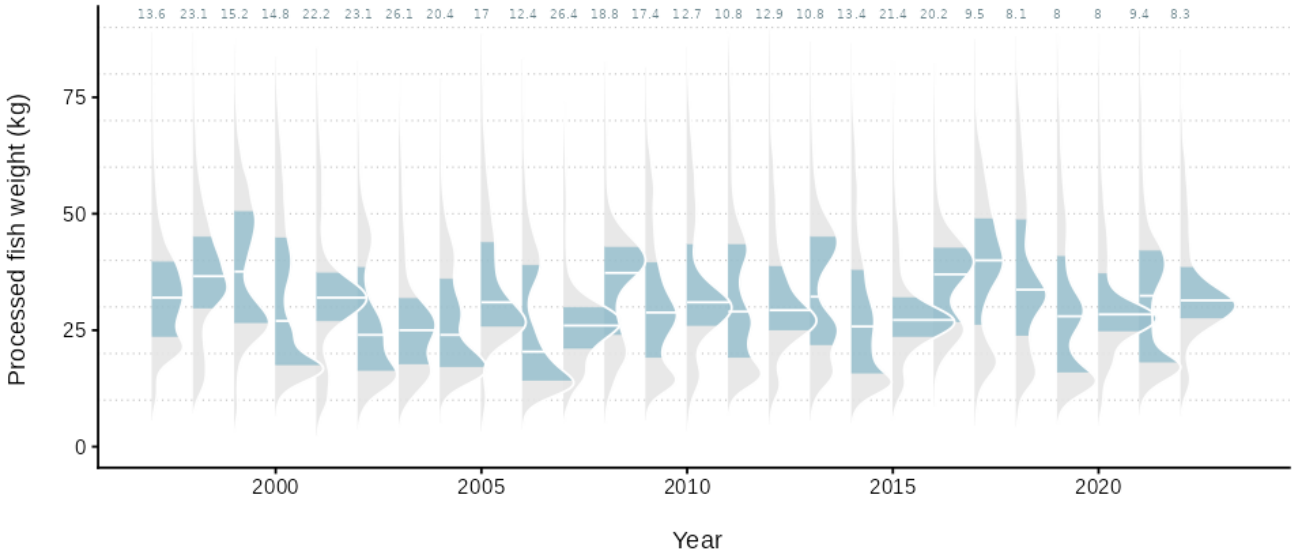

Figure 7 The distribution in processed weights (kg) of bigeye tuna caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay-Boyer and Williams, 2023b).

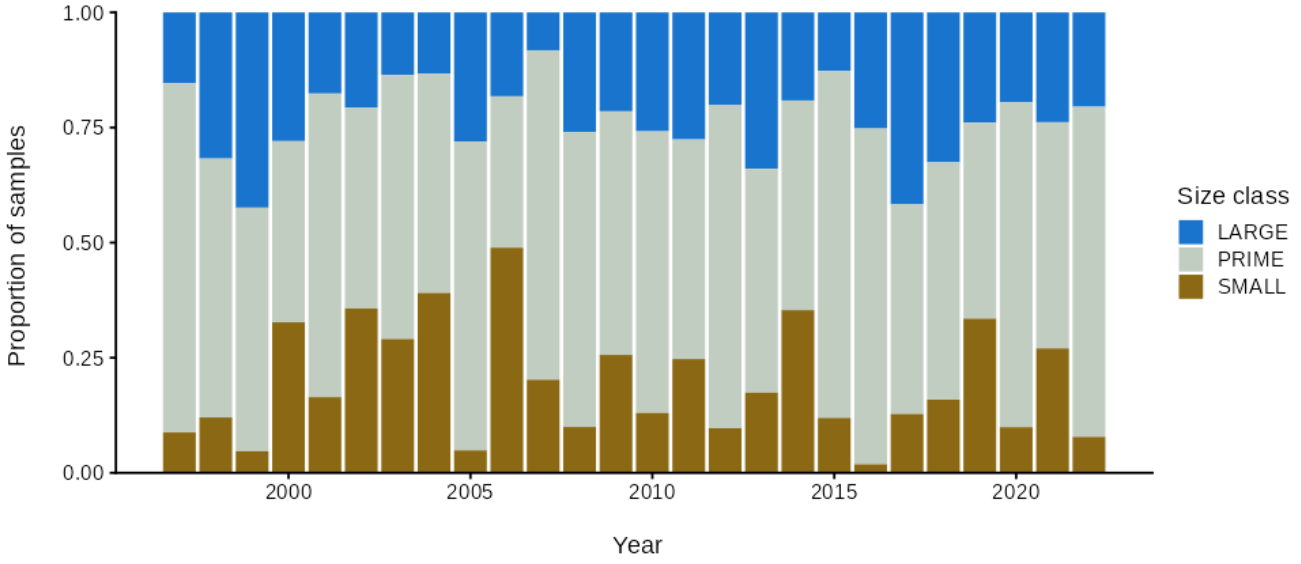

Figure 8 Size distribution of bigeye tuna caught in the ETBF across small, prime, and large size classes. (source: Tremblay-Boyer and Williams, 2023b)

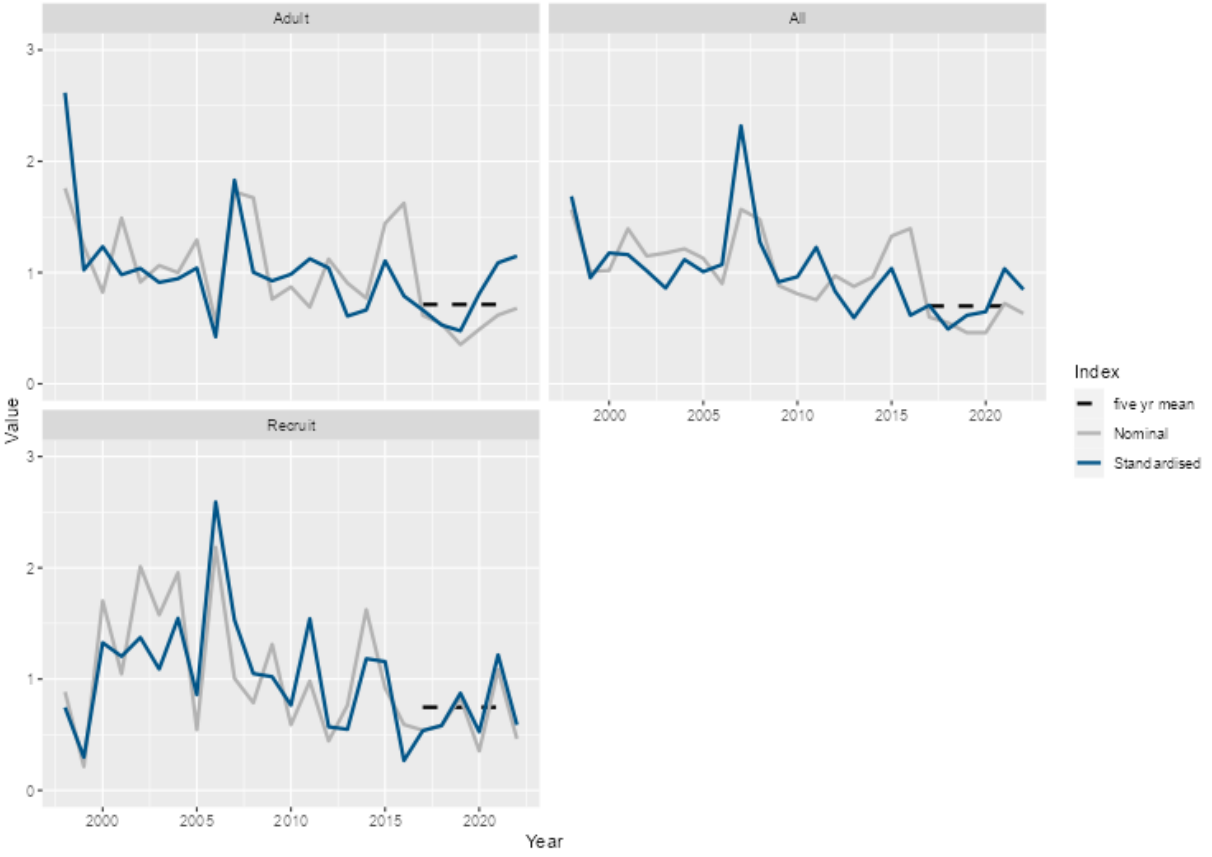

Figure 9 Nominal and standardised CPUE time series for bigeye tuna in the ETBF across size classes and the recent five-year average (2017-2021) (source: Tremblay-Boyer and Williams, 2023c).

4.3 Broadbill swordfish

Broadbill swordfish (*Xiphias gladius*) were last assessed in the WCPO in 2021 using data up to 2019 (Ducharme-Barth et al., 2021). The outcomes of the stock assessment are on average more optimistic than the 2017 assessment, however uncertainty in estimates has increased. In summary:

- Broadbill swordfish are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2018-2021; $SB_{recent}/SB_{F=0}$) was 0.39 with a range (80% CI) of 0.18-0.79. There is a 10% probability that depletion in spawning biomass is below 0.2.
- Broadbill swordfish are unlikely to be subject to overfishing. The median estimate of recent (2017-2020) fishing mortality relative to F_{MSY} (F_{recent}/F_{MSY}) was 0.47 with a range (80% CI) of 0.25-1.29. There is a 20% probability that fishing mortality is above F_{MSY}.

In the ETBF, the 2022 catch of broadbill swordfish (723 t) is below both the five-year and ten-year average catch in the ETBF of 846 t and 994 t respectively (Figure 10). Catches of broadbill swordfish in the ETBF have been gradually declining over time from a peak in the late 1990s and early 2000s, but have started to increase in the past 2 years since the lowest catches were reported in 2020.

The 2022 ETBF catch of broadbill swordfish represents 76% of the provisional total catch of broadbill swordfish within Region 1 (0-50^{o}S and 140-165^{o}E). The average contribution is 67% over the previous five years (2017-2021), with a maximum of 83% in 2007 (Tremblay-Boyer and Williams, 2023a).

The annual size distribution (Figure 11) shows a clear mode of smaller individuals and a median much higher than the mode across all years, reflecting a wide span of weights in the catch samples. The proportion of large broadbill swordfish landed has declined over the last six years, while the proportion of small fish has increased. However, the proportion of prime-sized broadbill swordfish has increased over the past year or two, likely due to the growth of small fish moving them into the prime size category, resulting in an increase in the overall median size of fish (Figure 11 and 1) (Tremblay-Boyer and Williams, 2023b).

For all size groups, the standardised CPUE index appears to vary cyclically with a low period from 2016. There is an increase in the standardised CPUE indices from 2021 to 2022 for all size groups, except recruits where the index remains stable (Figure 13) (Tremblay-Boyer and Williams, 2023c). The sub-adults group shows the steepest increase in 2022.

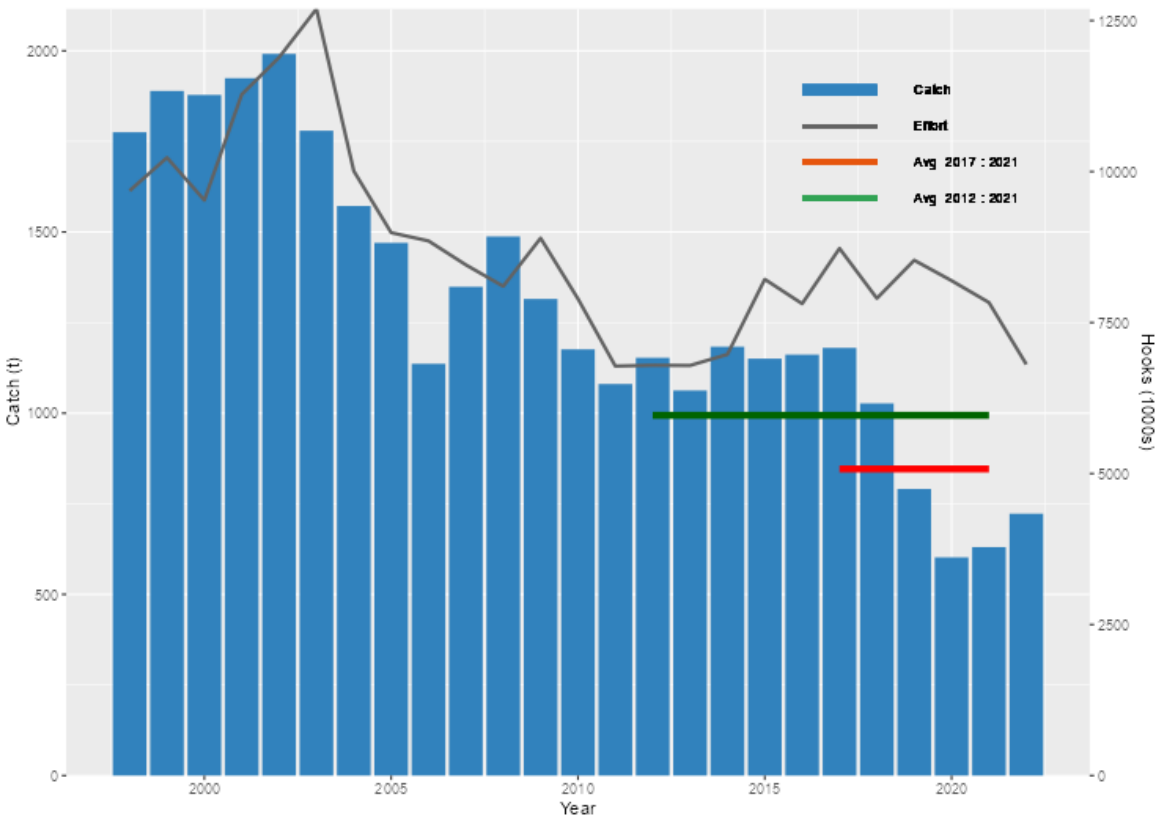

Figure 10 Total broadbill swordfish catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

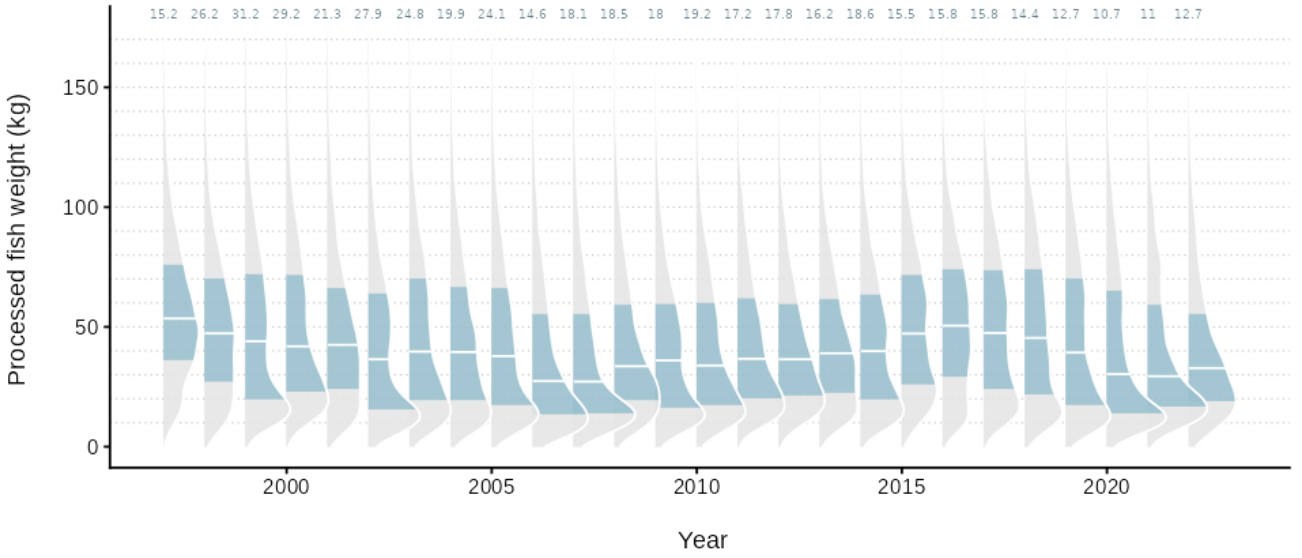

Figure 11 The distribution in processed weights (kg) of broadbill swordfish caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay-Boyer and Williams, 2023b).

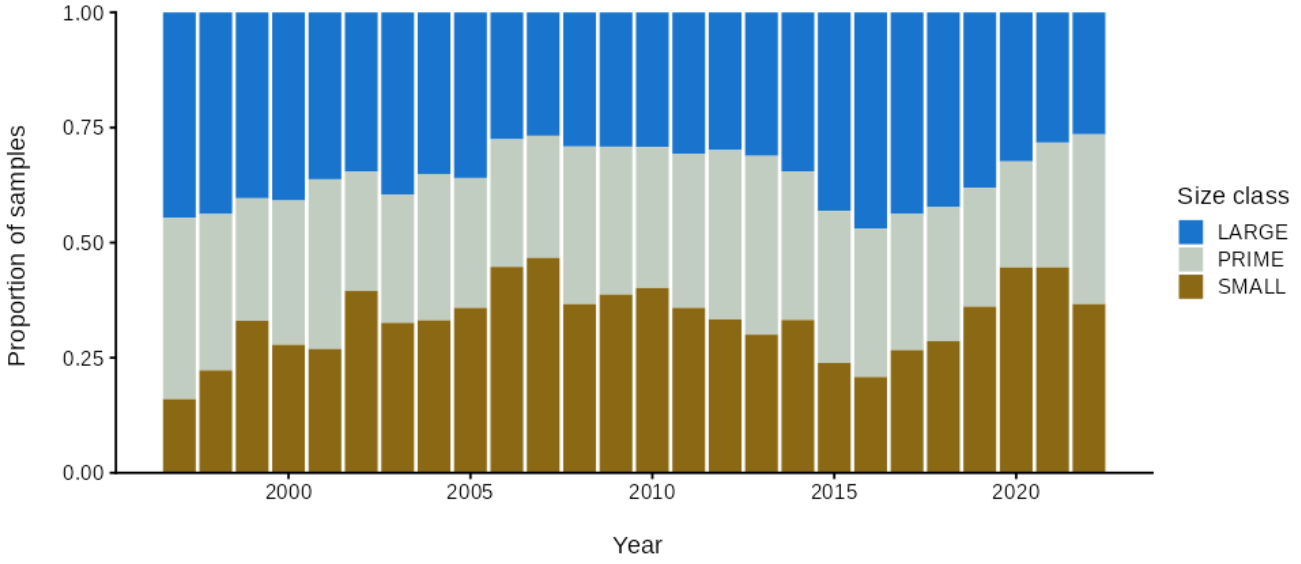

Figure 1 Size distribution of broadbill swordfish caught in the ETBF across small, prime, and large size classes (source: Tremblay-Boyer and Williams, 2023b).

Figure 2 Nominal and standardised CPUE time series for broadbill swordfish in the ETBF across size classes and the recent five-year average (2017-2021) (source: Tremblay-Boyer and Williams, 2023c).

4.4 Striped marlin

Striped marlin (*Kajikia audax*) in the WCPO were last assessed in 2019 (Ducharme-Barth *et al*., 2019). In summary:

- Striped marlin are potentially overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2014-2017; $SB_{recent}/SB_{F=0}$) was 0.2 with a range (80% CI) of 0.09-0.46. There is a 50% probability that depletion in spawning biomass is below 0.2.
- Striped marlin are potentially subject to overfishing. Estimates of fishing mortality were highly uncertain, with the median estimate of recent (2013-2016) fishing mortality relative to F_{MSY} (F_{recent}/F_{MSY}) of 0.91 with a range (80% CI) of 0.31-1.89. There is a 44% probability that fishing mortality is above F_{MSY}.

In the ETBF, the 2022 catch of striped marlin (283 t) is above both the five-year and ten-year average catch in the ETBF of 239 t and 257 t respectively (Figure 3). Catches of striped marlin in the ETBF have been declining gradually over time since a peak in 2001, but increased sharply in 2022.

The 2022 ETBF catch of striped marlin represents 56% of the provisional total catch of striped marlin within Region 1 (0-50^{o}S and 140-165^{o}E). The average contribution is 60% over the previous five years (2017-2021), with a maximum of 72% in 2006 (Tremblay-Boyer and Williams, 2023b).

The annual size distribution shows a single mode between about 50 and 70 kg throughout the time series with a decline in median size over time but a slight increase from 2021 to 2022 (Figure 4 and 5) (Tremblay-Boyer and Williams, 2023b).

The standardised CPUE index for striped marlin has been relatively stable over the last two decades (Figure **Error! Reference source not found.**). Standardised CPUE reached a minimum in 2020, but it has increased sharply, above the five-year recent average in 2022 (Tremblay-Boyer and Williams, 2023c).

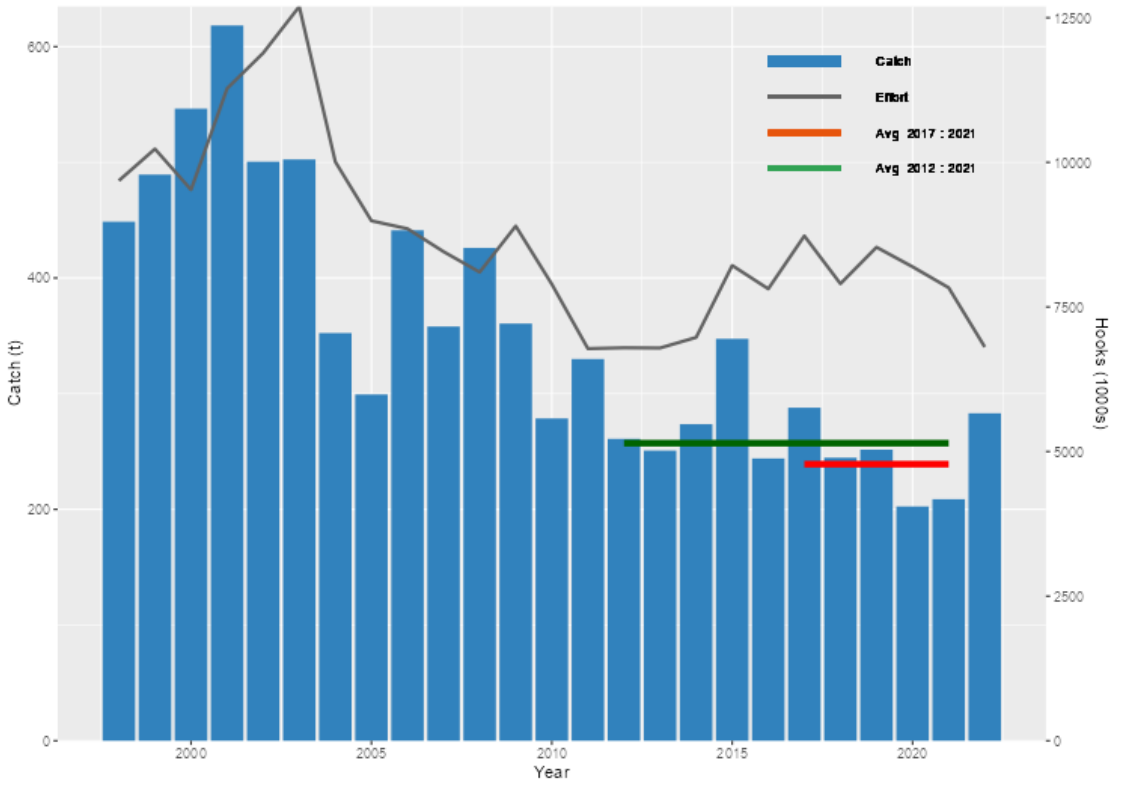

Figure 3 Total striped marlin catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

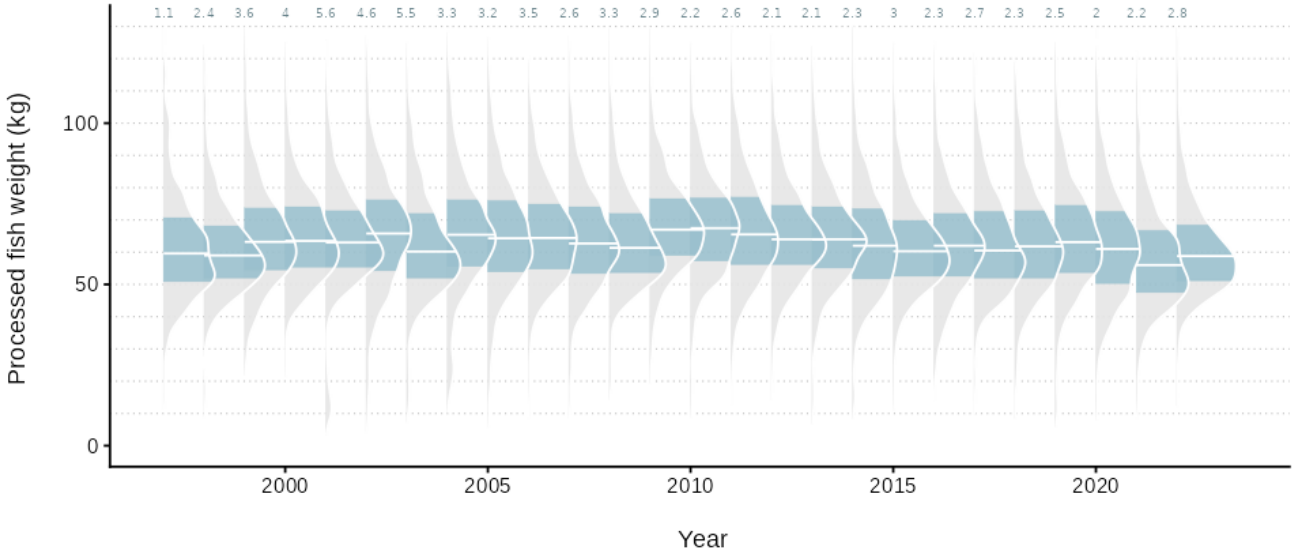

Figure 4 The distribution in processed weights (kg) of striped marlin caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay-Boyer and Williams, 2023b).

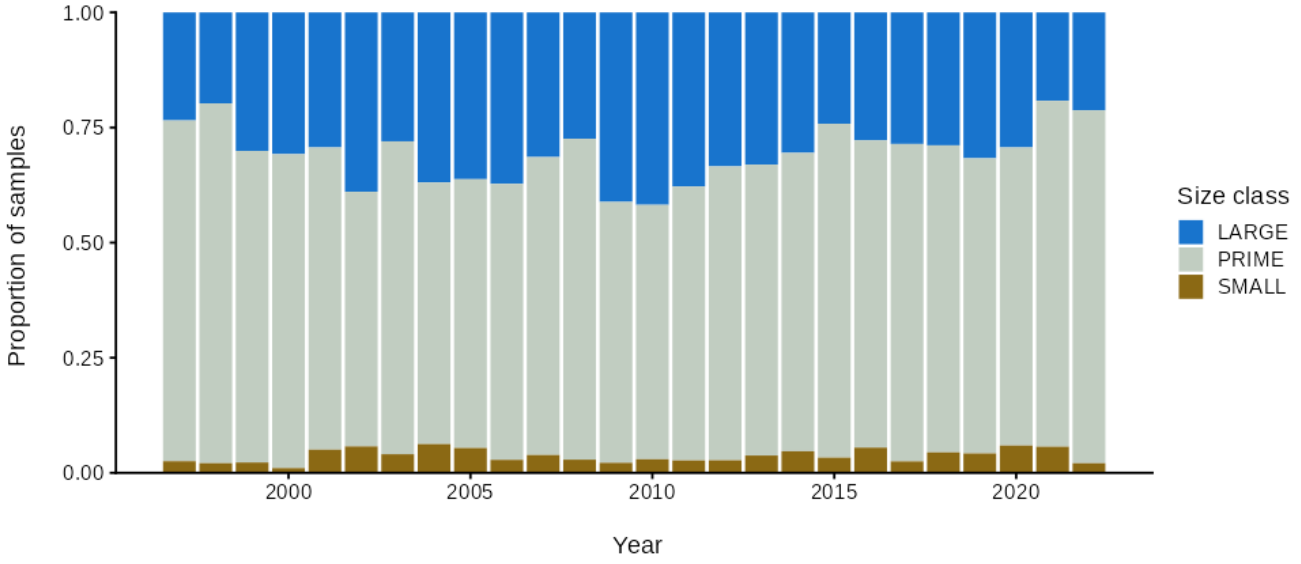

Figure 5 Size distribution of striped marlin caught in the ETBF across small, prime, and large size classes (source: Tremblay-Boyer and Williams, 2023b).

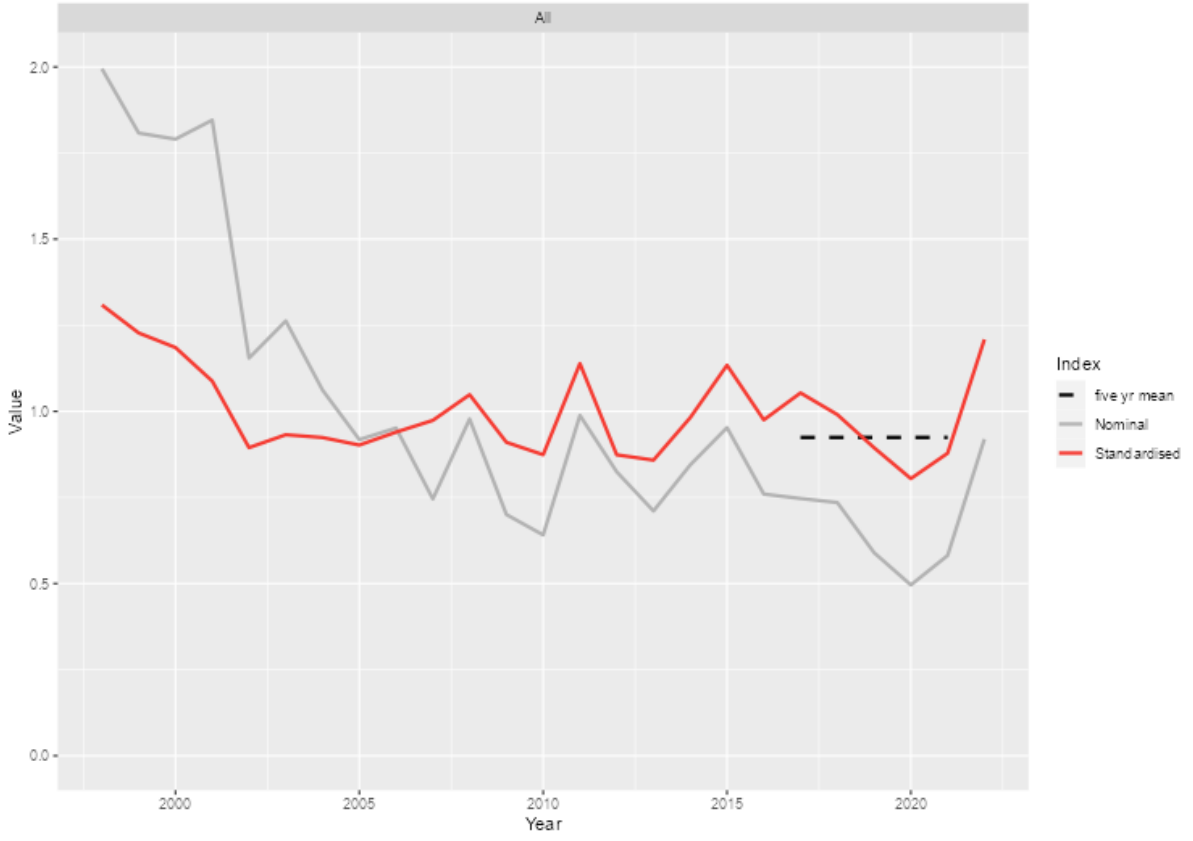

Figure 17 Nominal and standardised CPUE time series for striped marlin in the ETBF across size classes and the recent five-year average (2017-2021) (source: Tremblay-Boyer and Williams, 2023c).

4.5 Yellowfin tuna

A new stock assessment for yellowfin tuna (*Thunnus albacares*) in the WCPO was conducted in 2023 (Magnusson *et al*., 2023). Results were more pessimistic than the 2020 stock assessment (Vincent et al., 2020), with the stock estimated to be more depleted (lower depletion level) and higher levels of fishing mortality. In summary:

- Yellowfin tuna are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2018-2021; $SB_{recent}/SB_{F=0}$) was 0.47 with a range (80% CI) of 0.42–0.52. None of the model runs estimated depletion to be below 0.2.
- Yellowfin tuna are not subject to overfishing. The median estimate of recent (2017-2020) fishing mortality relative to F_{MSY} (F_{recent}/F_{MSY}) was 0.50 with a range (80% CI) of 0.41-0.62. None of the model runs estimated recent fishing mortality to be above F_{MSY}.

In the ETBF, the 2022 catch of yellowfin tuna (1358 t) was below both the five-year and ten-year average catch in the ETBF of 1754 t and 1699 t respectively (Figure 18). Catches of yellowfin tuna in the ETBF have been stable at values around 1500 t after a peak catch in 2003, but have declined in the last few years (since 2019).

The 2022 ETBF catch of yellowfin tuna represents 13% of the provisional total catch of yellowfin tuna within region 5 (10-50^{o}S and 140-170^{o}E). The average contribution is 15% over the previous five years (2017-2021), with a maximum of 20% in 2019 (Tremblay-Boyer and Williams, 2023a).

The annual size distribution (Figure 19) shows some variability in the median value across years with no clear trends in recent years and bimodality in 2022 (Tremblay-Boyer and Williams, 2023b). The frequency of smaller individuals (recruits) over time in the size samples has been variable over time, with most samples from 2022 coming from the ‘Small’ category in contrast to 2021 when most samples came from the ‘Prime’ category (Figure 20) (Tremblay-Boyer and Williams, 2023b).

Standardised CPUE indices for yellowfin tuna in the ETBF are variable for all size classes (recruit, adult, and all) (Figure 21). For all size classes, the standardised CPUE in 2022 was above the recent five-year average (Tremblay-Boyer and Williams, 2023c).

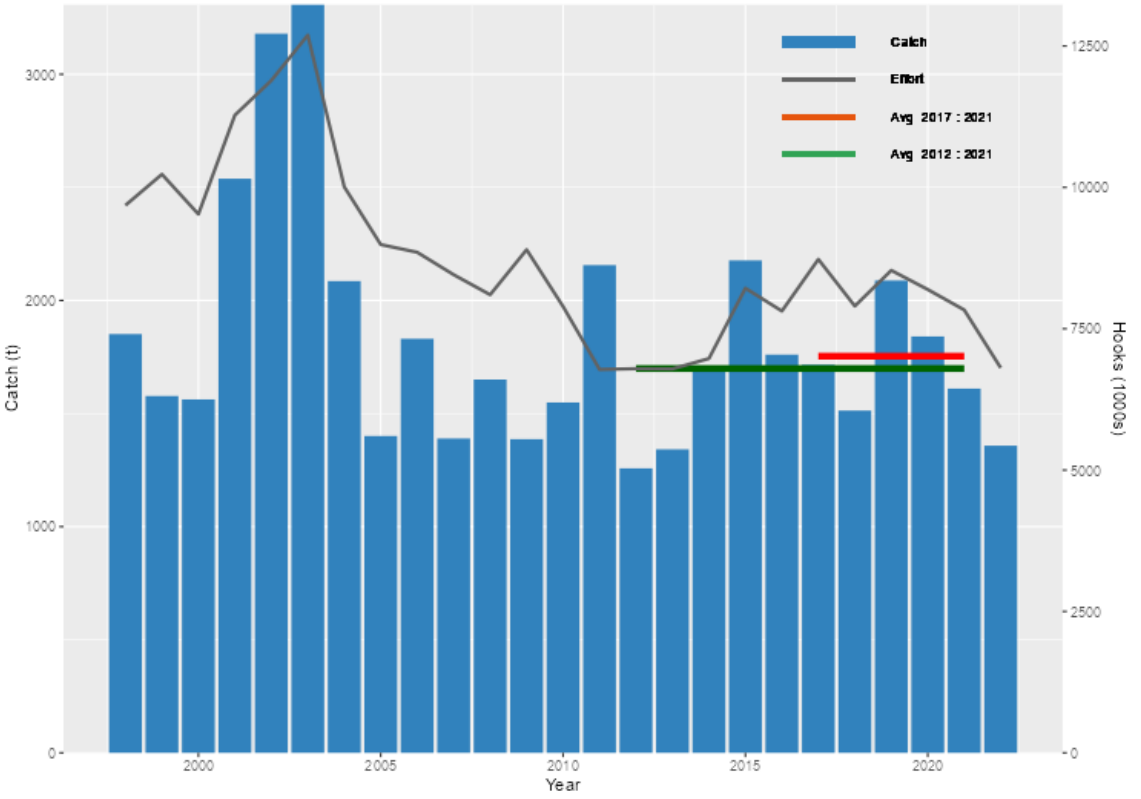

Figure 18 Total yellowfin tuna catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

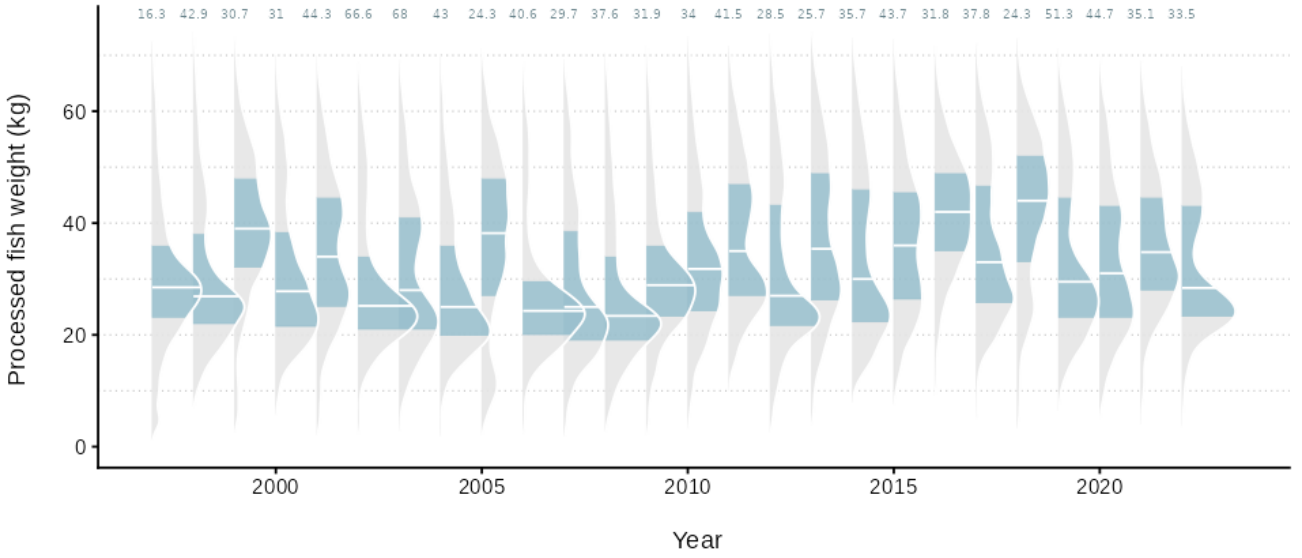

Figure 19 The distribution in processed weights (kg) of yellowfin tuna caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay-Boyer and Williams, 2023b).

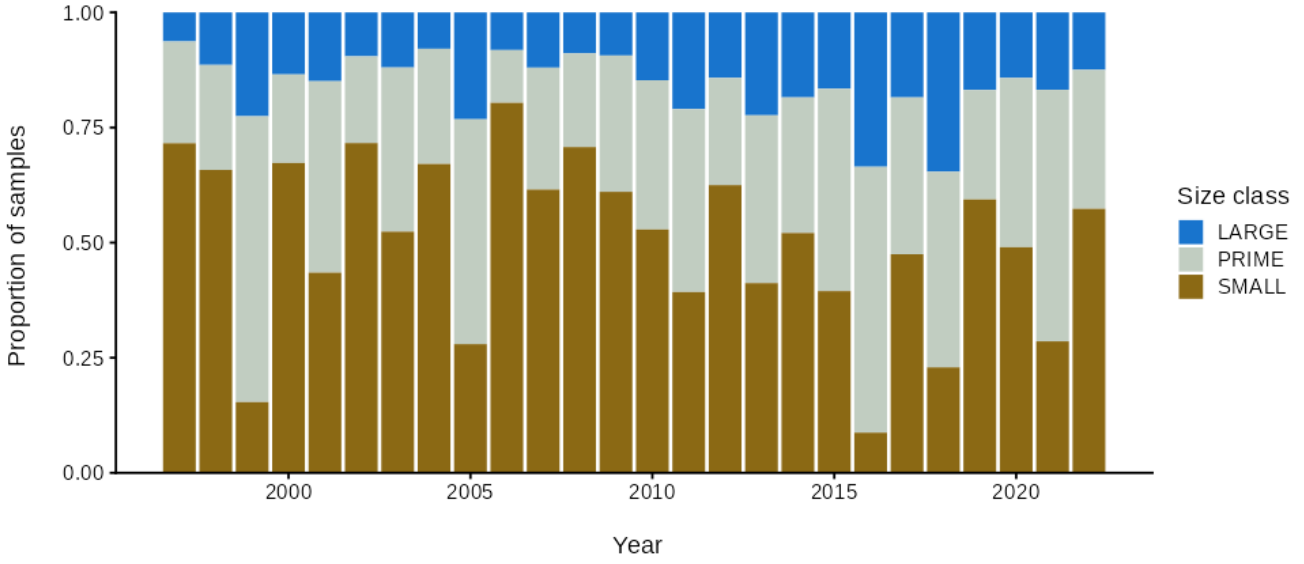

Figure 20 Size distribution of yellowfin tuna caught in the ETBF across small, prime, and large size classes (source: Tremblay-Boyer and Williams, 2023b).

Figure 21 Nominal and standardised CPUE time series for yellowfin tuna in the ETBF across size classes and the recent five-year average (2017-2021) (source: Tremblay-Boyer and Williams, 2023c).

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Attachment 4

Environment
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Calculation of broadbill swordfish Recommended Biological Commercial Catch in 2023

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26 September 2023

CSIRO Environment
Battery Point, Hobart 7000, Tasmania, Australia.

Citation

Hillary, R., Tremblay-Boyer, L. and Williams, A. (2023). Calculation of Broadbill Swordfish Recommended Biological Commercial Catch in 2023. Working paper presented to the 39th meeting of the Tropical Tuna Resource Assessment Group, 3 October 2023, virtual meeting.

Acknowledgement

This work was undertaken as part of the project "Data management, assessment and implementation of the harvest strategies for Australia's tropical tuna fisheries" funded by the Australian Fisheries Management Authority and CSIRO.

1 Executive Summary

This report updates the Recommended Biological Commercial Catch (RBCC) for broadbill swordfish (*Xiphias gladius*), under the modified Harvest Strategy for this species. Application of the Harvest Strategy for 2023 results in a calculated RBCC of 1,047 tonnes, i.e., **no change** from the recent Total Allowable Catch (TAC). The four year moving average abundance index from 2019–2022 (the key input to the Harvest Strategy) remains slightly below the lower edge of the buffer zone of the Harvest Control Rule. However, an accepted modification to the original Harvest Strategy accounting for catches well below RBCC is currently in place. Under this modified Harvest Strategy, there is no decrease in RBCC compared to the recent TAC because the predicted level of undercatch in 2024 is below the original RBCC by enough of a margin that the modified RBCC is set equal to recent TAC levels. In addition, observed catch-per-unit-effort is well within the range simulated in the Management Strategy Evaluation work, so no Exceptional Circumstances are identified at the moment. As such, a RBCC of 1,047 tonnes is recommended for the 2024 fishing season.

2 Background

The AFMA Commission adopted the Harvest Strategy (HS) for broadbill swordfish following a MSE under the direction of the Tropical Tuna Resource Assessment Group (TTRAG) and the Tropical Tuna Management Advisory Committee (TTMAC) (Hillary, 2020). Recently, a modification to the broadbill swordfish HS was developed under TTRAG and TTMAC's advice (Hillary, 2022) to account for unprecedented low levels of catch well below the Total Allowable Catch (TAC) over recent years due to the COVID pandemic. This report updates the RBCC for broadbill swordfish for 2024 as required under the yearly agreed cycle for the Harvest Strategy. It includes:

1. A summary of the modified Harvest Control Rule (HCR)
2. The Recommended Biological Commercial Catch (RBCC) calculated using the modified Harvest Strategy
3. A brief consideration of potential Exceptional Circumstances

3 Broadbill Swordfish Harvest Strategy

The HCR used in the broadbill swordfish Harvest Strategy can be seen in Figure 1. A single recent-average abundance index is used—the sub-adult ('prime') standardised catch-per-unit-effort (CPUE) index—to calculate a scalar multiplier (on the y-axis of Figure 1) which is applied to the current TAC to get the new proposed RBCC.

The CPUE index used in the broadbill swordfish Harvest Strategy was presented to TTRAG 38 (Tremblay-Boyer et al., 2023). In the Harvest Strategy a four year mean (i.e., from 2019–2022) was selected as the reference mean index to use as input to the HCR. The RBCC scalar is then calculated subject to the constraint that the relative change in RBCC cannot exceed 10% in either direction (up or down). In addition to this constraint, the modified Harvest Strategy (Hillary 2022;

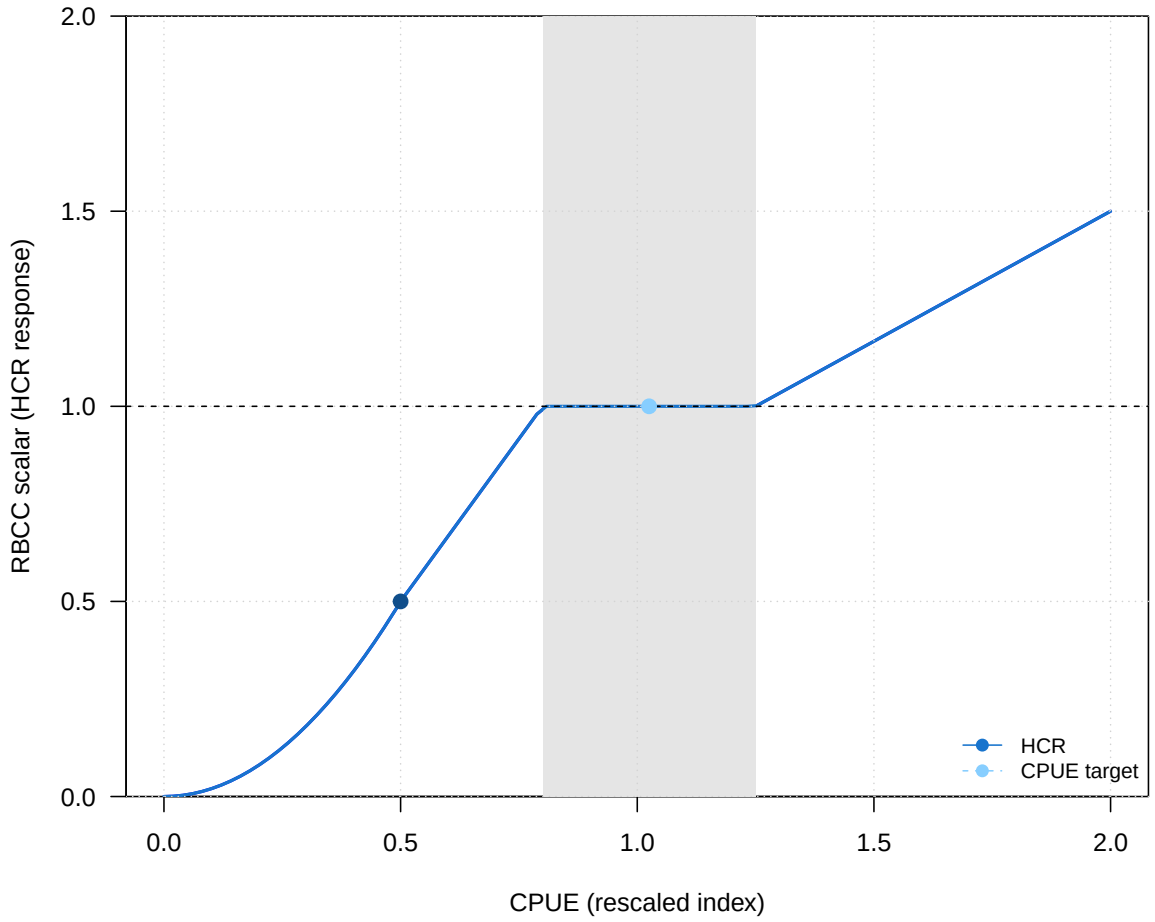

Figure 1: General functional form of the broadbill swordfish Harvest Strategy.

Figure 2) accounts for the amount of undercatch[1] by the fleet in the recent period as follows:

- In the event the original HS recommends a decrease in the RBCC, the following rules apply:

  (a) if current catches are below the RBCC, the difference (i.e. the predicted undercatch) is added to the RBCC *up to a maximum of the difference between the recent TAC and the RBCC* (i.e. the the modified RBCC is not allowed to exceed the recent TAC);

  (b) if the RBCC is below current catches, then the full RBCC decrease is applied.

- In the event the original HS recommends an increase in the RBCC, no modifications are made to the RBCC.

[1] where undercatch is defined as a catch deficit below the TAC.

4 RBCC calculation

The mean sub-adult standardised CPUE for the years 2019–2022 (correctly rescaled by the mean of the 1998–2018 index used in the original MSE work, Hillary 2020) was 0.772. This is slightly *below* the lower limit of the buffer of 0.8 in the HCR, which means a decrease in the RBCC should result. Of note, this is an improvement in scalar value from previous iterations of the HS (e.g. Hillary et al., 2022), reflecting recent increases in the sub-adult standardised CPUE index.

The resulting prescribed reduction in RBCC from the standardised CPUE alone is a scalar of 0.953 (Figure 3). This scalar is within the 10% maximum change constraint, so should normally be applied as is to the previous TAC. However, under the modified HS, current catches (723t) are below the original RBCC (998t) by a level greater than the difference between the RBCC and the recent TAC of 1,047t, so the recommended RBCC is set to the recent TAC (1,047 tonnes, no change) (see also Figure 2).

5 Exceptional Circumstances

The consideration of Exceptional Circumstances is an important component of the MSE-tested Harvest Strategy process. It consists of asking, for every HS cycle:

1. Are the current conditions (data, fishery, other relevant parameters) meaningfully different to those simulated and/or assumed when testing?
2. If so, does action need to be taken?

The Harvest Strategy was tested conditional on the assumption that simulations reflect future conditions in terms of the data, stock status and other factors that eventuate when the HS is actually implemented. If unforeseen conditions appear outside of the simulated range, the HS might not be robust to those conditions as they have not been tested against as part of the simulations. The metarules process outlines the procedure for unforeseen conditions. For this stock, the relevant group (i.e., TTRAG) will agree on possible solutions should Exceptional Circumstances be invoked.

For the current year, the most recent CPUE data falls well within the bounds of that simulated in the updated MSE work (Hillary, 2022). The previously identified Exceptional Circumstance (catches well below the TAC and in excess of the level tested in the original MSE) have been included explicitly in the modified Harvest Strategy (Hillary, 2022). Given no updates to the 2021 assessment (Ducharme-Barth et al., 2021), there is no obvious major shift in either the biological or stock status understanding for this population. Given no Exceptional Circumstances have been identified, it is recommended that the calculated RBCC under the modified HS be used for setting the 2024 TAC.

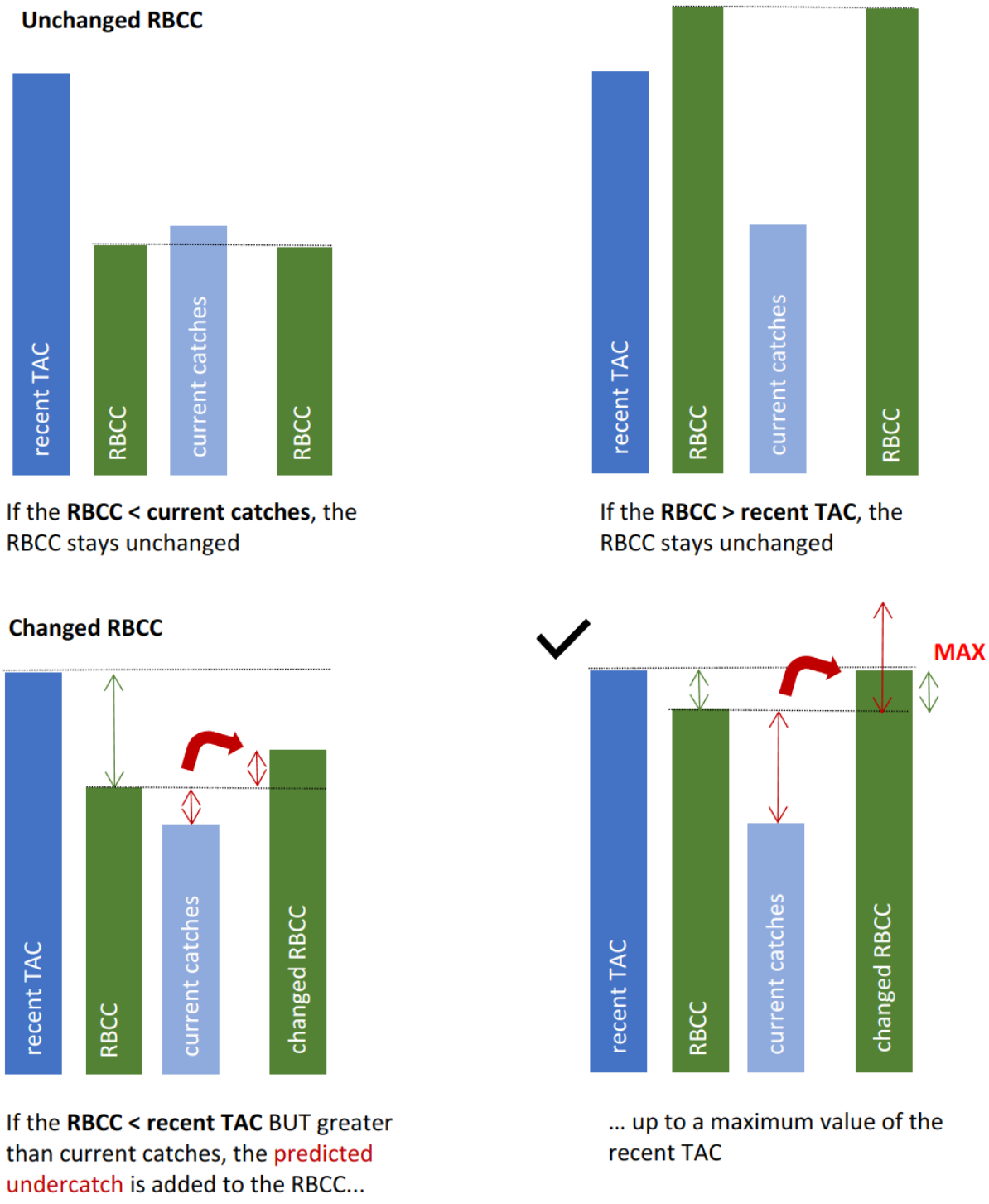

Figure 2: Illustration of the outcomes of the modified Harvest Strategy under different relative levels of recent TAC, RBCC (as prescribed by the original Harvest Strategy) and the predicted undercatch (i.e., the difference between the RBCC and current catches). The top row shows cases where the RBCC remained unchanged from the original recommendation, the bottom row shows cases where the RBCC is changed as a function of the extent of the predicted undercatch. The tick mark indicates the case applied for this year's Harvest Strategy update.

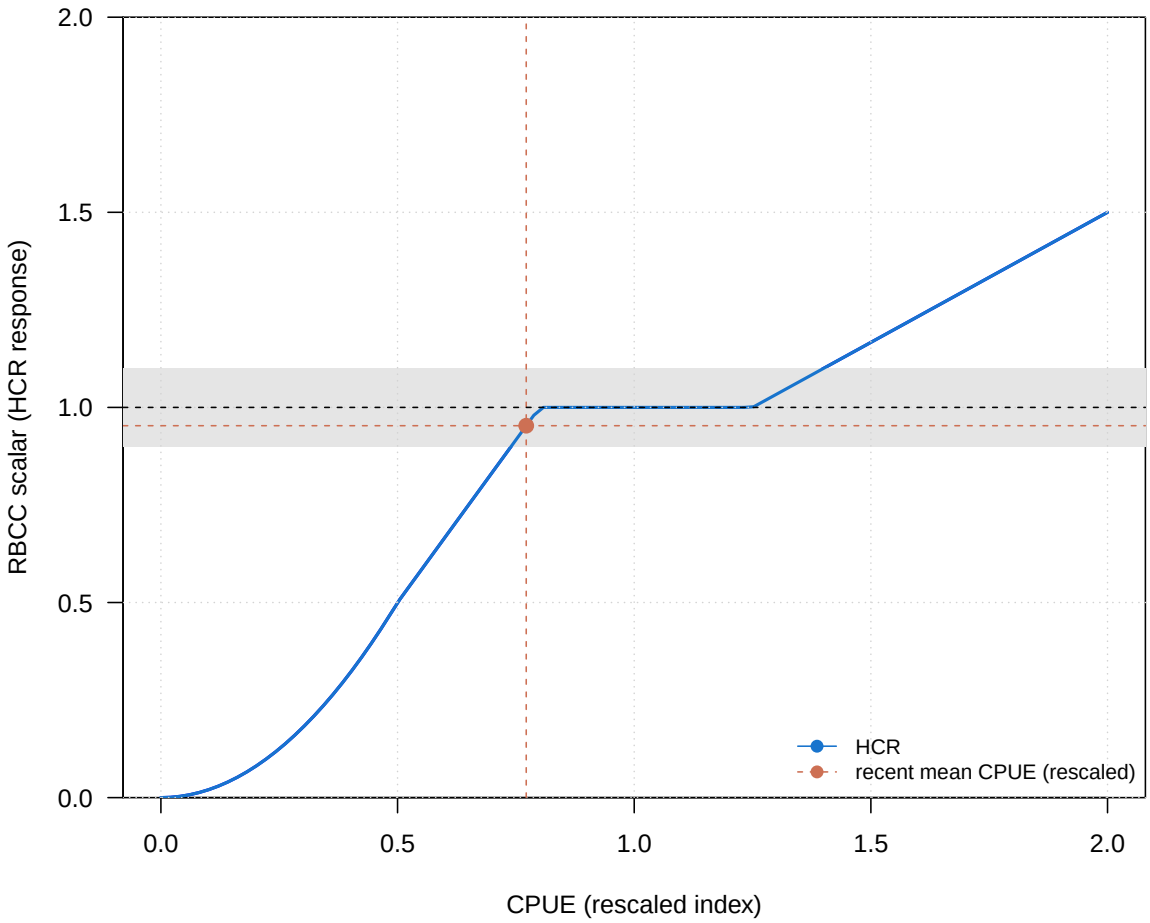

Figure 3: Adopted HCR for broadbill swordfish (blue), the observed mean recent sub-adult standardised CPUE and the associated RBCC multiplier (orange).

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TTRAG Advice for the Eastern Tuna and Billfish Fishery for the 2024 Season

October 2023

Overview

The tuna longline sector still recovering from the effects of COVID along with uncertainty of the economic environment, especially in relation to operational costs. International freight availability continues to be a challenge for industry. A freight logistics coordinator has been employed and has provided some cost-effective options to industry, such as sending product on partially filled planes.

Labour and skills shortages have resulted in some vessels being tied up, soft recruitment is still remains from other fishing sectors, and other primary industries. Combined with very high fuel prices, high bait costs, a shortage of labour in service industries impacting vessel maintenance and restricted market access created economic challenges for fishing businesses in 2022.

During 2022, additional MSE testing was undertaken to evaluate a modified HS for swordfish which adequately addressed the exceptional circumstances of the low catch to TACC ratio. The modified HS was endorsed by TTRAG and TTMAC out of session and has been used for setting the RBCC for SWO for 2023 and 2024.

The modified Swordfish (HS) was adopted by AFMA Commission in November 2022. The Commission noted, when making the modification to the ETBF Harvest Strategy, that the purpose of the modification is to explicitly account for recent low catch levels compared to the TAC and, in doing so, avoid unnecessary TAC reductions. The modification has been designed and tested assuming the level of recent under catching ceases from 2025 onwards. TTRAG advice was derived from the modified swordfish HS. TTRAG recommended a RBCC of 1047t, no change to the TACC for 2024 season.

For YFT, BET and ALB, TTRAG is providing advice based on fishery indicators. STM advice is under a constant catch scenario. TTRAG reviewed the annual conditions, ETBF climate change status report and indicators.

In providing this advice, TTRAG took into consideration the results of the most recent stock assessments undertaken for each of the principal catch species in the ETBF. These results indicate, based on the median values across the uncertainty grid adopted for each species, that for the four species (YFT, BET, ALB, SWO) the stock is not overfished (i.e. $SB_{recent}/SBF=0>0.20$) nor is overfishing occurring (i.e. $F_{recent}/F_{MSY}<1.0$) (c.f. Figure 1). For STM, the stock is close to being overfished based on the LRP adopted for tunas ($SB_{recent}/SBF=0\sim0.20$) and close to undergoing overfishing (i.e. $F_{recent}/F_{MSY}=0.91$) (Figure 1).

TTRAG also took into consideration the information about the ETBF catch relative to the catch of other fleets in regions adjacent to the ETBF (Region 1 for the two billfish species and Region 5 for the three tuna species – see next section). The proportion of the ETBF billfish catches in Region 1 (0-50oS and 140-165oE as shown in Figure 2) is different for each species – SWO (76%) and STM (56%) in 2021. If the estimated catch (assuming a 20% mortality for tagged and released fish) of the

recreational sector in Australia is included, then the proportion of the ETBF catch in Region 1 for striped marlin is ~51%. The proportion of the ETBF tuna catches in Region 5 (10-50oS and 140-170oE as shown in Figure 2) is: YFT (13%), BET (23%), and ALB (6%) in 2022. TTRAG noted that the catch estimates in these regions for 2022 are provisional.

In considering the number of years over which the trend in several of the resource indicators was assessed, TTRAG took into account the life-history (e.g. longevity) of each species. As such, trends were considered over five years for YFT and BET and ten years for ALB, SWO and STM.

Finally, TTRAG have included ETBF climate change status report and economic indicators information in this advice paper. Indicators are provided at whole fishery for climate change status and economic status/performance (see "Economic Conditions in the ETBF" below) and economic conditions at an individual species level.

At the end of the summary for each species, some additional Key Points are provided. Please note that in stock indicators sections, "CPUE" refers to standardised CPUE (std-CPUE) and in the economics sections, "CPUE" refers to nominal CPUE (un-standardised).

The results of the most recent stock assessments undertaken for each of the principal catch species in the ETBF are shown in Figure 1. Note that the year of the most recent assessment varies across species (i.e., 2023 for yellowfin and bigeye tuna, 2022 for skipjack tuna, 2021 for south Pacific albacore and broadbill swordfish, and 2019 for striped marlin)(Williams et al, 2023.).

The results from these assessments indicate, based on the median values across the uncertainty grid adopted for each species, that for five species (yellowfin tuna, bigeye tuna, south Pacific albacore, skipjack tuna and broadbill swordfish) the stock is not overfished (i.e. SBrecent/SBF=0 > 0.2) nor is overfishing occurring (i.e. Frecent/FMSY < 1). For striped marlin, however, the stock is at the point of being overfished (SBrecent/SBF=0~0.20) based on the limit reference point adopted for tunas of 0.2, and close to being subject to overfishing (i.e. Frecent/FMSY = 0.91).

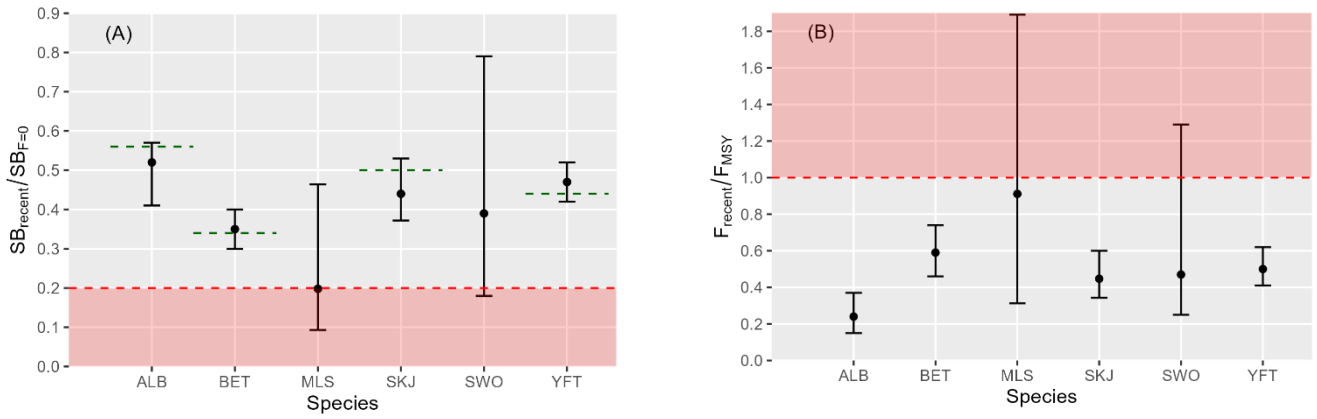


Figure 1. Median value (and 80% probability interval) of (A) the time-dynamic spawning biomass depletion ($SB_{recent}/SBF=0$) and (B) fishing mortality ratio (F_{recent}/F_{MSY}) across the respective uncertainty grid used in the stock assessment for each of the principal tuna and billfish species in the WCPO. In (A) the dotted red line indicates the Limit Reference Point (LRP) adopted by the WCPFC for tunas while the dotted green line indicates the Target Reference Point adopted for skipjack tuna, yellowfin tuna, bigeye tuna and south Pacific albacore tuna, while in (B) the dotted red line is a generally accepted MSY-based LRP for fishing mortality. ALB = south Pacific albacore, BET = bigeye tuna, MLS = striped marlin, SKJ = skipjack tuna, SWO = broadbill swordfish, YFT = yellowfin tuna.

Regions of interest

TTRAG takes into consideration information about the ETBF catch relative to the catch of other fleets in regions adjacent to the ETBF. To do this, “Region 1” is used for the two billfish species and “Region 5” is used for the three tuna species. A third “ANZ region” region is used elsewhere (but not in this paper) for any species. A map of these regions is shown in Figure 2 and a description is as follows:

Region 1

Region 1 is used for the two billfish species. This region, bounded by 0-50oS and 140-165oE, extends eastwards from the east coast of Australia and comprises most of the area fished by the ETBF fleet in recent years. Region 1 is one of the two regions used in stock assessments for broadbill swordfish in the south Pacific (Ducharme-Barth et al. 2021). Note, at present no regional structure is used in the assessment for southwest Pacific striped marlin.

Region 5

Region 5 is based on two of the nine regions used in the 2020 stock assessment models for yellowfin tuna (Vincent et al., 2020) and bigeye tuna (Ducharme-Barth et al., 2020) within the WCPO. These two assessment regions (5 and 9) bounded by 10-40oS, and 140-170oE, extend eastwards from the east coast of Australia and comprise both the main area fished by the ETBF fleet and a large proportion of both the Coral and Tasman Seas. These two regions are combined for the analyses presented here and referred to as Region 5. Also, in order to encompass all ETBF fishing operations, including those off eastern Tasmania, the southern boundary was extended to 50oS. Note, the regions used in the assessment for South Pacific albacore tuna do not align with those used for the two tropical tunas, with region bounded by 0-50oS, and 140-150oW divided into three latitudinal zones with boundaries at 10oS and 25oS.

Australia-New Zealand (ANZ) region

This region represents an extension of the eastern boundary of Region 5 to 175oW, encompassing much of the New Zealand exclusive economic zone and adjacent high seas. This region is not used in the figures reported in this paper but is mainly used in other papers to look at relative regional catches of broadbill swordfish and striped marlin in an extended area where there is uncertainty around stock connectivity with the ETBF. This region is distinct from and smaller than the SW-Pacific regions used in the assessments for the two billfish species.

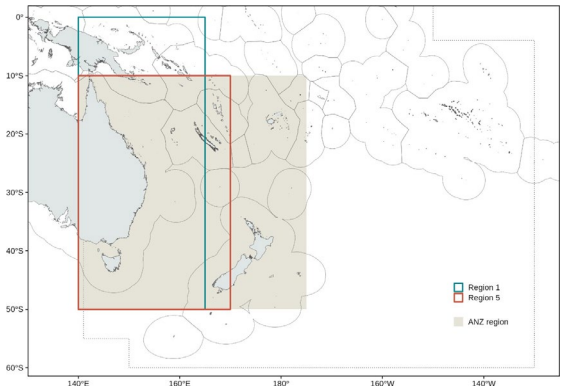


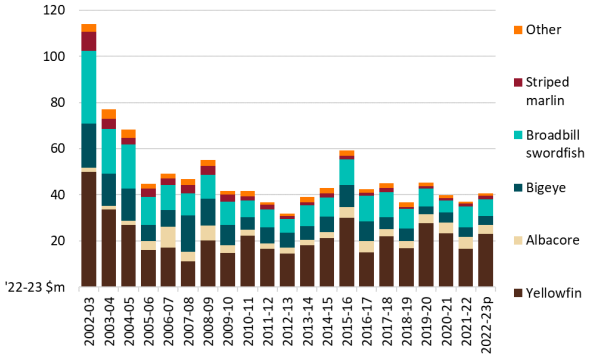
Figure 2. Map showing the boundaries of the three regions used in the analyses described in this paper. The boundaries associated with the exclusive economic zones for the nations within this region are also shown. Region-5 is used for the three tuna species, Region-1 is used for the two billfish species, while the ANZ region is used for all species. The dotted line indicates the boundary of the WCPFC Convention area.

Economic conditions in the ETBF

Derived ETBF economic working paper *Economic conditions in the Eastern Tuna and Billfish Fishery September 2023* ABARES.

Gross value of production

Gross value of production (GVP) in the ETBF decreased between 2002–03 and 2012–13 from $114.4 million to $31.9 million in real terms (2022−23 dollars), reflecting lower landed catch and falling average prices. Average prices are likely to have been influenced by movements in the Japanese Yen and Australian dollar exchange rate. Between 2012–13 and 2015–16, GVP increased to an 11-year high of $59.1 million in 2015–16 in real terms (2022−23 dollars). This increase resulted from higher landed catch and rising prices of key targeted species (particularly yellowfin tuna).

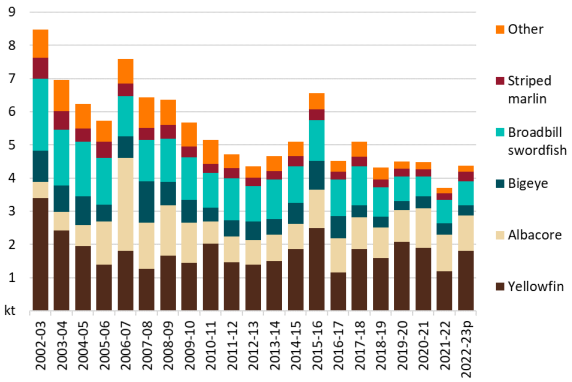


The decrease in GVP between 2015–16 and 2022−23 largely resulted from lower bigeye tuna, Broadbill swordfish and Yellowfin tuna production value.

Catch

Catch in the ETBF has trended downwards between 2002–03 and 2022−23, with peaks during those years in 2002–03, 2006−07 and 2015–16.

Since 2002–03 the number of active vessels (and fishing effort to a lesser extent) decreased significantly, likely because of a decline in economic conditions in the fishery and the removal of vessels through the Securing Our Fishing Future structural adjustment package (Patterson et al 2020). Declining prices and rising input costs during this period may have also reduced fishing effort and catch.

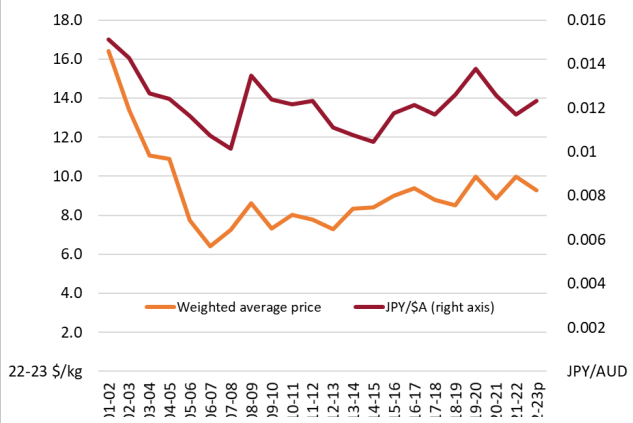


Between 2012–13 and 2015–16 landed catch increased by 50% to 6,572 tonnes and has remained well below this level since 2015–16.

Weighted average price of landed catch tracks the JPY/AUD exchange rate

The weighted average price of fish caught in the ETBF fell significantly in the early 2000s, largely a result of the appreciation of the Australian dollar against the Japanese Yen. Japan was Australia's major export market for yellowfin tuna, and bigeye tuna during this period.

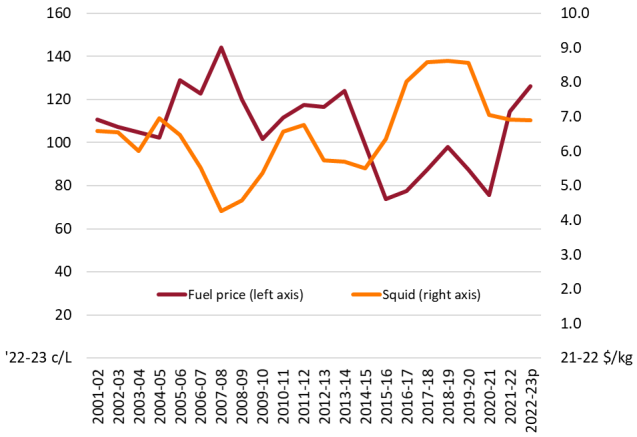
The weighted average price of fish caught in the ETBF trended upwards from 2006–07. There is a strong correlation of the Australian dollar against the Japanese Yen and the weighted average price movement.



Input prices – fuel and squid

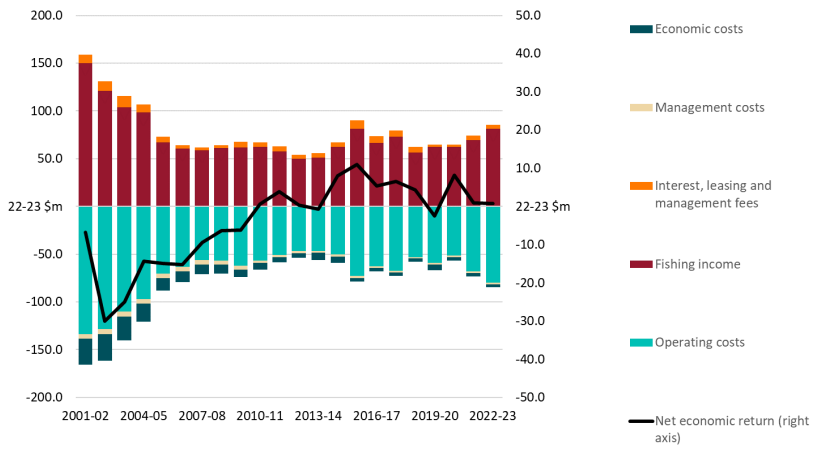
The price of fuel and squid in real terms (2022–23 dollars) have varied significantly between 2000–01 and 2022–23.

The average real price of fuel peaked in 2007–08, 2013–14 and 2022-23. Real fuel prices have trended upwards since 2015–16 and were at historically high levels through 2022–23.



The average real price of squid imports (a proxy for bait price) peaked in 2017–18 at more than double the average price in 2007–08. According to the FAO (2019), squid prices have risen on tight world supplies which are not expected to ease in the short term. Squid prices declined in 2020-21, but remained high in 2021–22 and 2022–23 in real terms compared to the early 2000s period.

Economic performance (ABARES surveys)

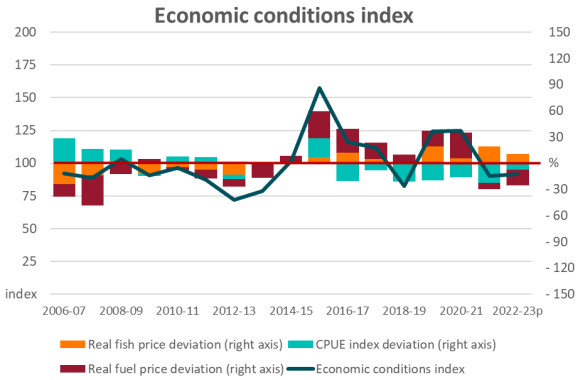


Net economic returns (NER) generated in the ETBF are measured by ABARES surveys. NER in real terms (2022–23 dollars) trended upwards from 2002–03. NER were negative between 2002–03 and 2009–10. In 2010–11 the fishery achieved positive real NER, driven primarily by reduced operating costs, and peaked at $11.0 million in 2015–16.

From 2016–17 real NER in the ETBF has followed a generally declining trend, dipping to negative $2.6 million in 2019–20. Preliminary non-survey-based estimates indicate real NER averaging $0.8 million 2021–22 and 2022–23. These low levels of NER are attributed to higher input costs experienced in these years.

Economic conditions index (weighted)

The ECI reflects that the ETBF is a multi-species fishery. Nominal GVP weights of the 5 key commercial species in the ETBF were used to calculate ECI and deviations in its component indices from the long-term (2005–06 to 2022–23) average.

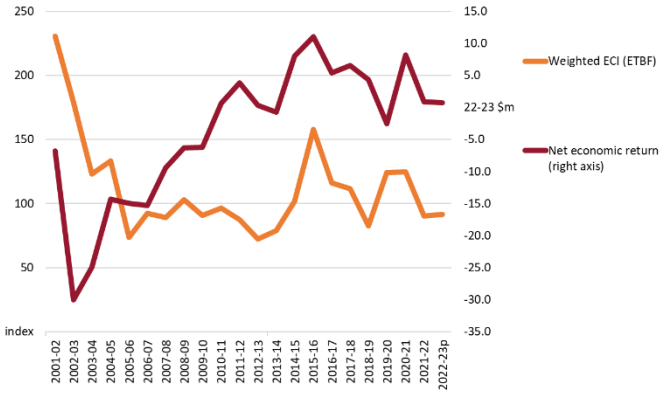


Using the weighted ECI approach, in 2022−23 the ECI remains at around a level of 90.0 indicating below average economic operating conditions. This outcome is attributed to elevated input costs in an environment of steady fish prices, and declining catch per unit effort.

During early 2023-24 fuel prices are likely to continue to limit economic conditions in the fishery. It is unclear to what extent price improvements or catch rates can offset the downward pressure on the index in this period from higher fuel prices. It is also unclear if current high fuel prices will persist into 2024.

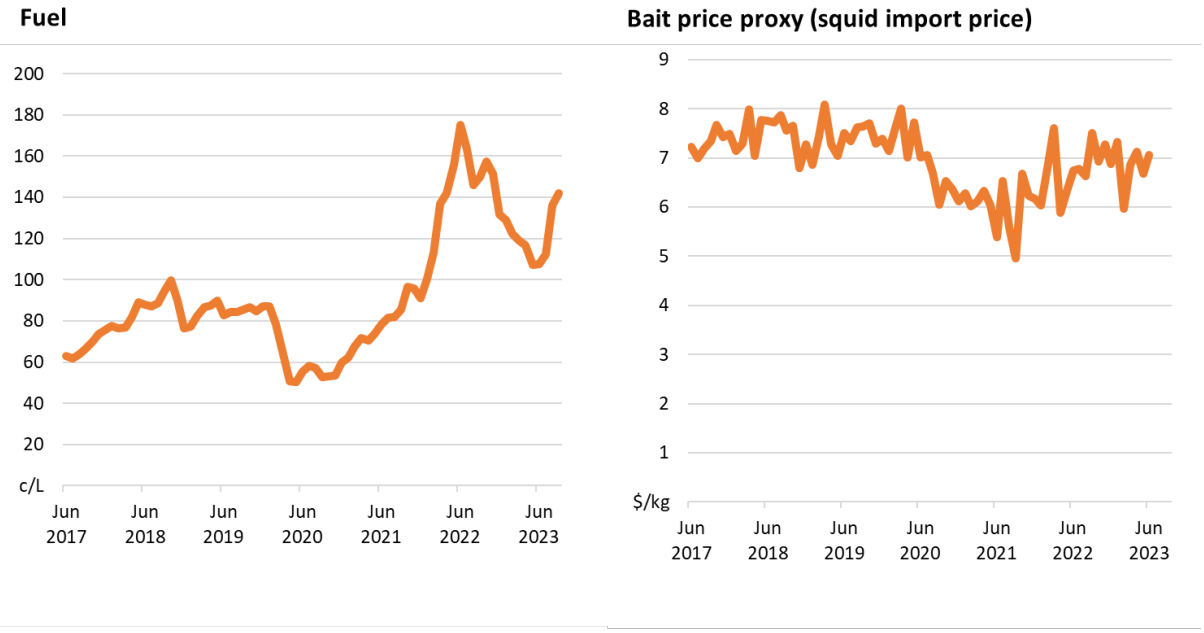
Economic conditions index (weighted) and NER

The weighted ECI approach has the potential to be a leading indicator of NER. Weighted ECI and NER are highly correlated: 60% since 2012–13.

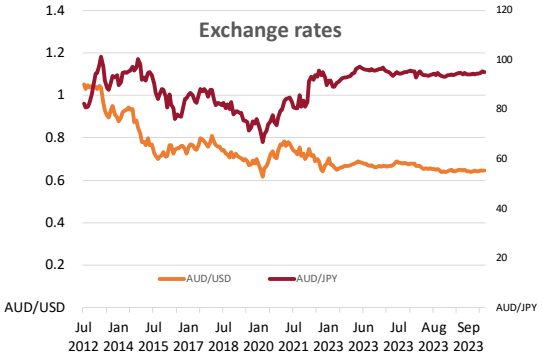


Economic conditions in the Eastern Tuna and Billfish Fishery Monthly indicators

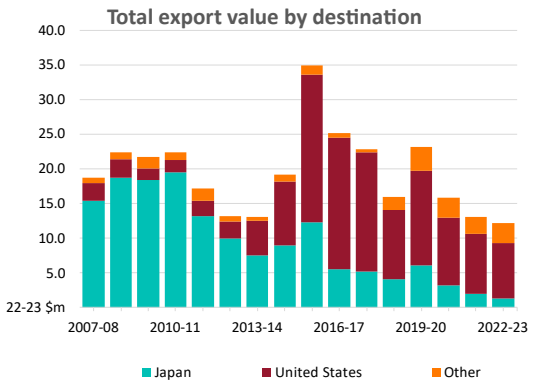
Input prices



Notes: Nominal dollars. Fuel price (diesel) excludes GST and excise.
Source: ABARES.



Note: Nominal dollars. Source: ABS, ABARES.



Climate Indicators

The Report at *Climate and Ecosystem Status Report for the Eastern Tuna and Billfish Fishery June 2023* **(Attachment A)** is preliminary in nature and supported discussion and feedback on relevant indicators. The ETBF climate change status report, provided the RAG with supplementary guidance when considering TACs for the ETBF in 2024. The RAG noted the following from the status report. Additionally, further detailed information on the report can be found at **(Attachment A):**

- That it is anticipated that ETBF tuna fishing will experience normal shifts in distribution and abundance with the El Niño-Southern Oscillation (ENSO) cycle (i.e. La Niña and El Niño).

- El Niño is typically associated with higher catches in some of key target species.

- Further warming to sea surface temperatures in central and Eastern Pacific likely and sea surface temperatures above average off Victoria and Tasmania, and Queensland to a lesser extent, during August.

Species summaries

South Pacific albacore tuna

South Pacific albacore tuna (Thunnus alalunga) were last assessed and presented at the WCPFC scientific committee meeting in 2021 (Jordán et al., 2021). The assessment results were consistent with the 2018 assessment. Annual catch estimates for albacore in the South Pacific peaked at 93,835 mt (all gears) in 2017 (SC17-SA-IP-04). Catch by longliners represented 93% of the catch weight in 2020 at 64,963 mt and represented a 21% decrease from 2019 despite a shift of effort from the tropical to the southern longline fishery in 2020. By comparison, the 2020 total albacore catch within the southern part of the WCPFC-CA was 61,778 mt and the longline catch was 57,006 mt.

Indicators summary:

- In the ETBF, the 2022 catch of albacore tuna (1132 t) was above both the five-year (2017-2021) and ten-year (2012-2021) average catch of albacore tuna in the ETBF of 1015 t and 934 t respectively (Figure 3). Catches of albacore tuna in the ETBF have been slowly increasing over the last decade after a sharp decline from a peak in 2006.

- The 2022 ETBF catch of albacore tuna represents 6% of the provisional total catch of albacore tuna within Region 5 (10-50oS and 140-170oE). The average contribution is 7% over the previous five years (2017-2021), with a maximum in recent years of 9% in 2016 (Tremblay-Boyer and Williams, 2023a).

- South Pacific albacore tuna are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2016-2019; $SB_{recent}/SBF=0$) was 0.52 with a range (80% CI) of 0.41–0.57. None of the 72 model runs estimated depletion to be below 0.2. South Pacific albacore tuna are not subject to overfishing. The median estimate of recent (2015- 2018) fishing mortality relative to FMSY ($F_{recent}/FMSY$) was 0.24 with a range (80% CI) of 0.15-0.37. None of the 72 model runs estimated recent fishing mortality to be above FMSY.

- The median of processed fish weights has increased slightly over time, with bimodality for some years, including 2021 and 2022, (Figure 4) (Tremblay-Boyer and Williams, 2023b).

- The standardised CPUE index of albacore tuna has been highly variable over time. It remains above the recent five-year average in 2022 (Figure 5) (Tremblay-Boyer and Williams, 2023c).

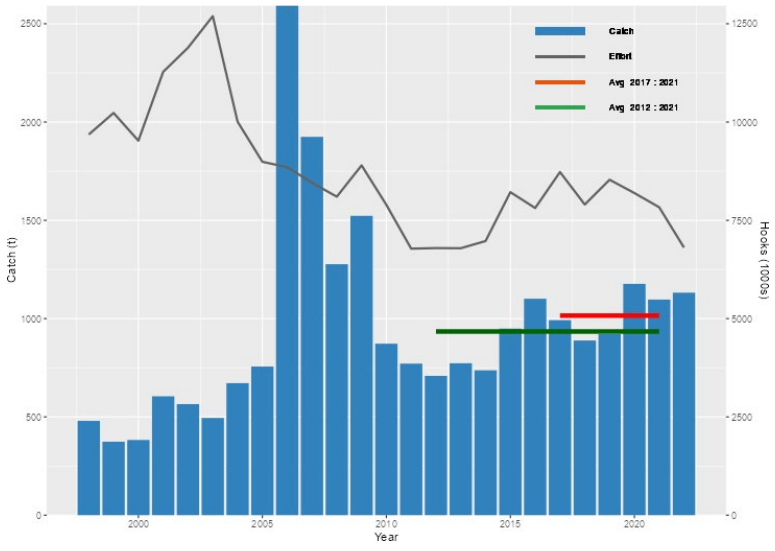


Figure 3 Total albacore tuna catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

Figure 4 The distribution in processed weights (kg) of albacore tuna caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay-Boyer and Williams, 2023b).

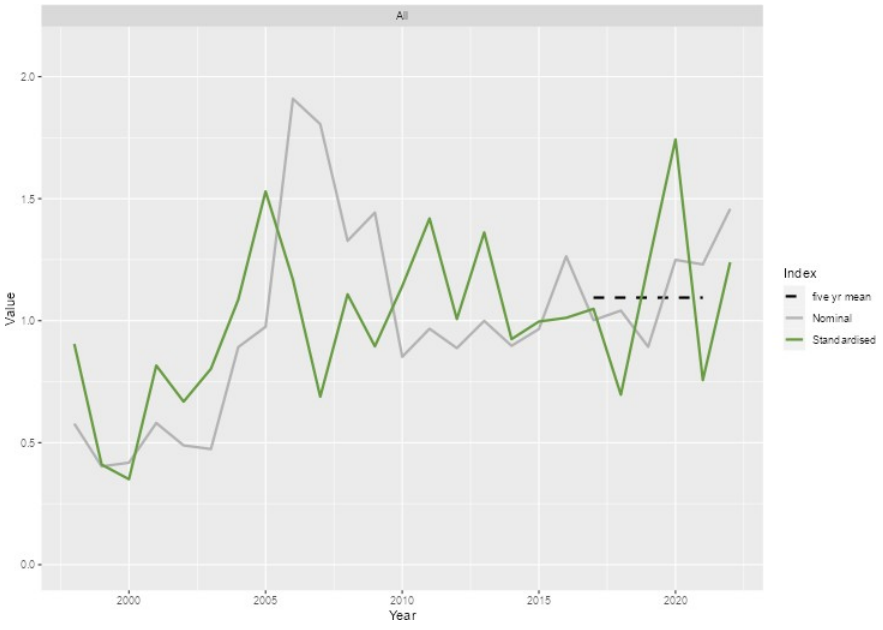


Figure 5 Nominal and standardised CPUE time series for albacore tuna in the ETBF and the recent five-year average (2017-2021) (source: Tremblay-Boyer and Williams, 2023c).

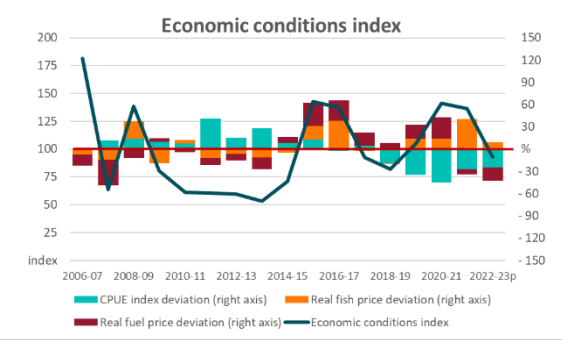
Stock Status Albacore Tuna

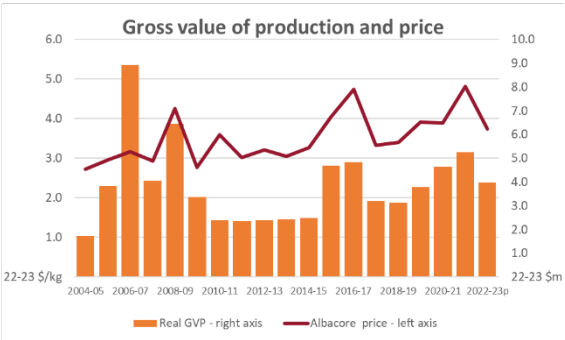
Indicator	Comment
Stock	Considered single stock in the south Pacific.
South Pacific (SP) Stock Assessment[1]	Last assessment: 2021[2]. Overfished[3]: No Overfishing[4]: No South Pacific albacore were last assessed in 2021 (Castillo Jordán *et al.*, 2018). A short summary: • The median estimate of fished-to-unfished spawning biomass ratio was 0.52 with a range (80% CI) of 0.41-0.57(across the swathe of different runs in the uncertainty grid) with none of the 72 models estimating a depletion level lower than 0.2. • All the 72 model runs have an estimate of the MSY fishing mortality ratio less than 1 (no overfishing at all). 1) • WCPFC CPUE analysis: CPUE analysis for South Pacific albacore | WCPFC Next assessment: 2024.
WCPFC Scientific Committee Management advice 2021	• The 2021 South Pacific albacore stock assessment provided results consistent with the 2018 assessment; that is, a decline in estimated spawning potential over most of the assessment period, and in particular, within the most recent years. The addition of the EPO region into the current entire South Pacific assessment did not notably alter the main assessment outcomes, and similar trajectories and terminal depletion were estimated in both RFMO regions. • For the WCPFC-CA region, the 'recent' and 'latest' SB estimates are on average both below the interim target reference point of 0.56. Further, 86% of models (62 out of 72 models) estimated that SBrecent/SBF=0 was below the interim TRP. In relation to management objectives for the WCPFC-CA longline fishery, this assessment estimated that the median `latest' (2019) and `recent' (2016-2019) longline vulnerable biomass for the WCPFC-CA are 56% and 76% of the 2013+8% target level that defined the interim TRP. • SC17 scheduled a recalibration of the interim TRP for review at WCPFC18. The analysis will estimate the constant catch levels that would achieve that TRP on average over the long-term.

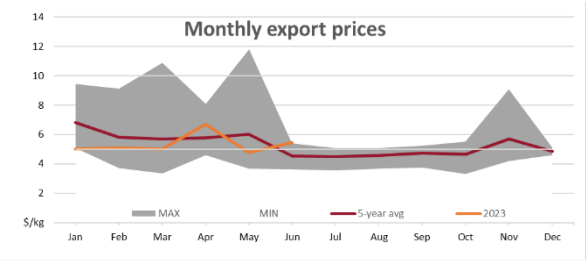
[1] The stock assessment area for south-Pacific ALB in 2021 covers the entire region of the south Pacific from 0-50oS.
[2] The assessment covers the period from July 1960 to December 2019.
[3] The WCPFC has adopted the indicator $SB_{latest}/SBF=0 = 0.2$ as a Limit Reference Point for ALB where in the latest assessment SB_{latest} refers to the mean annual spawning biomass in 2019 and SBF=0 is the estimated average annual spawning biomass over the period 2009- 2018 in the absence of fishing.
[4] The indictor $F_{recent}/FMSY$ is used to estimate fishing pressure on the stock where in the latest assessment F_{recent} is the mean fishing mortality over the period 2015- 2018 and FMSY is the fishing mortality at Maximum Sustainable Yield (MSY).

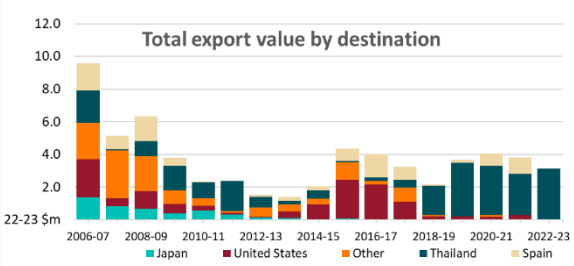
	• Noting the Commission is scheduled to adopt an MP for South Pacific albacore tuna in 2022, SC18 reviewed the progress on developing and testing MPs for South Pacific albacore tuna as outlined in SC18-MI-WP-05 (Progress update and technical challenges for the South Pacific albacore MSE framework). • SC18 noted the progress on the development of MPs using model-based approaches for South Pacific albacore tuna and recommended that candidate HCRs for this species be adapted from those already considered for skipjack tuna. • SC18 recommended that both the Science-Management Dialogue and WCPFC19 take note of the progress to date on the development of an MSE framework for South Pacific albacore tuna and that further work is required prior to adoption of an MP.

Economic conditions in the Eastern Tuna and Billfish Fishery Albacore









Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Monthly export prices based on all albacore exports. Total export value by destination based on all albacore exports from Australia. Albacore export product form varies and between 2016–17 and 2020–21 on average 78% was exported frozen and 22% was exported as 'fresh or chilled'. In 2020–21 only 5% was exported as 'fresh or chilled'.

Sources: ABARES, ABS, FFA.

TTRAG TACC Advice for Albacore:

South Pacific albacore tuna (Thunnus alalunga) were last assessed and presented at the WCPFC scientific committee meeting in 2021. TTRAG considered the available information and indicators and concluded:

• Albacore tuna are not overfished. The median estimate of spawning biomass was 0.52 SBF=0) with a range (80% CI) of 0.41-0.57 SBF=0. The spawning biomass was estimated to be below the level that would be considered overfished (0.2 SBF=0).

• Albacore tuna are not subject to overfishing. Fishing mortality was estimated to be below the level that would achieve maximum sustainable yield (F_{MSY}).

• The ETBF is considered to be part of a common south pacific albacore stock.

• Noting the stock is not assessed as overfished or subject to overfishing it is important to note the following from a recent WCPFC SC17 meeting (2021): under "status quo" conditions (2017–2019 or 2020 average catch or, separately, fishing effort) results of model projections show a steep and rapid decline in biomass towards the LRP in the year 2021 followed by an increase in biomass thereafter.

• The 2022 ETBF catch of albacore tuna was 1132 t which represents 6% of the provisional total catch of albacore tuna within region 5 (10-50oS and 140oE-170oW).

• In the ETBF, the 2022 catch of albacore tuna (1132 t) was above both the five-year (2017-2021) and ten-year average (2012-2021)

• The median of processed fish weights has increased slightly over time, with some evidence of a recruitment pulse entering the fishery in 2020 progressing into 2021 and a new cohort of recruits entering into the fishery in 2022.

• The standardised CPUE index of albacore tuna has been highly variable over time. It remains above the recent five-year average in 2022

• Economic conditions index for 2022 is below average with a distinct downward trend since 2020-2021.

TTRAG TACC recommendation 2024:
2,500t

Bigeye tuna

A new stock assessment for bigeye tuna (Thunnus obesus) in the WCPO was conducted in 2023 (Day et al., 2023). Preliminary results were similar to the 2020 stock assessment (Ducharme-Barth et al., 2020), except that the stock was estimated to be more depleted (lower depletion level), and fishing mortality was estimated to be lower in the 2023 assessment (Day et al., 2023). The total catch of WCPO bigeye tuna for 2022 was 140,664 mt which was similar to the 2021 level.

Indicators summary:

- In the ETBF, the 2022 catch of bigeye tuna (346 t) is below both the five-year and ten-year average catch in the ETBF of 360 t and 499 t respectively (Figure 6). Catches of bigeye tuna in the ETBF have declined since a peak in 2016, however catches have shown a slight increase in 2021 and 2022.

- The 2022 ETBF catch of bigeye tuna represents 23% of the provisional total catch of bigeye tuna within Region 5 (10-50oS and 140-170oE). The average contribution is 22% over the previous five years (2017-2021), with a maximum of 38% in 2016 (Tremblay-Boyer and Williams, 2023a).

- Bigeye tuna are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2018-2021; $SB_{recent}/SBF=0$) was 0.35 with a range (80% CI) of 0.30–0.40. None of the model runs estimated depletion to be below 0.2.

- Bigeye tuna are not subject to overfishing. The median estimate of recent (2017-2020) fishing mortality relative to FMSY (F_{recent}/F_{MSY}) was 0.59 with a range (80% CI) of 0.46-0.74. None of the model runs estimated recent fishing mortality to be above F_{MSY}.

- The distribution of processed fish weights of bigeye tuna has been variable across size classes (small, prime, and large), but with no clear directional trends (Figures 7 and 8). There is a bimodal distribution of sizes in several years, potentially indicating progression of cohorts (Tremblay-Boyer and Williams, 2023b).

- The standardised CPUE indices for bigeye tuna increased for adults but decreased for recruits in 2022 (Figure 9) (Tremblay-Boyer and Williams, 2023c). Overall, the standardised CPUE index for all sizes declined slightly in 2022. The CPUE indices for adults and all sizes combined were above the recent five-year average in 2022, while the CPUE for recruits was below. Each of the indices have been below average or declining over the last five to ten years and these increases show a return of the index toward the long-term average.

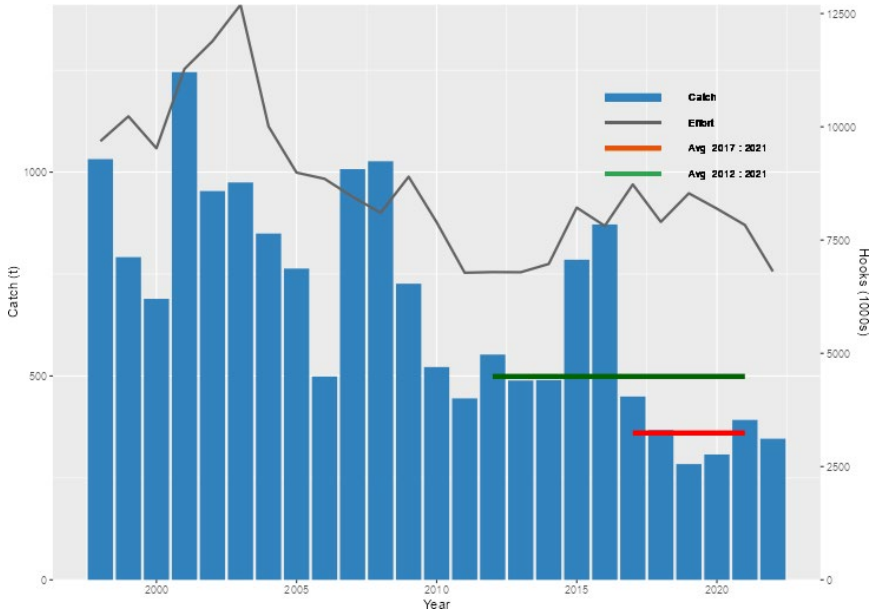


Figure 6 Total bigeye tuna catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

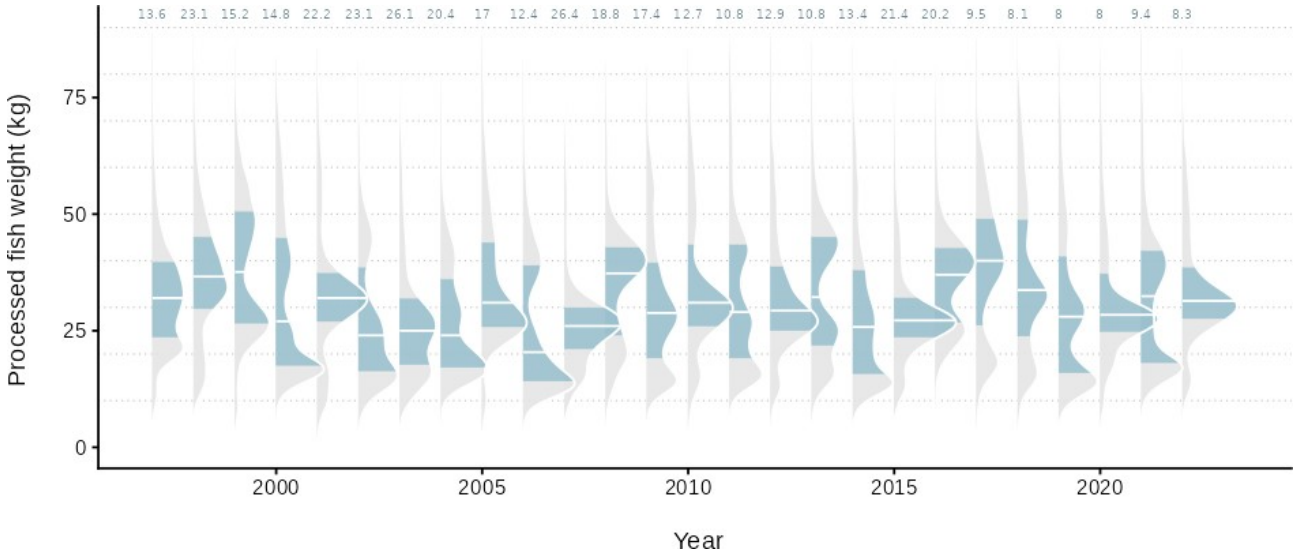


Figure 7 The distribution in processed weights (kg) of bigeye tuna caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay-Boyer and Williams, 2023b).

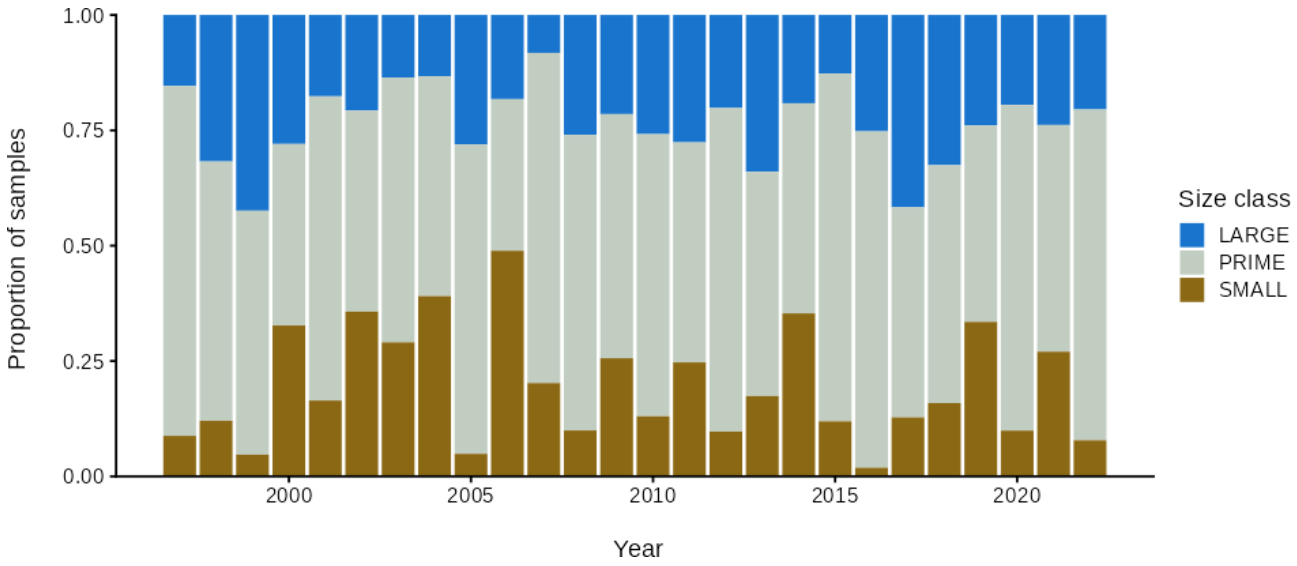


Figure 8 Size distribution of bigeye tuna caught in the ETBF across small, prime, and large size classes. (source: Tremblay-Boyer and Williams, 2023b)

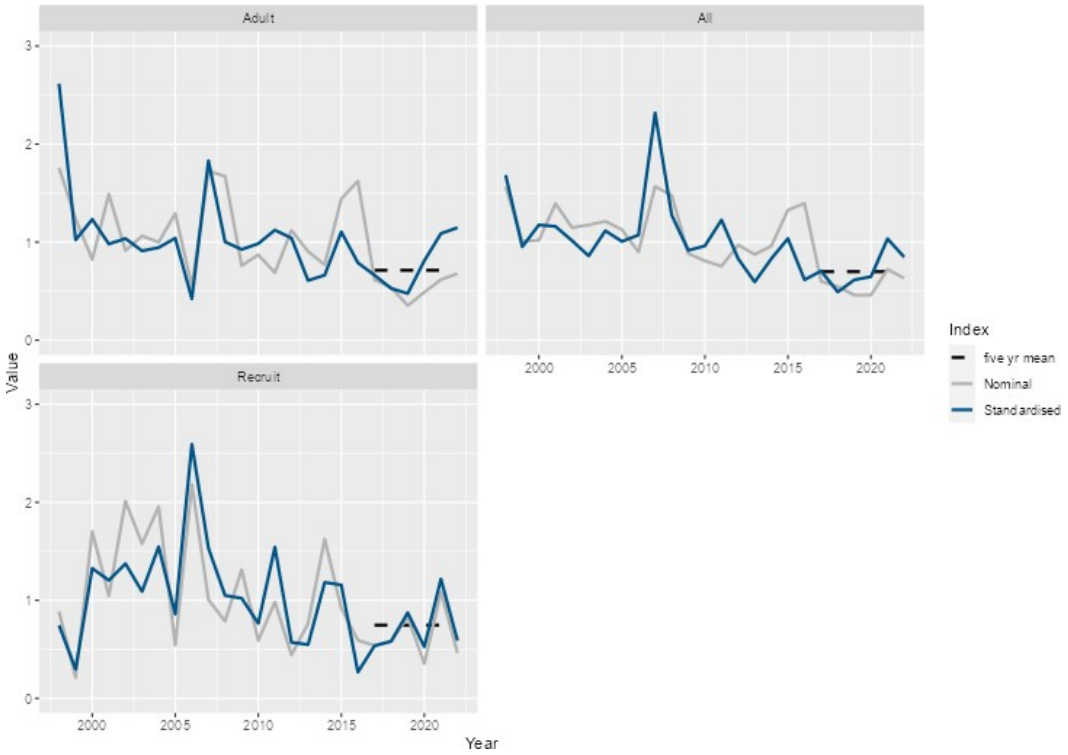


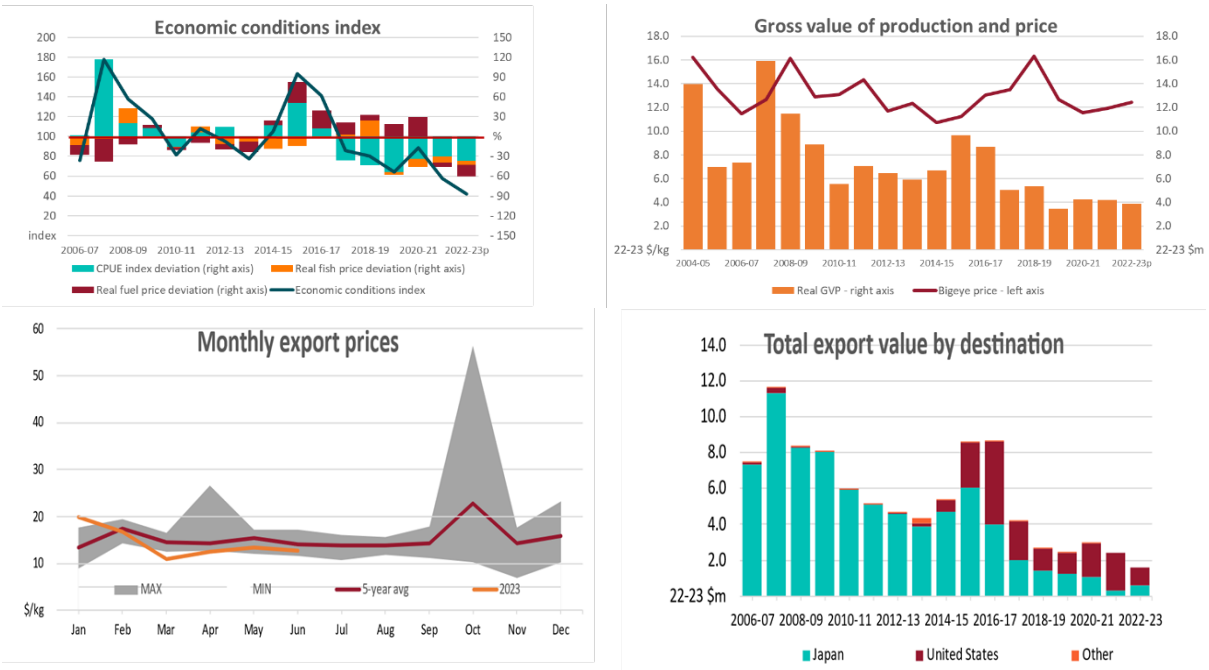
Figure 9 Nominal and standardised CPUE time series for bigeye tuna in the ETBF across size classes and the recent five-year average (2017-2021) (source: Tremblay-Boyer and Williams, 2023c).

Stock Status Bigeye Tuna

Indicator	Comment
Stock	Considered a single stock in the Pacific Ocean – connectivity between ETBF and equatorial regions uncertain but may be small.
WCPO Stock Assessment	Preliminary results: Last assessment: 2023. Overfished: Not Overfished Overfishing: No Overfishing The last full assessment of bigeye tuna was in 2023. Please note the preliminary estimates below. Next assessment: TBA
WCPFC Scientific Committee noted the preliminary estimates 2023	• SC19 noted that the preliminary estimate of total catch of WCPO bigeye tuna for 2022 was 140,664 mt which was similar to the 2021 level. Longline catch in 2022 (54,800 mt) was similar to the 2021 catch and lower than the recent ten-year average and understood to be partly due to the impacts of the COVID-19 pandemic. Purse-seine catch in 2022 (62,811 mt) was also similar to the 2021 catch, and lower than the recent ten-year average. • The 2023 WCPO bigeye tuna stock assessment median depletion from the model grid for the recent period (2018-2021; $SB_{recent}/SBF=0$) was 0.35 (10th to 90th percentile interval of 0.30 to 0.40, including estimation and structural uncertainty, Table BET-02). For all models in the grid $SB_{recent}/SBF=0$ was above the biomass limit reference point. The recent median fishing mortality (2017-2020;

	F_{recent}/F_{MSY}) was 0.59 (10th to 90th percentile interval of 0.46 to 0.74, including estimation and structural uncertainty, Table BET-02). For all models in the grid, F_{recent}/F^{MSY} was less than one. • SC19 noted that the catch in the last year of the assessment (2021) was less than the median MSY (164,640 mt), which is a 17% increase in the estimated MSY for bigeye tuna from the 2020 stock assessment (140,720 mt). • The objective for bigeye tuna in CMM 2021-01 (the Tropical Tuna Measure) – to maintain the spawning biomass depletion ratio at or above the average $SB/SB_{F=0}$ for 2012-2015 – is being achieved. $SB_{recent}/SB_{F=0}$ (35%) is very close to the average $SB/SB_{F=0}$ for 2012-2015 (34%) calculated across the unweighted grid. • The WCPO bigeye tuna spawning biomass is above the biomass LRP, and F_{recent} is below F_{MSY} for all models in the uncertainty grid. The stock is very likely not experiencing overfishing (100% probability $F_{recent}<F_{MSY}$) and is not in an overfished condition (0% probability $SB_{recent}/SB_{F=0}$<LRP). • The interim objective of bigeye tuna stock under CMM 2021-01 is to maintain the depletion level of the stock at or above the average $SB/SB_{F=0}$ for 2012-2015. The recent depletion level of bigeye tuna is close to this interim objective. SC19 noted that while the projection results based on the 2023 bigeye tuna assessment were not available for SC19 to review, this information will be available for the 4th tropical tuna management workshop and will provide the Commission guidance on future expected levels of fishing mortality and the outcomes relative to the interim or future management objectives.

Economic conditions in the Eastern Tuna and Billfish Fishery Bigeye tuna



Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Monthly export prices based on fresh or chilled bigeye tuna exports. Total export value by destination based on all bigeye tuna exports from Australia. 99.9% of bigeye tuna exports are as 'fresh or chilled'.Sources: ABARES, ABS, FFA.

TTRAG TACC Advice for Bigeye Tuna:

A new stock assessment for bigeye tuna (Thunnus obesus) in the WCPO was conducted in 2023. TTRAG considered the available information and indicators and concluded:

• Bigeye tuna are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2018-2021; $SB_{recent}/SBF=0$) was 0.35 with a range (80% CI) of 0.30–0.40. None of the model runs estimated depletion to be below 0.2.

• Bigeye tuna are not subject to overfishing. The median estimate of recent (2017-2020) fishing mortality relative to FMSY (F_{recent}/F_{MSY}) was 0.59 with a range (80% CI) of 0.46- 0.74. None of the model runs estimated recent fishing mortality to be above F_{MSY}.

• The 2022 ETBF catch of bigeye tuna was 346 t which represents 23% of the provisional total catch of bigeye tuna within region 5 (10-50oS and 140oE-170oW). The average contribution is 22% over the previous five years (2017-2022).

• In the ETBF, the 2022 catch of bigeye tuna is below both the five-year and ten-year average catch 360 t and 499 t respectively. Catches of bigeye tuna in the ETBF have declined since a peak in 2016, however catches have shown a slight increase in 2021 and 2022.

• The standardised CPUE indices for bigeye tuna (adults, recruits and combined) increased for adults but decreased for recruits in 2022.Overall, the standardised CPUE index for all sizes declined slightly in 2022. The CPUE indices for adults and all sizes combined were above the recent five-year average in 2022, while the CPUE for recruits was below. Each of the indices have been below average or declining over the last five to ten years and these increases show a return of the index toward the long-term average.

• Economic conditions index for 2022 is below average with a distinct downward trend since 2020-2021.

TTRAG TACC recommendation 2024:
1,056t

Broadbill swordfish

Broadbill swordfish (Xiphias gladius) were last assessed in the WCPO in 2021 using data up to 2019 (Ducharme-Barth et al., 2021). Annual catch estimates for Southwest Pacific swordfish peaked at 11,128 mt in 2012 (SC17-ST-IP-01). Catch by longline vessels in 2020 was 5,373 mt compared to 5,812 mt in 2019, a decline of 7.6%.

Indicators summary:

- In the ETBF, the 2022 catch of broadbill swordfish (723 t) is below both the five-year and ten-year average catch in the ETBF of 846 t and 994 t respectively (Figure 10). Catches of broadbill swordfish in the ETBF have been gradually declining over time from a peak in the late 1990s and early 2000s, but have started to increase in the past 2 years since the lowest catches were reported in 2020.

- The 2022 ETBF catch of broadbill swordfish represents 76% of the provisional total catch of broadbill swordfish within Region 1 (0-50oS and 140-165oE). The average contribution is 67% over the previous five years (2017-2021), with a maximum of 83% in 2007 (Tremblay-Boyer and Williams, 2023a).

- The outcomes of the stock assessment are on average more optimistic than the 2017 assessment, however uncertainty in estimates has increased. Broadbill swordfish are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2018-2021; $SB_{recent}/SBF=0$) was 0.39 with a range (80% CI) of 0.18-0.79. There is a 10% probability that depletion in spawning biomass is below 0.2.

- Broadbill swordfish are unlikely to be subject to overfishing. The median estimate of recent (2017- 2020) fishing mortality relative to FMSY (F_{recent}/F_{MSY}) was 0.47 with a range (80% CI) of 0.25-1.29. There is a 20% probability that fishing mortality is above F_{MSY}.

- The annual size distribution (Figure 11) shows a clear mode of smaller individuals and a median much higher than the mode across all years, reflecting a wide span of weights in the catch samples. The proportion of large broadbill swordfish landed has declined over the last six years, while the proportion of small fish has increased. However, the proportion of prime-sized broadbill swordfish has increased over the past year or two, likely due to the growth of small fish moving them into the prime size category, resulting in an increase in the overall median size of fish (Figure 11 and 1) (Tremblay-Boyer and Williams, 2023b).

- For all size groups, the standardised CPUE index appears to vary cyclically with a low period from 2016. There is an increase in the standardised CPUE indices from 2021 to 2022 for all size groups, except recruits where the index remains stable (Figure 13) (Tremblay-Boyer and Williams, 2023c). The sub-adults group shows the steepest increase in 2022.

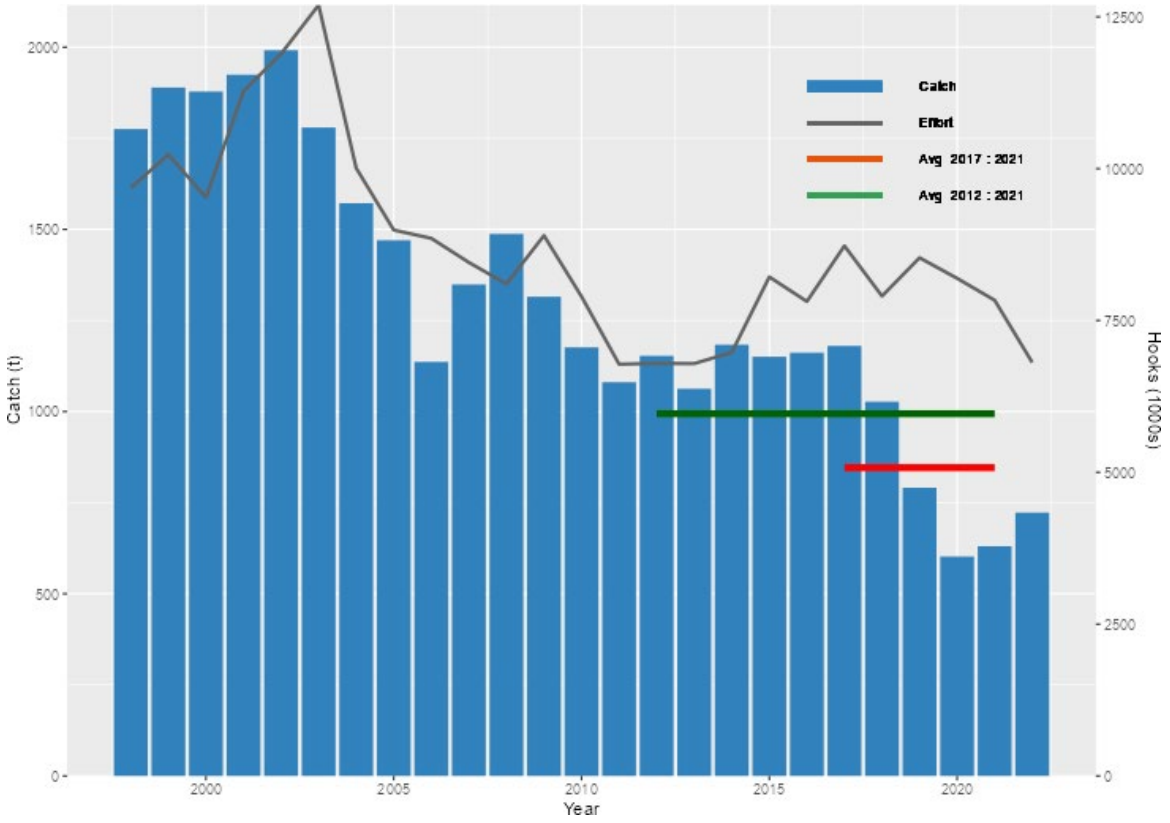


Figure 10 Total broadbill swordfish catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

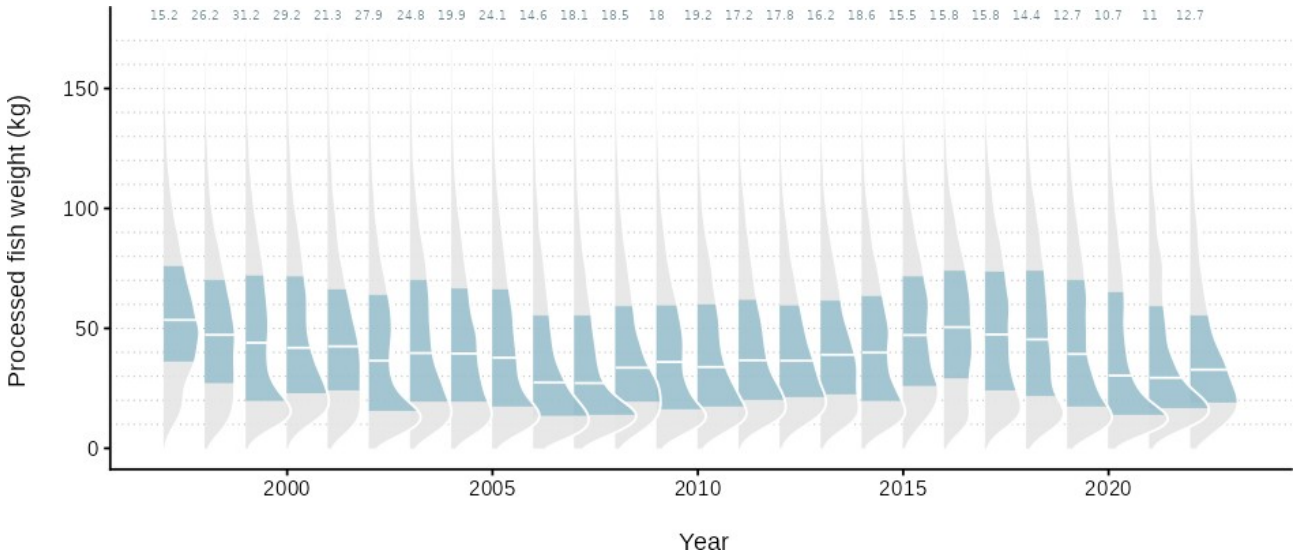


Figure 11 The distribution in processed weights (kg) of broadbill swordfish caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay- Boyer and Williams, 2023b).

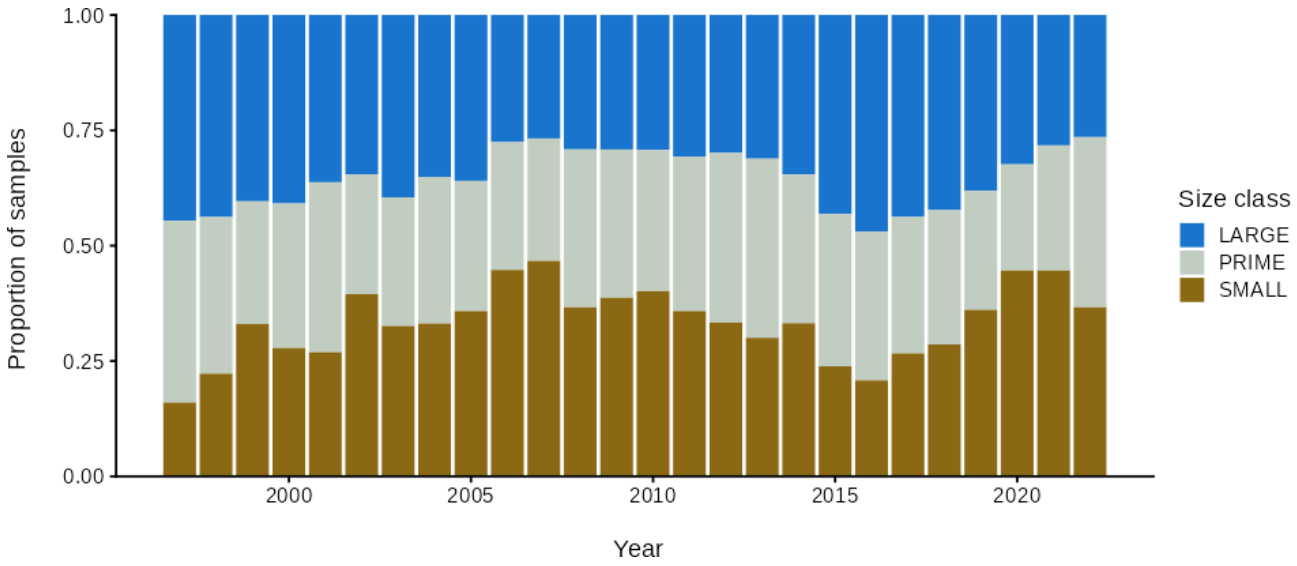


Figure 1 Size distribution of broadbill swordfish caught in the ETBF across small, prime, and large size classes (source: Tremblay-Boyer and Williams, 2023b).

Figure 2 Nominal and standardised CPUE time series for broadbill swordfish in the ETBF across size classes and the recent five-year average (2017-2021) (source: Tremblay-Boyer and Williams, 2023c).

Stock Status

Indicator	Comment
Stock Structure	The results of genetic studies support a separate south-western Pacific stock of Broadbill Swordfish. At its July meeting (TTRAG 38) TTRAG agreed, although there is limited data on swordfish movements, the current available data suggests the swordfish stock movements are predominantly north/south rather than east/west within the Australian region. The RAG agreed that this information supports the hypothesis that there is a swordfish sub stock within Australia's exclusive economic zone. The RAG recognised that further research should be undertaken to further reduce the uncertainty of swordfish stock structure. Please refer TTRAG 38 Minutes, Agenda Item 5.1 – Harvest Strategy Review.
WCPO[5] Stock Assessment – Stock wide status	Last assessment: 2021[6] Overfished[7]: Highly Unlikely Overfishing[8]: Unlikely Broadbill Swordfish were last assessed in 2021 (Ducharme-Barth et al., 2021) using data through to 2019. The outcomes of the assessment are on average more optimistic compared to the 2017 assessment, but the estimated uncertainty has increased. A short summary: • Broadbill swordfish are not overfished. The median estimate of spawning biomass was 0.39 B0 with a range (80% CI) of 0.18-0.79. There is a 10% probability that spawning biomass is below 0.2 B0. • Broadbill swordfish are unlikely to be subject to overfishing. Fishing mortality was estimated to be 0.47 of FMSY with a range (80% CI) of 0.25-1.29. There is a 20% probability that fishing mortality is above FMSY. Next assessment: 2025
WCPFC Scientific Committee Management advice 2021	• The outcomes of the assessment are on average more optimistic in relation to the 2017 assessment, but the estimated uncertainty has increased. Noting that a LRP for Southwest Pacific swordfish has not yet been adopted by WCPFC, SC17 noted that the median latest • Southwest Pacific swordfish spawning biomass is above both SB_{MSY} and the LRP 20%SBF=0 applied to tunas, and recent fishing mortality is below F_{MSY}. The stock is likely not experiencing overfishing (80% probability $F<F_{MSY}$ and 20% probability $F>F_{MSY}$) and is likely not in an overfished condition (13% probability that SBlatest/SBMSY < 1 and a 10% probability that SBlatest/SBF=0<0.2). • SC17 noted that the levels of fishing mortality and depletion in the diagnostic case differ

[5] The stock assessment area for the SW-Pacific SWO stock covers the region of the south Pacific from 0-50oS and 140oE-130oW (excluding the smaller region 0-5oS,130-150oW)

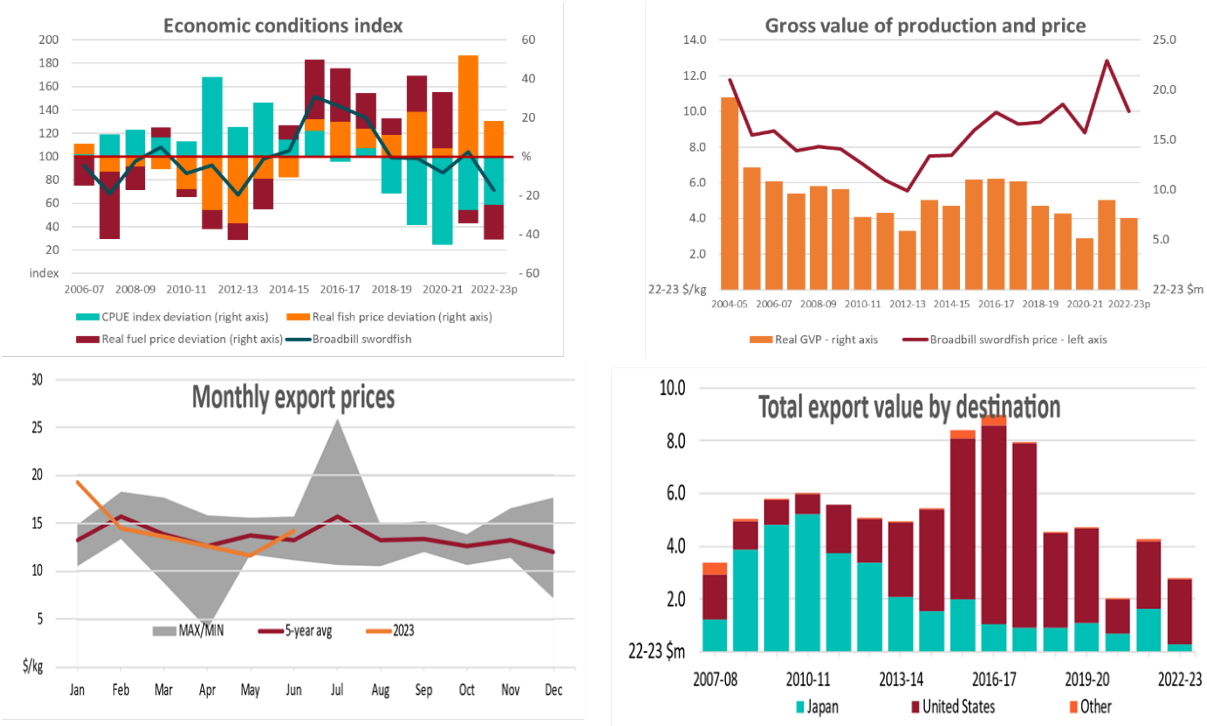
[6] The assessment covers the years 1952-2019.

[7] As the WCPFC has not adopted a Limit Reference Point for SWO, the indictor $SB_{recent}/SBF=0$ is used where in the latest assessment SB_{recent} refers to the mean annual spawning biomass over the period 2015-19 and SBF=0 is the estimated average annual spawning biomass over the period 2009-18 in the absence of fishing. No Target Reference Point has yet been adopted for SWO.

[8] The indictor F_{recent}/F_{MSY} is used to estimate fishing pressure on the stock where in the latest assessment F_{recent} is the mean fishing mortality over the period 2015-19 and FMSY is the fishing mortality at Maximum Sustainable Yield (MSY).

	between the two model regions, with fishing mortality higher in Region 1 but spawning biomass depletion greater (more depleted) in Region 2. SC17 noted that over the past two decades, the majority of catch has been taken by a combination of swordfish targeting fleets (in the area south of 20°S; 42% of catches) and fleets taking swordfish as a bycatch on the high seas (in particular in the eastern stock area north of 20°S; 34% of catches). • SC17 recommended that research priorities for this stock include directed longitudinal tagging of swordfish and a feasibility study on the utility of Close Kin Mark Recapture (CKMR). • SC17 noted the current measure (CMM 2009-03) for this stock does not contain provisions to limit total fishing mortality on the stock and emphasized the continued importance of WCPFC to develop a revised and strengthened CMM that will ensure the ongoing future sustainability of the Southwest Pacific swordfish. SC17 noted that the suite of catch projections requested by WCPFC16, which are to be undertaken by the SSP postSC17 and prior to WCPFC18, are intended to test the future likely state of the stock under a range of potential future catch or effort scenarios. This information will inform the revision of the future measure.

Economic conditions in the Eastern Tuna and Billfish Fishery Swordfish



Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Monthly export prices based on fresh or chilled swordfish exports. Total export value by destination based on all swordfish exports from Australia. 99% of swordfish exports are as 'fresh or chilled'.

Sources: ABARES, ABS, FFA.

Application of the modified harvest strategy

- The modified harvest strategy was supported by both TTRAG (meeting 35, July 2022) and TTMAC (out of session, August 2022) and will be applied to calculate a TACC recommendation for the 2023 and 2024 fishing seasons.

- At its September meeting 36, TTRAG advice was derived from the modified swordfish HS. TTRAG recommended a RBCC of 1047t, no change to the TACC for 2023 season.

- At its 86th AFMA Commission meeting (November 2022), the AFMA Commission agreed to modify the ETBF Harvest Strategy. The Commission noted, when making the modification to the ETBF Harvest Strategy, that the purpose of the modification is to explicitly account for recent low catch levels compared to the TACC and, in doing so, avoid unnecessary TACC reductions. The modification has been designed and tested assuming the level of recent under catching ceases.

RBCC Calculation

The mean sub-adult standardised CPUE for the years 2019–2022 (correctly rescaled by the mean of the 1998–2018 index used in the original MSE work, Hillary 2020) was 0.772. This is slightly below the lower limit of the buffer of 0.8 in the HCR, which means a decrease in the RBCC should result. Of note, this is an improvement in scalar value from previous iterations of the HS (e.g. Hillary et al., 2022), reflecting recent increases in the sub-adult standardised CPUE index.

The resulting prescribed reduction in RBCC from the standardised CPUE alone is a scalar of 0.953. This scalar is within the 10% maximum change constraint, so should normally be applied as is to the previous TAC. However, under the modified HS, current catches (723t) are below the original RBCC (998t) by a level greater than the difference between the RBCC and the recent TAC of 1,047t, so the recommended RBCC is set to the recent TAC (1,047 tonnes, no change) (Figure 2) (Hillary et al., 2022).

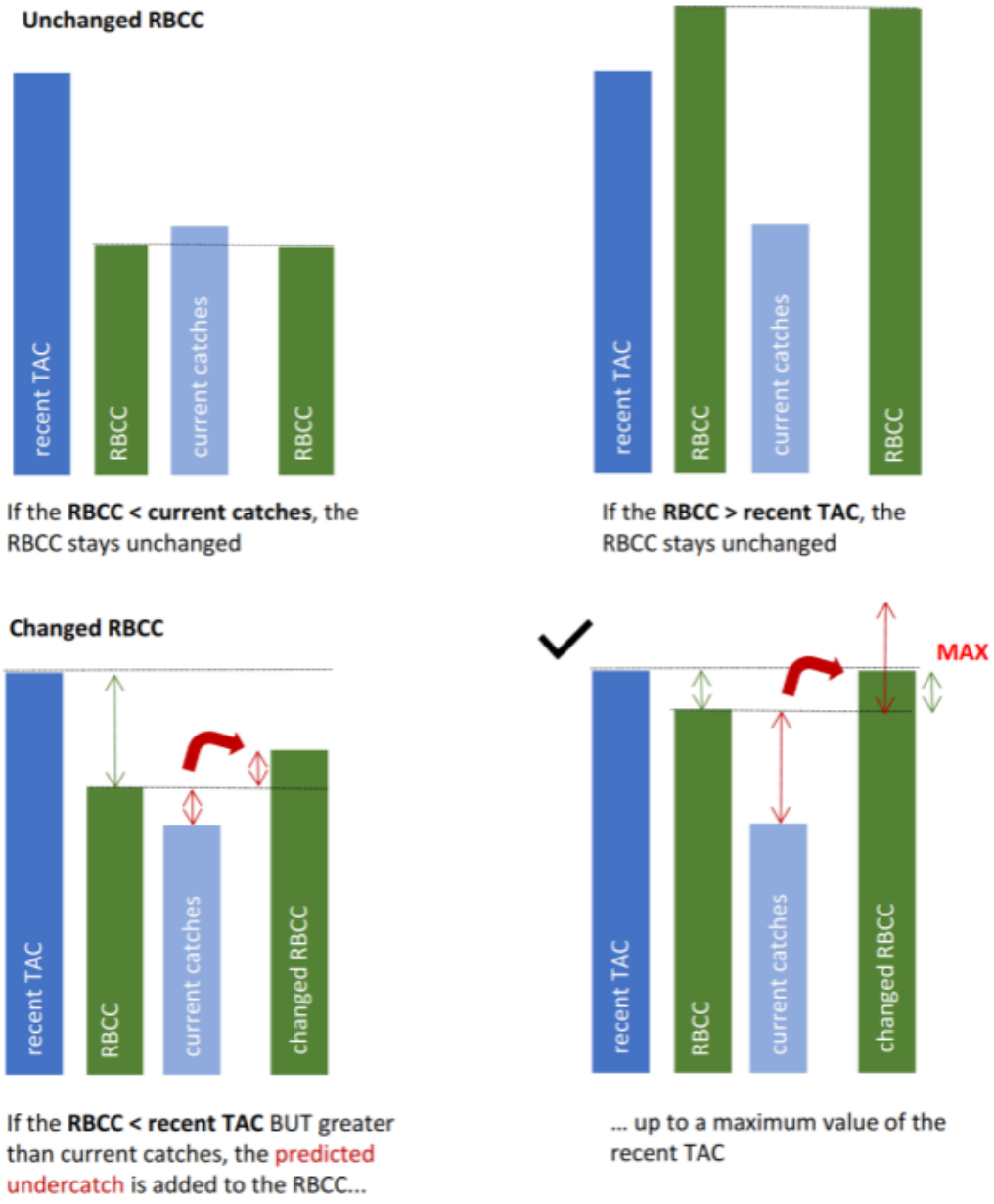


Figure 2: Illustration of the outcomes of the modified Harvest Strategy under different relative levels of recent TAC, RBCC (as prescribed by the original Harvest Strategy) and the predicted undercatch (i.e., the difference between the RBCC and current catches). The top row shows cases where the RBCC remained unchanged from the original recommendation, the bottom row shows cases where the RBCC is changed as a function of the extent of the predicted undercatch. The tick mark indicates the case applied for this year's Harvest Strategy update.

Hillary et al., 2023

TTRAG TACC Advice for Broadbill Swordfish:

Broadbill swordfish were last assessed in the WCPO in 2021 using data up to 2019. TTRAG considered the available information and indicators and concluded:

• Broadbill swordfish are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2018-2021; $SB_{recent}/SBF=0$) was 0.39 with a range (80% CI) of 0.18-0.79. There is a 10% probability that depletion in spawning biomass is below 0.2.

• Broadbill swordfish are unlikely to be subject to overfishing. The median estimate of recent (2017- 2020) fishing mortality relative to FMSY (F_{recent}/F_{MSY}) was 0.47 with a range (80% CI) of 0.25-1.29. There is a 20% probability that fishing mortality is above F_{MSY}.

• The 2022 ETBF catch of broadbill swordfish was 723 t which represents 76% of the provisional total catch of broadbill swordfish within Region 1 of the southwest Pacific (0-50oS and 140-165oE). The average contribution is 67% over the previous five years (2017-2021).

• In the ETBF, the 2022 catch of broadbill swordfish (723 t) is below both the five-year and ten-year average catch in the ETBF of 846 t and 994 t respectively. Catches of broadbill swordfish in the ETBF have been gradually declining over time from a peak in the late 1990s and early 2000s, but have started to increase in the past 2 years since the lowest catches were reported in 2020.

•Economic conditions index for 2022 is below average with a distinct downward trend since 2021-2022.

There have been temporally sequential trends in the standardised CPUE indices for the different size classes (small, prime, large, combined) of broadbill swordfish that are consistent with a series of weak cohorts has moved through the fishery over the last few years. For all size groups, the standardised CPUE index appears to vary cyclically with a low period from 2016. There is an increase in the standardised CPUE indices from 2021 to 2022 for all size groups, except recruits where the index remains stable. The sub-adults group shows the steepest increase in 2022.

• There is no evidence to suggest that drivers for the sequence of poor recruitments are related to a decline in adult fish within the ETBF and may be related to environmental conditions.

• Industry members have previously raised strong concerns about the CPUE standardisation, which they consider does not reflect changes to fishing behaviours (avoidance due to a lack of market) over recent years. However, scientific members noted that while the overall nominal CPUE drops significantly in recent years (consistent with industry observations), the std-CPUE does not and thus considered it to be capturing some of recent changes in the fishery. Significant efforts have been made to enhance CPUE standardisation, and this work is ongoing

• The RAG advice was derived from implementation of the ETBF modified swordfish Harvest Strategy (endorsed by TTMAC in 2022). The ETBF harvest strategy for Swordfish, modified in 2022, was used to recommend the RBCC setting of the 2023 TACC. No further exceptional circumstances were identified by TTRAG 39.

•The harvest strategy has been MSE tested to address the low catch to TACC. The additional MSE testing of the modified HS adequately addressed the exceptional circumstances of the low catch to TACC. Noting

that, now that the scenario of under-catch to the TAC has been explored, the exceptional circumstances is no longer applied as the new modified harvest strategy has been accepted.

TTRAG TACC recommendation 2024:
1,047t

Striped marlin

Striped marlin (Kajikia audax) in the WCPO were last assessed in 2019 (Ducharme-Barth et al., 2019). SC15 noted that recent catches are approximately half the MSY, and that recent fishing mortality is slightly less than the fishing mortality that would result in MSY.

Indicators summary:

- In the ETBF, the 2022 catch of striped marlin (283 t) is above both the five-year and ten-year average catch in the ETBF of 239 t and 257 t respectively (Figure 3). Catches of striped marlin in the ETBF have been declining gradually over time since a peak in 2001, but increased sharply in 2022.

- The 2022 ETBF catch of striped marlin represents 56% of the provisional total catch of striped marlin within Region 1 (0-50oS and 140-165oE). The average contribution is 60% over the previous five years (2017-2021), with a maximum of 72% in 2006 (Tremblay-Boyer and Williams, 2023b).

- Striped marlin are potentially overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2014-2017; SBrecent/SBF=0) was 0.2 with a range (80% CI) of 0.09-0.46. There is a 50% probability that depletion in spawning biomass is below 0.2.

- Striped marlin are potentially subject to overfishing. Estimates of fishing mortality were highly uncertain, with the median estimate of recent (2013-2016) fishing mortality relative to FMSY (Frecent/FMSY) of 0.91 with a range (80% CI) of 0.31-1.89. There is a 44% probability that fishing mortality is above FMSY.

- The annual size distribution shows a single mode between about 50 and 70 kg throughout the time series with a decline in median size over time but a slight increase from 2021 to 2022 (Figure 4 and 5) (Tremblay-Boyer and Williams, 2023b).

- The standardised CPUE index for striped marlin has been relatively stable over the last two decades (Figure 17.). Standardised CPUE reached a minimum in 2020, but it has increased sharply, above the five-year recent average in 2022 (Tremblay-Boyer and Williams, 2023c).

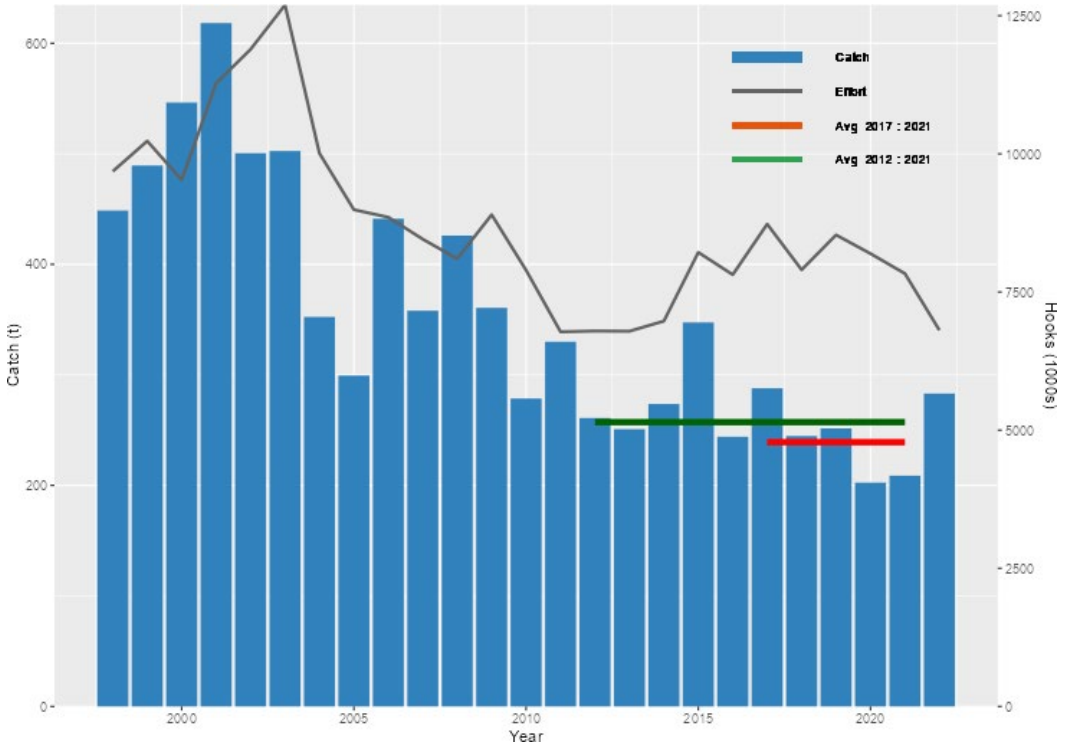


Figure 3 Total striped marlin catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

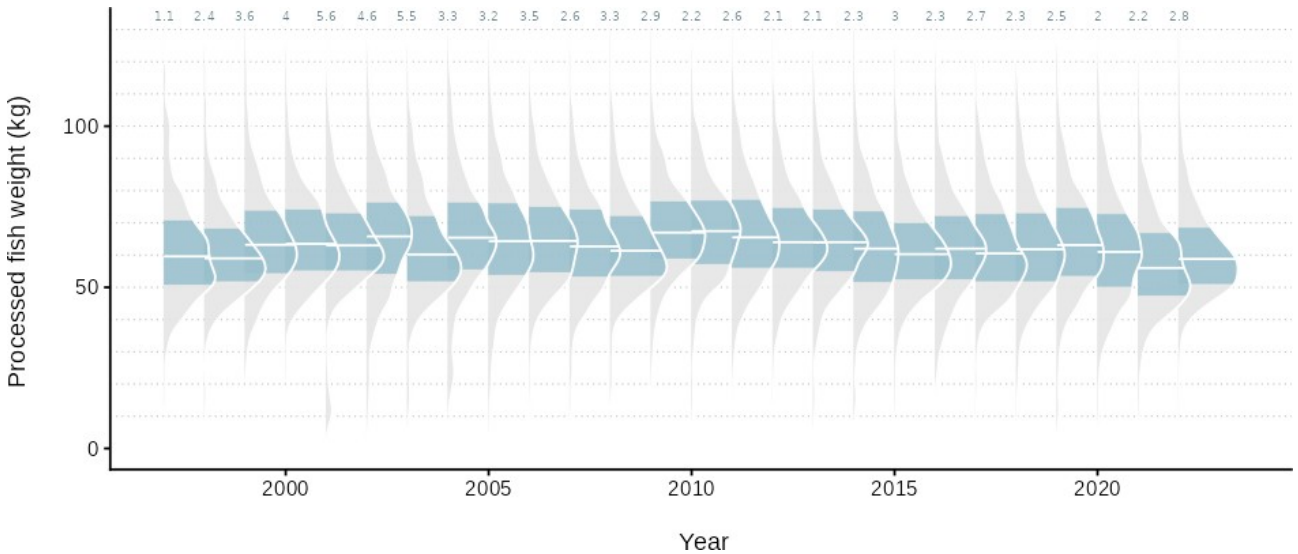


Figure 4 The distribution in processed weights (kg) of striped marlin caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay-Boyer and Williams, 2023b).

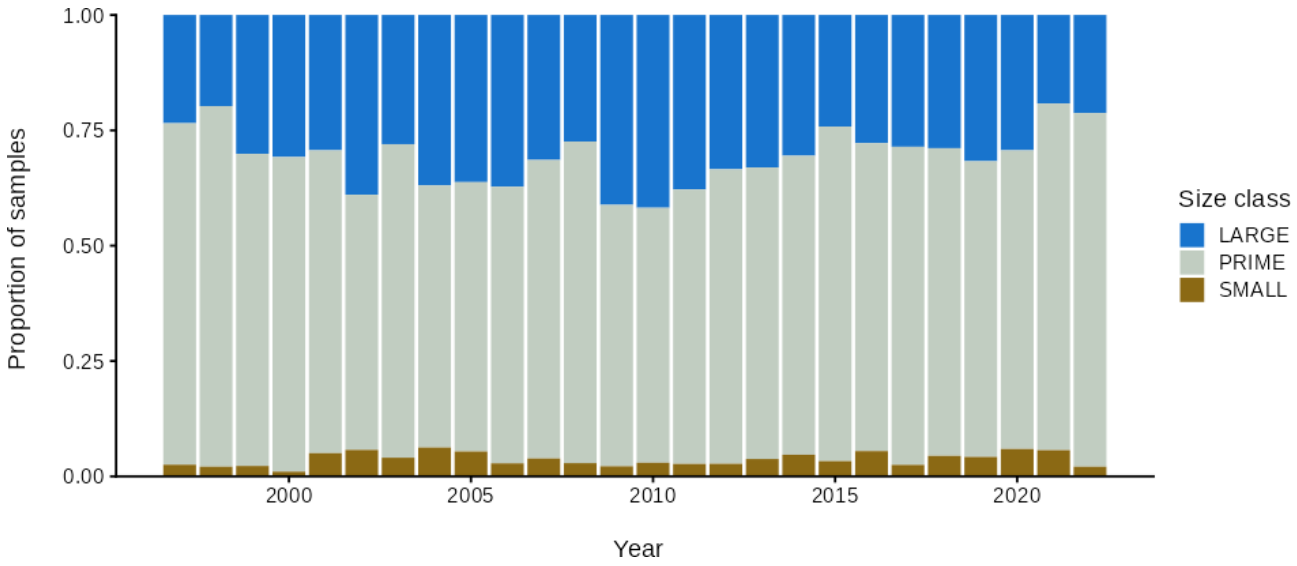


Figure 5 Size distribution of striped marlin caught in the ETBF across small, prime, and large size classes (source: Tremblay-Boyer and Williams, 2023b).

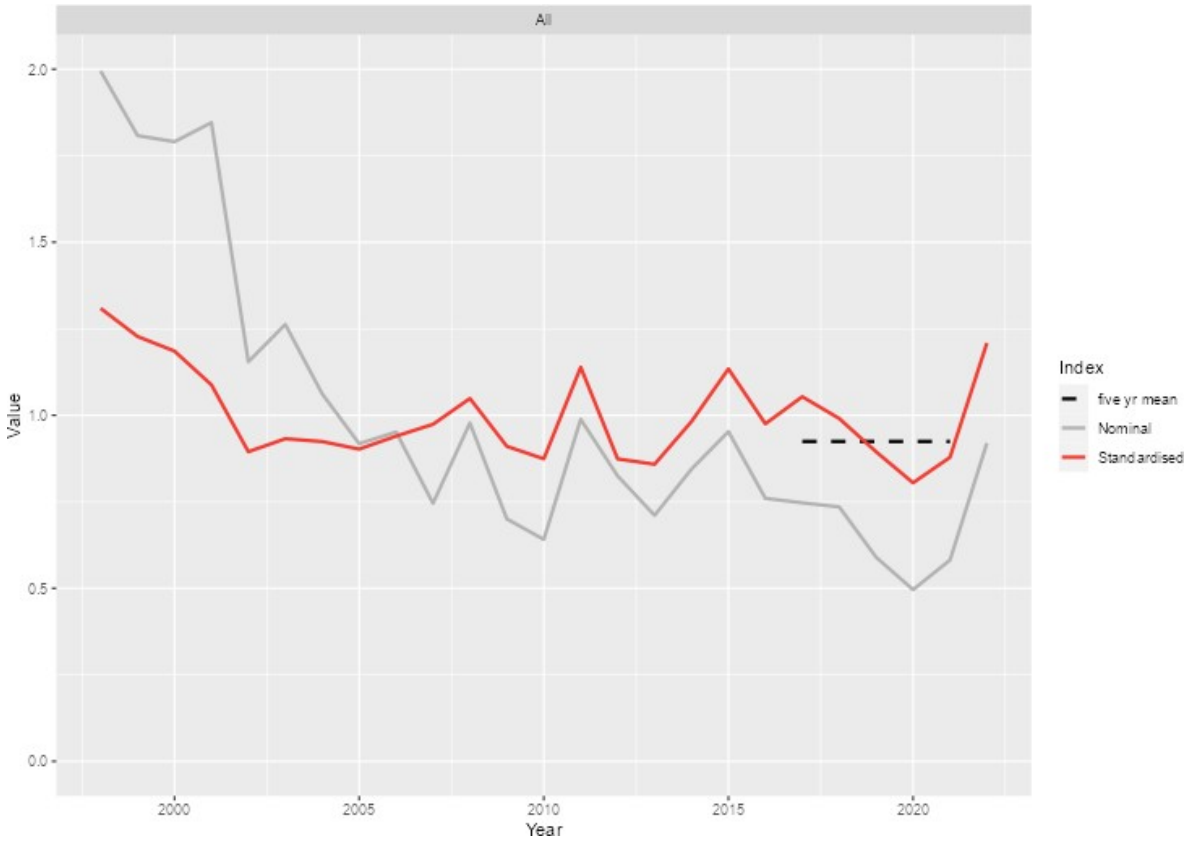


Figure 17 Nominal and standardised CPUE time series for striped marlin in the ETBF across size classes and the recent five-year average (2017-2021) (source: Tremblay-Boyer)

Stock Status Striped Marlin

Indicator	Comment
Stock Structure	The results of genetic studies support a separate south-western Pacific stock of Striped Marlin. TTRAG therefore considered that Striped Marlin is a single stock within the south-west Pacific.
WCPO[9] Stock Assessment – Stock wide status	Last assessment 2019[10] Overfished[11]: Likely Overfishing[12]: Undergoing • The striped marlin stock was last assessed in 2019 (Ducharme-Barth et al. 2019), so the major indicators with respect to the stock assessment haven't changed since 2019. • Striped marlin are potentially overfished. The median estimate of spawning stock biomass was 0.2B0 with 69% of model runs below the value expected to support catches at MSY. • Striped marlin are potentially subject to overfishing. Estimates of fishing mortality were very uncertain, ranging from 0.03-3.5 of FMSY with the median estimate at 0.91 FMSY and 56% of model runs estimating that overfishing is occurring. Fishing mortality has increased continuously (since major fishing operations began post-war) on both juveniles and adults up to 2010 and has been slowly decreasing since then. Recruitment has shown a general downward trend over the assessment period consistent with previous assessments, but with recent recruitment somewhat above the average predicted by the stock-recruit relationship. Next assessment: TBA
WCPFC Scientific Committee Management advice 2019	• SC15 noted that there are no agreed limit reference points for the WCPO billfish. • SC15 noted that recent catches are approximately half the MSY, and that recent fishing mortality is slightly less than the fishing mortality that would result in MSY. • SC15 recommended that WCPFC16 consider measures to reduce the overall catch of this stock, including through the expansion of the geographical scope of CMM2006-04, in order to cover the distribution range of the stock.

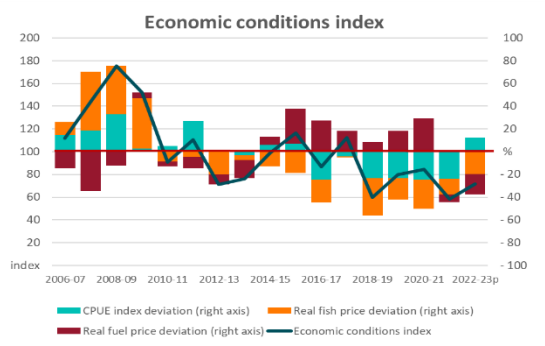
[9] The stock assessment area for SW-Pacific STM covers the region of the south Pacific from 0-50oS and 140oE-130oW.

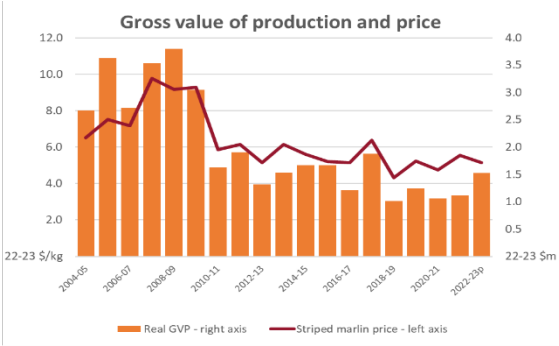
[10] The assessment covers the years 1952-2017.The assessment covers the years 1952-2017.

[11] As the WCPFC has not adopted a Limit Reference Point for STM the indictor SB_{recent}/SB_{MSY} is used where in the latest assessment SBMSY refers to the mean annual spawning biomass at Maximum Sustainable Yield (MSY) and SBF=0 is the estimated average annual spawning biomass over the period 2008-17 in the absence of fishing. No Target Reference Point has yet been adopted for STM.

[12] The indictor F_{recent}/F_{MSY} is used to estimate fishing pressure on the stock where in the latest assessment F_{recent} is the mean fishing mortality over the period 2014-17 and F_{MSY} is the fishing mortality at Maximum Sustainable Yield (MSY).

Economic conditions in the Eastern Tuna and Billfish Fishery Striped Marlin





TTRAG TACC Advice for Striped Marlin:

Striped marlin (Kajikia audax) in the WCPO were last assessed in 2019. TTRAG considered the available information and indicators and concluded:

• Striped marlin are potentially overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2014-2017; $SB_{recent}/SBF=0$) was 0.2 with a range (80% CI) of 0.09-0.46. There is a 50% probability that depletion in spawning biomass is below 0.2.

• Striped marlin are potentially subject to overfishing. Estimates of fishing mortality were highly uncertain, with the median estimate of recent (2013-2016) fishing mortality relative to F_{MSY} (F_{recent}/F_{MSY}) of 0.91 with a range (80% CI) of 0.31-1.89. There is a 44% probability that fishing mortality is above F_{MSY}.

• Recruitment has shown a general downward trend over the assessment period consistent with previous assessments, but with recent recruitment somewhat above the average predicted by the stock-recruit relationship.

• Overall catches from the stock have declined over the past 15 years while biomass has been relatively stable but at historically low levels since 2005.

• The 2022 ETBF catch of striped marlin was 283 t which represents 56% of the provisional total catch of striped marlin within Region 1 of the southwest Pacific (0-50oS and 140-165oE). The average contribution is 60% over the previous five years (2017-2021), with a maximum of 72% in 2006.

• In the ETBF, the 2022 catch of striped marlin (283 t) is above both the five-year and ten-year average catch in the ETBF of 239 t and 257 t respectively. Catches of striped marlin in the ETBF have been declining gradually over time since a peak of 730 t in 2001 but increased sharply in 2022.

• The distribution of processed fish weights of striped marlin has been stable over time with a recent minor decline apparent in the proportion of large fish harvested.

• Over the past two years, there have been notably fewer tags applied in New Zealand and Australia compared to the long-term average. This trend may be connected to La Niña.

• Economic conditions index for 2022 is below average with an upward trend in 2022-2023.

•TTRAG reviewed the following indicators in reference to triggering a review of the HS for Striped Marlin:

- **The most recent WCPFC stock assessment of south western Pacific Striped Marlin**
- **Any changes in targeting practice**
- **Industry desire to increase catch.**

i. TTRAG assessed the most recent WCPFC stock assessment of south western Pacific Striped Marlin which was in 2019, and noted there has not been a new stock assessment since last year's TTRAG recommendation.
ii. Industry members noted there have been no changes in targeting practices. The 2022 catch of striped marlin (283 t) is above both the five-year and ten-year average catch in the ETBF of 239 t and 257 t

respectively. Catches of striped marlin in the ETBF have been declining gradually over time since a peak of 730 t in 2001, but increased sharply in 2022.these changes in catch have mirrored changes in overall effort in the ETBF. The RAG noted that increase of striped marlin catches could increase of striped marlin catches, if yellowfin tuna catches increase.

iii. Presently there is no change in industry's desire to increase catch.

TTRAG does not anticipate conditions that would trigger a review of the constant catch HS.

TTRAG TACC recommendation 2024:
351t

Yellowfin tuna

A new stock assessment for yellowfin tuna (Thunnus albacares) in the WCPO was conducted in 2023 (Magnusson et al., 2023). Preliminary results were more pessimistic than the 2020 stock assessment (Vincent et al., 2020), with the stock estimated to be more depleted (lower depletion level) and higher levels of fishing mortality. The total catch of WCPO yellowfin tuna for 2022 was 721,169 mt which was lower than the 2021 level.

Indicators summary:

- In the ETBF, the 2022 catch of yellowfin tuna (1358 t) was below both the five-year and ten-year average catch in the ETBF of 1754 t and 1699 t respectively (Figure 18). Catches of yellowfin tuna in the ETBF have been stable at values around 1500 t after a peak catch in 2003, but have declined in the last few years (since 2019).

- The 2022 ETBF catch of yellowfin tuna represents 13% of the provisional total catch of yellowfin tuna within region 5 (10-50oS and 140-170oE). The average contribution is 15% over the previous five years (2017-2021), with a maximum of 20% in 2019 (Tremblay-Boyer and Williams, 2023a).

- Yellowfin tuna are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2018-2021; $SB_{recent}/SBF=0$) was 0.47 with a range (80% CI) of 0.42–0.52. None of the model runs estimated depletion to be below 0.2.

- Yellowfin tuna are not subject to overfishing. The median estimate of recent (2017-2020) fishing mortality relative to FMSY (F_{recent}/F_{MSY}) was 0.50 with a range (80% CI) of 0.41-0.62. None of the model runs estimated recent fishing mortality to be above FMSY.

- The annual size distribution (Figure 19) shows some variability in the median value across years with no clear trends in recent years and bimodality in 2022 (Tremblay-Boyer and Williams, 2023b). The frequency of smaller individuals (recruits) over time in the size samples has been variable over time, with most samples from 2022 coming from the ‘Small’ category in contrast to 2021 when most samples came from the ‘Prime’ category (Figure 20) (Tremblay-Boyer and Williams, 2023b).

- Standardised CPUE indices for yellowfin tuna in the ETBF are variable for all size classes (recruit, adult, and all) (Figure 21). For all size classes, the standardised CPUE in 2022 was above the recent five-year average (Tremblay-Boyer and Williams, 2023c).

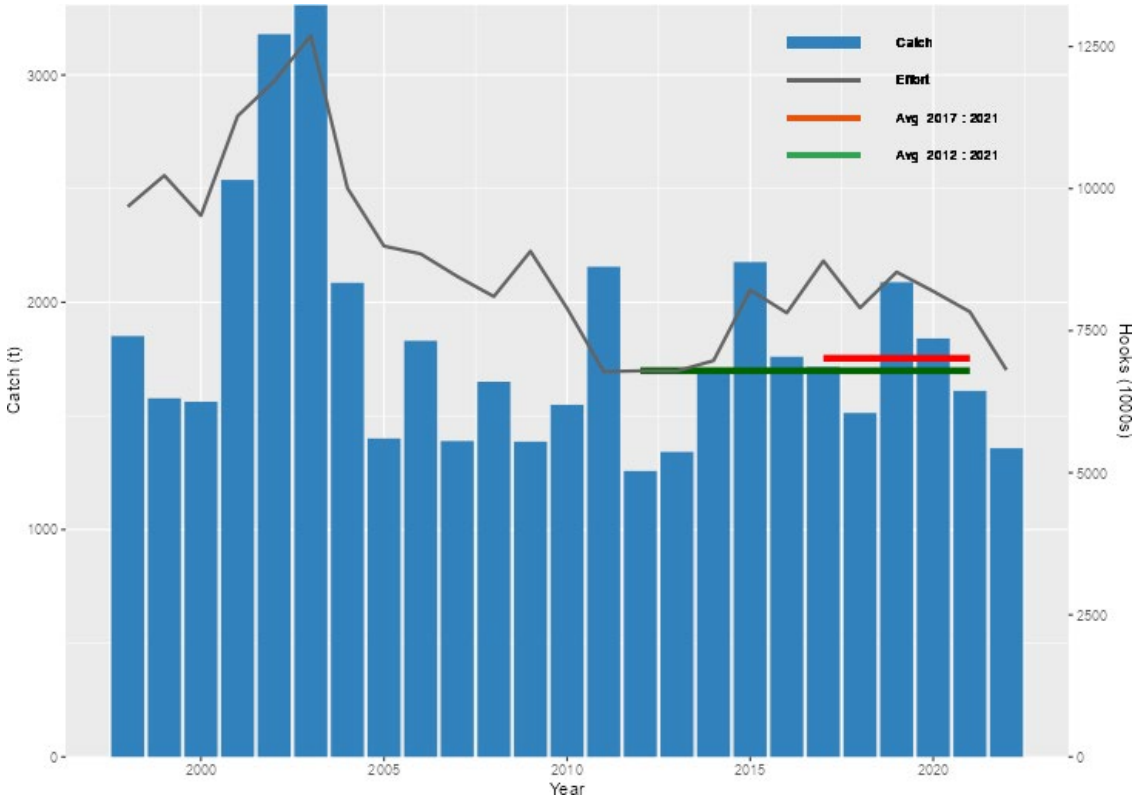


Figure 18 Total yellowfin tuna catch (tonnes) and overall effort (hooks) in the ETBF. The average catch is shown for the periods 2012-21 (green) and 2017-21 (red).

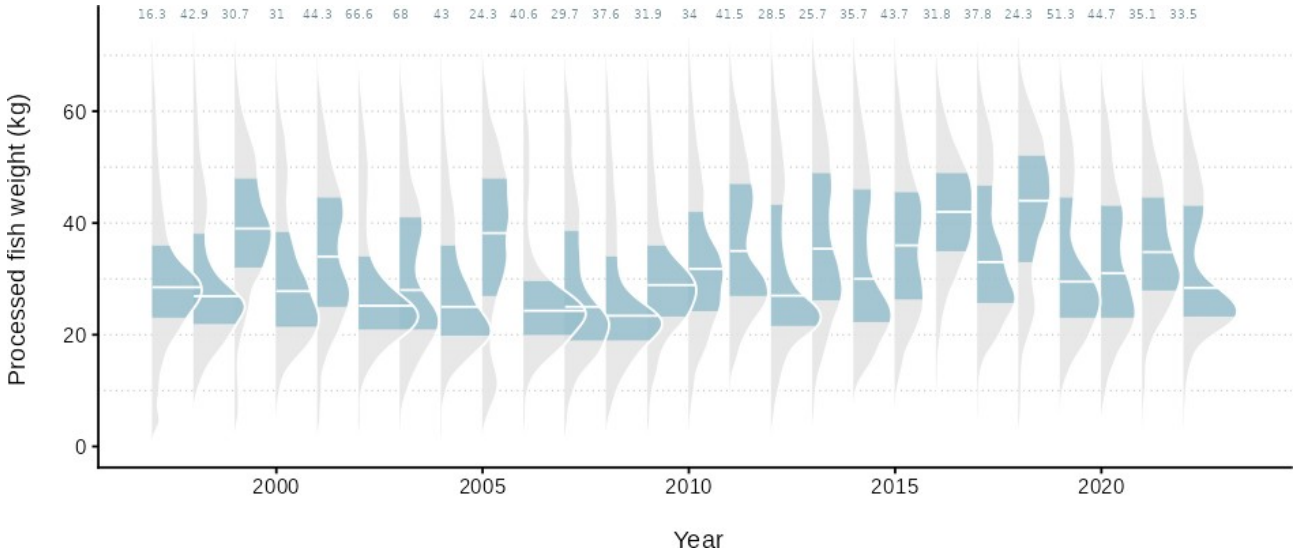


Figure 19 The distribution in processed weights (kg) of yellowfin tuna caught in the ETBF. The horizontal line in each annual distribution represents the median weight and shaded blue area the 50th percentiles (source: Tremblay-Boyer and Williams, 2023b).

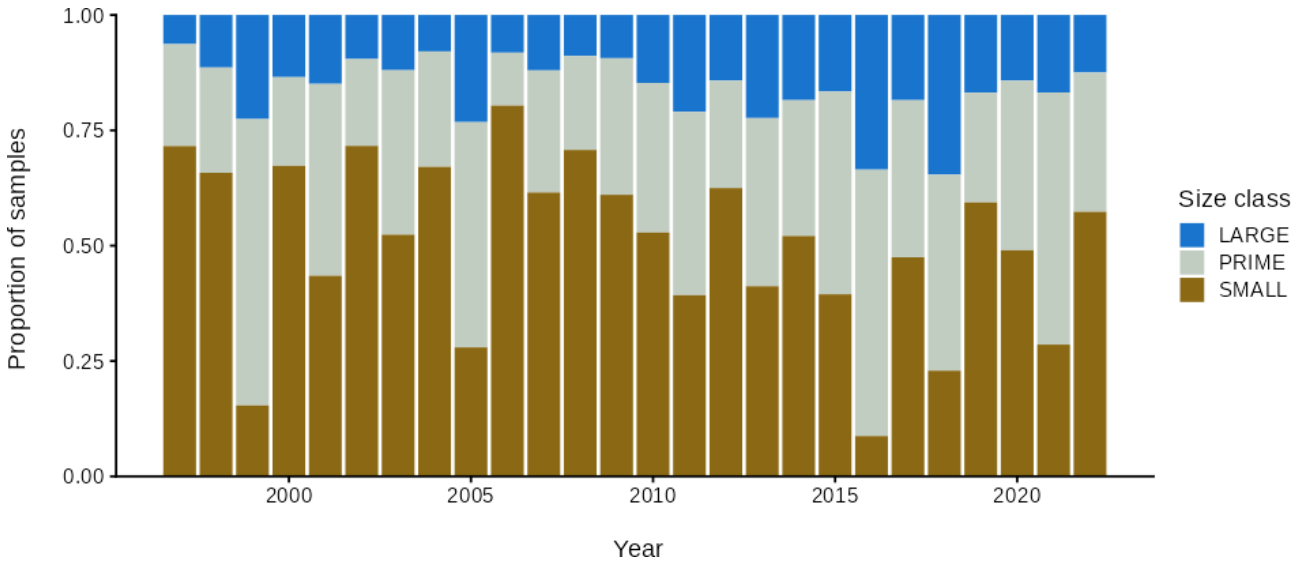


Figure 20 Size distribution of yellowfin tuna caught in the ETBF across small, prime, and large size classes (source: Tremblay-Boyer and Williams, 2023b).

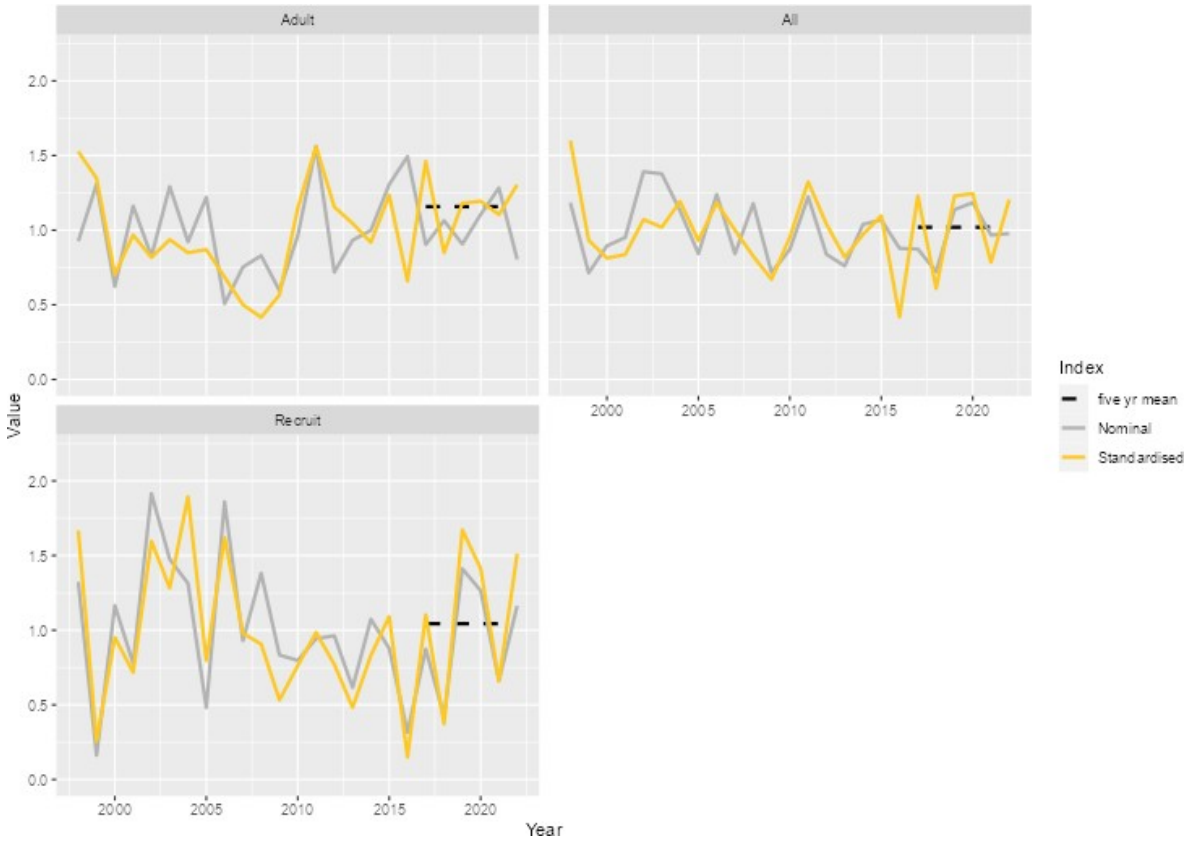
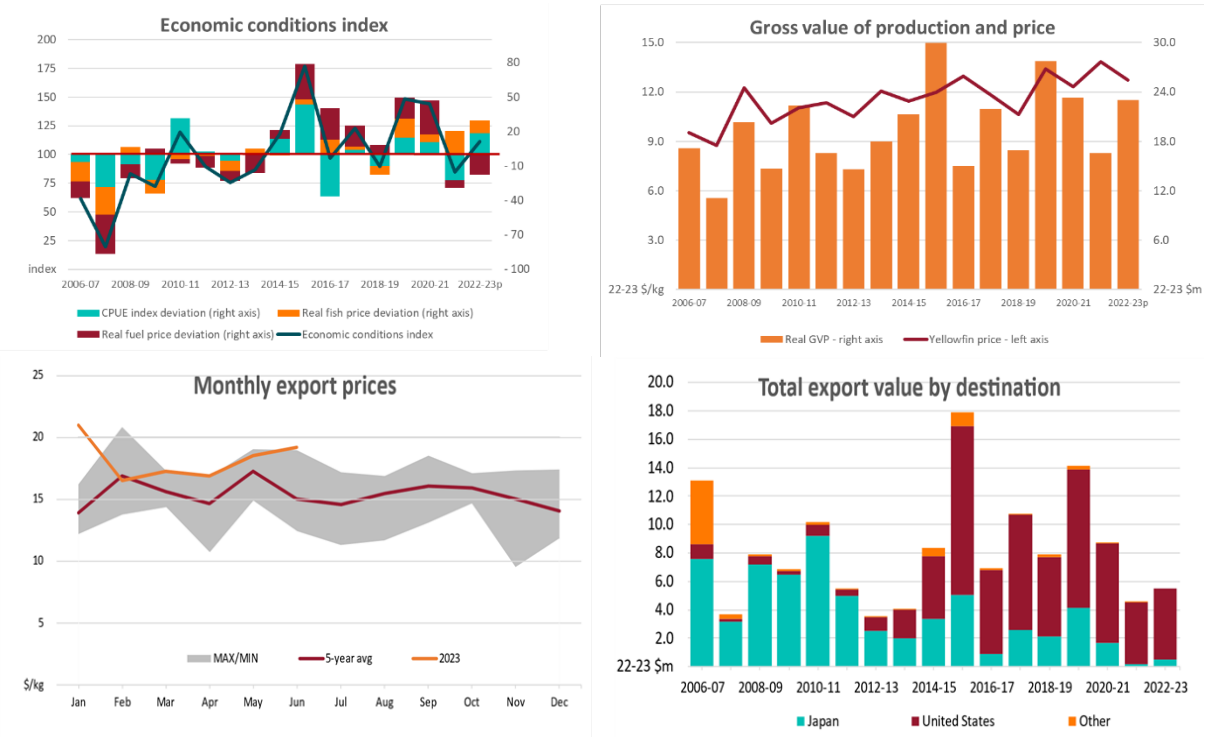


Figure 21 Nominal and standardised CPUE time series for yellowfin tuna in the ETBF across size classes and the recent five-year average (2017-2021) (source: Tremblay-Boyer and Williams, 2023c).

Stock Status Yellowfin Tuna

Indicator	Comment
Stock Structure	Considered a single stock in the Western and Central Pacific Ocean (WCPO) – connectivity between ETBF and equatorial regions uncertain but may be small.
WCPO Stock Assessment – Stock wide status	Preliminary results Last assessment: 2023. Overfished: Unlikely Overfishing: Unlikely The last full assessment of yellowfin tuna was in 2023. Please note the preliminary estimates below. Next assessment: TBA
WCPFC Scientific Committee noted the preliminary estimates 2023	• SC19 noted that the preliminary estimate of total catch of WCPO yellowfin tuna for 2022 was 721,169 mt which was lower than the 2021 level. Longline catch in 2022 (84,232 mt) was higher than the 2021 catch, but lower than the recent 10-year average. Purse-seine catch in 2022 (379,715 mt) was similar to the 2021 catch, and higher than the recent 10-year average. • The 2023 WCPO yellowfin tuna stock assessment median depletion from the model grid for the recent period (2018–2021; $SB_{recent}/SB_{F=0}$) was estimated at 0.47 (10^{th} to 90^{th} percentile interval of 0.42 to 0.52, including estimation and structural uncertainty). For all models in the grid $SB_{recent}/SB_{F=0}$ was above the biomass limit reference point. The recent median fishing mortality (2017–2020; F_{recent}/F_{MSY}) was 0.50 (10^{th} to 90^{th} percentile interval of 0.41 to 0.62, including estimation and structural uncertainty, Table YFT-02). For all models in the grid, F_{recent}/F_{MSY} was less than one. • SC19 noted that the spawning potential of the stock has become more depleted across all model regions until around 2010, after which it has become more stable, or shown a slight increase. • SC19 also noted that average fishing mortality rates for juvenile and adult age-classes have increased throughout the period of the assessment, although more so for juveniles which have experienced considerably higher fishing mortality than adults. In the recent period (2015-2021), a sharp increase in juvenile fishing mortality was estimated, while adult fishing mortality stabilized. • The objective for yellowfin tuna in CMM 2021-01 (the Tropical Tuna Measure) to maintain the spawning biomass depletion ratio at or above the average $SB/SB_{F=0}$ for 2012-2015 is being achieved. $SB_{recent}/SB_{F=0}$ (47%) exceeds the average $SB/SB_{F=0}$ for 2012-2015. • The interim objective for the yellowfin tuna stock under CMM 2022-01 is to maintain the depletion level of the stock at or above the average $SB/SB_{F=0}$ for 2012-2015 and the recent depletion level of yellowfin tuna is close to the interim objective. SC19 noted that while the projection results based on the 2023 yellowfin tuna assessment were not available for SC19 to review, this information will be available when for the 4^{th} tropical tuna management workshop and will provide the Commission guidance on future expected levels of fishing mortality and the outcomes relative to the interim or future management objectives.

Economic conditions in the Eastern Tuna and Billfish Fishery Yellowfin tuna



Notes: Economic conditions index (and component indices) 2006–07 to 2022–23 average = 100. Deviation represents percentage difference of each component index from long-term average. Monthly export prices based on fresh or chilled yellowfin tuna exports. Total export value by destination based on all yellowfin tuna exports from Australia. 99% of yellowfin tuna exports are as 'fresh or chilled'.

Sources: ABARES, ABS, FFA.

TTRAG TACC Advice for Yellowfin Tuna:

A new stock assessment for yellowfin tuna (Thunnus albacares) in the WCPO was conducted in 2023. TTRAG considered the available information and indicators and concluded:

• Yellowfin tuna are not overfished. The median estimate of spawning biomass (SB) depletion for the recent period (2018-2021; $SB_{recent}/SBF=0$) was 0.47 with a range (80% CI) of 0.42–0.52. None of the model runs estimated depletion to be below 0.2.

• Yellowfin tuna are not subject to overfishing. The median estimate of fishing mortality was 0.50 of F_{MSY} with a range (80% CI) of 0.41-0.62 and there is a 0% probability that fishing mortality was above F_{MSY}.

• The 2022 ETBF catch of yellowfin tuna was 1358 t which represents 13% of the provisional total catch of yellowfin tuna within region 5 (10-50oS and 140oE-170oW). The average contribution is 15% over the previous five years (2017-2021).

• In the ETBF, the 2022 catch of yellowfin tuna (1358 t) was below both the five-year and ten-year average catch in the ETBF of 1754 t and 1699 t respectively. Catches of yellowfin tuna in the ETBF have been stable at values around 1500 t after a peak catch in 2003 but have declined in the last few years (since 2019).

• The annual size distribution shows some variability in the median value across years with no clear trends in recent years and bimodality in 2022. The frequency of smaller individuals (recruits) over time in the size samples has been variable over time, with most samples from 2022 coming from the 'Small' category in contrast to 2021 when most samples came from the 'Prime' category
• Standardised CPUE indices for yellowfin tuna in the ETBF are variable for all size classes (recruit, adult, and all) (Figure 21). For all size classes, the standardised CPUE in 2022 was above the recent five-year average

• Economic conditions index for 2022 is above average with an upward trend in 2022-2023.

TTRAG TACC recommendation 2024: 2,400t

Attachment A

Climate & Ecosystem Status Report

Eastern Tuna and Billfish Fishery

June 2023

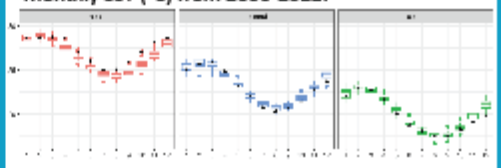
Historical Period

Climate Drivers

Monthly Southern Oscillation Index[1] (link).

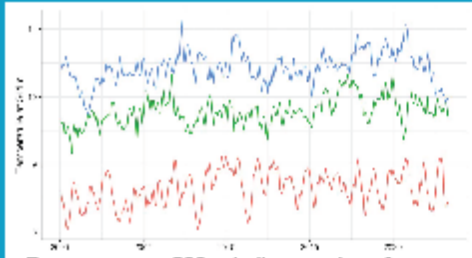
Sea Surface Temperature

Monthly SST (°C) from 2000-2022:



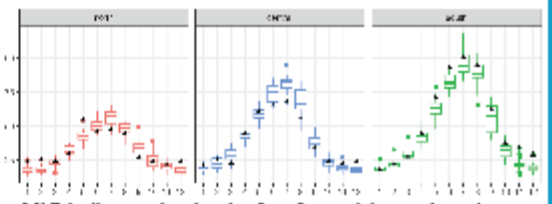
Seasonal SST dynamics for each region, with black triangles show the most recent monthly SST (July 2022-June 2023). SST last year was warmer than average in the North, but cooler than average in Central and South regions. This may support higher recruitment.

Subsurface Temperature



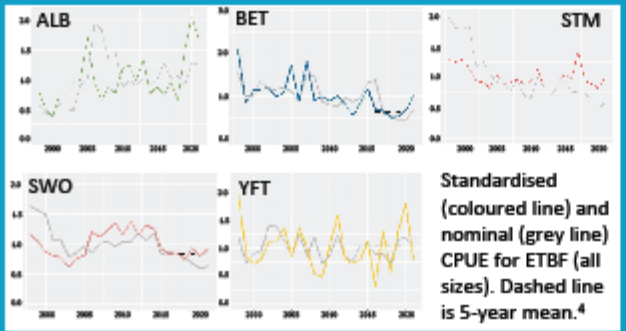
Temperature at 500 m indicates sub-surface ocean structure. All regions have warmed over time, but more so in the Central and South regions[3].

Monthly Mixed Layer Depth (MLD; m) from 2000-2022:



MLD indicates the depth of surface mixing and can impact the distribution of top predators. MLD can be deeper in the South & Central regions but varies seasonally. Black triangles show the most recent monthly MLD (Jun 2022-May2023).

Ecosystem and Fishery



Standardised (coloured line) and nominal (grey line) CPUE for ETBF (all sizes). Dashed line is 5-year mean.[4]

Observations

- Catches higher during El Niño.
- Recreational fishing sector noted a recruitment event is occurring due to juvenile species being caught.
- Bigeye is usually fished at different depths especially before El Niño.
- High sea temperatures during La Niña thought to be good conditions for spawning.

Sources: BOM[1] NOAA[2] CMEMS[3] CSIRO[4] AFMA[5]

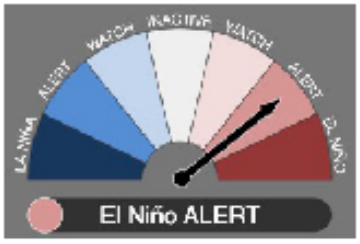
Climate & Ecosystem Status Report

Eastern Tuna and Billfish Fishery

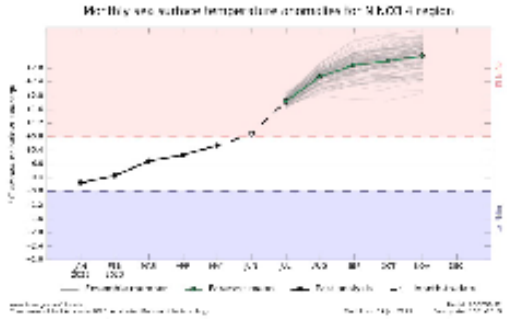
June 2023

Future Outlook for 2023

Climate Drivers

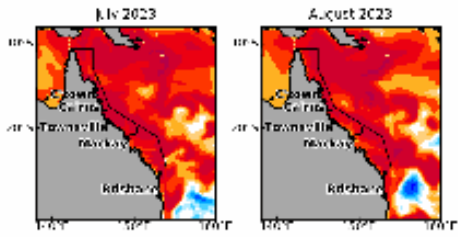


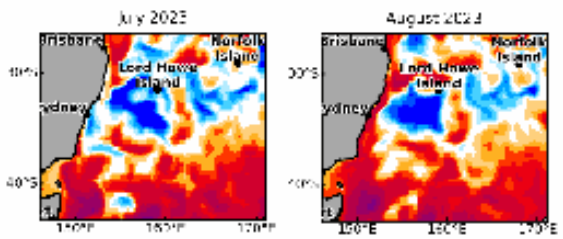
Currently transitioning to El Niño[1] (link)



El Niño is predicted[1] (link). These conditions can favour higher catches for YFT, BET, ALB, & STM in the Western Central Pacific[4]

Temperature for the region

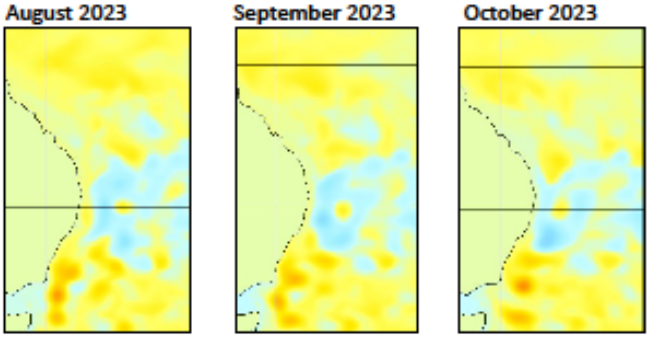




Forecasts of SST anomalies for July and August indicate warmer conditions off QLD and cooler conditions seen off NSW[1] (link).

Base period 1981-2018

Sea Surface Height Forecasts



Forecasts of sea surface height show how regional ocean dynamics may change over the next 3 months[1]. Sea surface Height anomalies can indicate the location of eddies.

Sources: BOM[1] NOAA[2] CMEMS[3] CSIRO[4] AFMA[5]

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steph.brodie@csiro.au

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Australian Government
Australian Fisheries Management Authority

TTRAG Indicators Paper for the Western Tuna and Billfish Fishery (WTBF)

October 2023

It is important to note in this report that the stock status reported for the Indian Ocean Tuna Commission (IOTC) differs from that which is measured by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) within the Fisheries Status Reports. ABARES applies the default limit reference points within the Commonwealth Fisheries Harvest Strategy Policy (Department of Agriculture and Water Resources 2018) which establish the limit reference points for biomass as 20% of unfished levels (0.2_{B0}); and for fishing mortality the limit reference point is the fishing mortality that would achieve maximum sustainable yield (F_{MSY}). It is important to note that the IOTC determines stock status using MSY-based reference points for most stocks (specifically B_{MSY} and F_{MSY}) which can result in IOTC reporting different biomass ('overfished') status for some stocks, notably for yellowfin.

Broadbill Swordfish (SWO)

Current TACC: 3,000t WTBF catch in 2022 quota year (CDR based): 85t 2021 catch* in IOTC Area: 23,917t (average catch 2017 – 2021: 31,157t)

*Based on data supplied by the IOTC status summary for species of tuna and tuna like species. 2022 catch data for IOTC are not due to be submitted by CPCs until 30 June 2023 and not finalised until 30 December 2023.

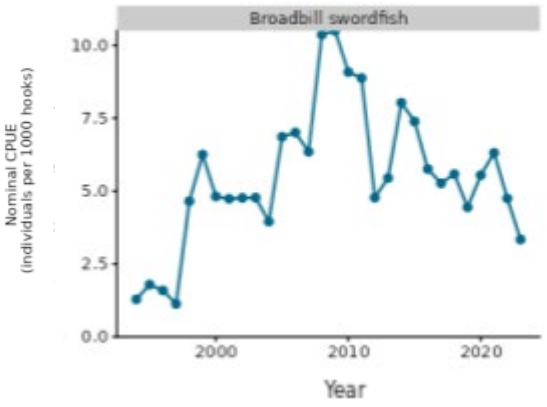
Indicators

A summary of the main indicators is found in the table below.

Indicator	Comment	
Stock[1]	In the Indian Ocean, genetic and otolith microchemistry analyses have not indicated more than a single biological stock (Muths et al. 2013, Davies et al. 2019). In the Pacific Ocean, genetic studies have suggested the presence of several biological stocks (Takeuchi et al. 2017), although the degree of genetic variation among these stocks is low (Kasapidis et al. 2008).	
IOTC[2] Stock status (based on most relevant regional stock assessments)	**Last Assessment**: 2020 Overfished: No Subject to overfishing: No An assessment was undertaken in 2020 using stock synthesis with fisheries data up to 2018. The assessment uses a spatially disaggregated, sex explicit and age structured model. The SS3 model, used for stock status advice, indicated that MSY-based reference points were not exceeded for the Indian Ocean population as a whole ($F_{2018}/F_{MSY}< 1$; $SB_{2018}/SB_{MSY}> 1$). The two alternative models (ASPIC and JABBA) applied to swordfish also indicated that the stock was above a biomass level that would produce MSY. Spawning biomass in 2018 was estimated to be 40-83% of the unfished levels. Next assessment: 2023 - full assessment	
Present IOTC Management Arrangements	There are no specific measures to limit catches of swordfish.	
	IOTC	**WTBF**
Catch	Most recent catches of 24,528t in 2021 and is below the MSY level (33,000t).	Annual swordfish catch in the WTBF peaked at around 2,000t in the early 2000s, but has declined to below 350t since 2005.

[1] Advice obtained from stock status swordfish IOTC executive summary and supporting information

[2] Schedule of Stock Assessment for IOTC Species of interest from 2023-2027, and for other working party priorities Status summary for species of tuna and tuna-like species under the IOTC mandate, as well as other species impacted by IOTC fisheries | IOTC

CPUE is the Nominal catch-per-unit-effort (CPUE from retained catch) in individuals per thousand hooks for key species of tuna and billfish in the WTBF over 1998-2022. Species panel are ordered from highest to lowest maximum CPUE. CPUE is only shown when at least 50 individuals were retained for the calendar year.		 Tremblay Boyer et.al 2023

Management advice from the IOTC Scientific Committee Meeting

No further management advice has been provided by IOTC Scientific Committee since TTRAG met in 2022.

1. **Maximum Sustainable Yield (MSY):** estimate for the Indian Ocean is 33,000 t.
2. **Provisional reference points:** noting that the Commission in 2015 agreed to Resolution 15/10 on target and limit reference points and a decision framework, the following should be noted:
   a. **Fishing mortality:** current fishing mortality is considered to be below the provisional target reference point of F_{MSY} and below the provisional limit reference point of $1.4*F_{MSY}$.
   b. **Biomass:** current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$.
3. **Main fisheries (mean annual catch 2017-2021)**: swordfish are caught using longline (53.9%), followed by line (30.2%) and gillnet (14.9%). The remaining catches taken with other gears contributed to 1% of the total catches in recent years **(Fig 1)**.
4. **Main fleets (mean annual catch 2017-2021):** the majority of swordfish catches are attributed to vessels flagged to Sri Lanka (29.2%) followed by Taiwan, China (17.9%) and EU (Spain) (6.5%). The 25 other fleets catching swordfish contributed to 46.4% of the total catch in recent years.

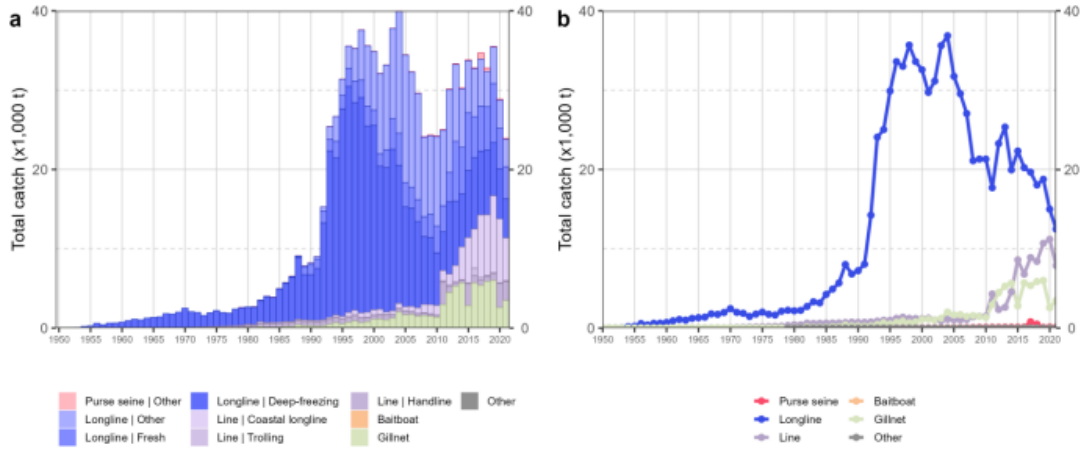


Fig. 1. Annual time series of (a) cumulative nominal catches (metric tons; t) by fishery and (b) individual nominal catches (metric tons; t) by fishery group for swordfish during 1950–2021. Longline|Other: swordfish and sharks-targeting longlines; Other: all remaining fishing gears

TTRAG's summary of information relevant to TACC decisions

The implications of any given TACC decision (i.e. maintaining, increasing or decreasing the TACC) for the Broadbill swordfish stock at both regional and subregional levels will be dependent on and informed by a number of factors:

- The most recent IOTC stock status advice (2020) has determined Broadbill Swordfish is not overfished and not subject to overfishing.
- The current TACC of 3000t is much higher than recent historical catch levels (85t in 2022/23 season or 2.8% of TACC). If caught, the TACC would represent ~10% of total IOTC catch.
- There is little recent information available to determine if 3000 t catch in the WTBF is "locally sustainable" i.e. would lead to local depletions. Historically the domestic component of the fishery took upwards of 1,000 t, and in 2001 and 2002 took around 2,000 t. In any case the TACC levels should be reviewed if the fishery were to significantly expand, using and assessing catch and CPUE information from the expanding fishery.
- At current catch levels, there is no risk to the IOTC stock, however if catch were to increase towards the TACC and other factors (recruitment, environmental etc.) took place then risk is uncertain.
- TTRAG recognises that other considerations (whole of government position in allocation discussions) may be taken into account when setting the TACC level.

TTRAG's TACC recommendation:

3,000t

Current TACC: 2,000t WTBF catch in 2022 quota year (CDR based): 22t 2021 catch* in IOTC Area: 94,803t (average catch 2017 – 2021: 87,488t)

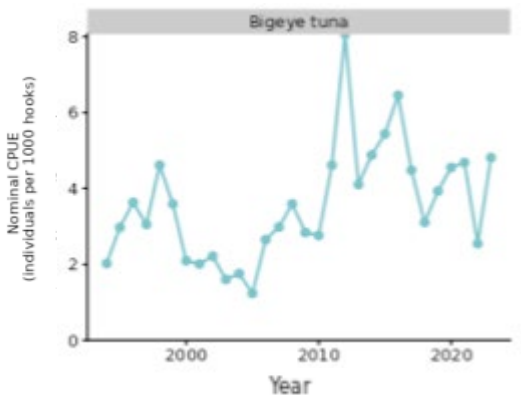
Bigeye Tuna (BET)

*Based on data supplied by the IOTC status summary for species of tuna and tuna like species. 2022 catch data for IOTC are not due to be submitted by CPCs until 30 June 2023 and not finalised until 30 December 2023.

Indicators

A summary of the main indicators is found in the table below.

Indicator	Comment
Stock	The stock structure of bigeye tuna in the Indian Ocean is uncertain, but the species is a single distinct biological stock for assessments. The assumption of a single stock is based on genetic studies (Chiang et al. 2008, Davies et al. 2020) that indicated no genetic differentiation within the Indian Ocean and tagging studies that have demonstrated large-scale movements of bigeye tuna within the Indian Ocean (IOTC 2014).
IOTC[1] Stock status (based on most relevant regional stock assessments)	**Last Assessment**: 2022 Overfished: Yes Subject to overfishing: Yes In 2022 a new stock assessment was carried out for bigeye tuna in the IOTC area of competence to update the stock assessment undertaken in 2019. Two models were applied to the bigeye stock (Statistical Catch at Size (SCAS) and Stock Synthesis (SS3)), with the SS3 stock assessment selected to provide scientific advice. The reported stock status is based on a grid of 24 model configurations designed to capture the uncertainty on stock recruitment relationship, longline selectivity, growth and natural mortality. Spawning biomass in 2021 was estimated to be 25% (80% CI: 23-27%) of the unfished levels in 2021 and 90% (75-105%) of the level that can support MSY. Fishing mortality was estimated at 1.43 (1.1-1.77) times the F_{MSY} level. Considering the characterized uncertainty, the assessment indicates that SB_{2021} is below SB_{MSY} and that F_{2021} is above F_{MSY} (79%). As IOTC agreed on a bigeye Management Procedure (Res. 22/03) it should be noted that the stock assessment is not used to provide a recommendation on the TAC. Next assessment: 2023 – indicators and 2024 Indicators MP to be run.
Present IOTC Management Arrangements	Management Procedure. A management procedure for Indian Ocean Bigeye tuna was adopted under Resolution 22/03 by the IOTC Commission in May 2022 and was applied to determine a recommended TAC for Bigeye tuna for 2024 and 2025. A review of evidence for exceptional circumstances, was also conducted following the adopted guideline (ref SC 2021 report) as per the requirements of Resolution 22/03. The review covered information pertaining to i) new knowledge about the stock, population dynamics or biology, ii) changes in fisheries or fisheries operations,

	iii) changes to input data or missing data, and iv) inconsistent implementation of the MP advice. The evaluation concluded that there were no exceptional circumstances requiring either further research or management action on the TAC calculated by the MP. Application of the MP in 2022 results in a recommended TAC of 80,583t per year for 2024 and 2025.	
	IOTC	**WTBF**
Catch	Catch in 2021 (94,803t) of bigeye tuna is above the recommended TAC for 2024 and 2025 from the application of the bigeye tuna MP. Achieving the objectives of the Commission for this stock will require effective implementation of the MP TAC advice by the Commission going forward, a requirement further emphasised by the current status of the stock estimated from the stock assessment to be overfished and subject to overfishing. At its 8-12 May 2023 meeting (IOTC27), IOTC adopted Resolution 23/04 *On establishing catch limits for bigeye tuna in the IOTC area of competence* (the bigeye resolution). The bigeye resolution imposes an annual TAC for bigeye tuna of 80,583t in 2024 and 2025 in line with the MP for the species. The TAC is 15 per cent below the 2021 catch (94,803t). Note 15 per cent is the maximum change permitted under the MP.	Historical catches of Bigeye tuna in the WTBF have varied widely from peaks of around 800t in 1984 and 1995 to less than 22t in 1991. Since the early 2000s, declining effort in the WTBF has resulted in reduced catches of bigeye tuna. Catches have not exceeded 200t since 2004.
CPUE is the Nominal catch-per-unit-effort (CPUE from retained catch) in individuals per thousand hooks for key species of tuna and billfish in the WTBF over 1998-2022. Species panel are ordered		 Tremblay Boyer et.al 2023

from highest to lowest maximum CPUE. CPUE is only shown when at least 50 individuals were retained for the calendar year.		

Management advice from the IOTC Scientific Committee Meeting

1. **Management advice.** The TAC recommended from the application of the MP specified in Resolution 22/03 is 80,583t / year for the period 2024-2025. The recommended TAC is 15% below the 2021 catch. The following key points should also be noted:
2. **Main fisheries (mean annual catch 2017-2021):** bigeye tuna are caught using purse seine (41.7%), followed by longline (37%) and line (13.5%). The remaining catches taken with other gears contributed to 7.8% of the total catches in recent years **(Fig. 2).**
3. **Main fleets (mean annual catch 2017-2021):** the majority of bigeye tuna catches are attributed to vessels flagged to Indonesia (23.7%) followed by Taiwan, China (15.4%) and Seychelles (15.3%). The 30 other fleets catching bigeye tuna contributed to 45.8% of the total catch in recent years.

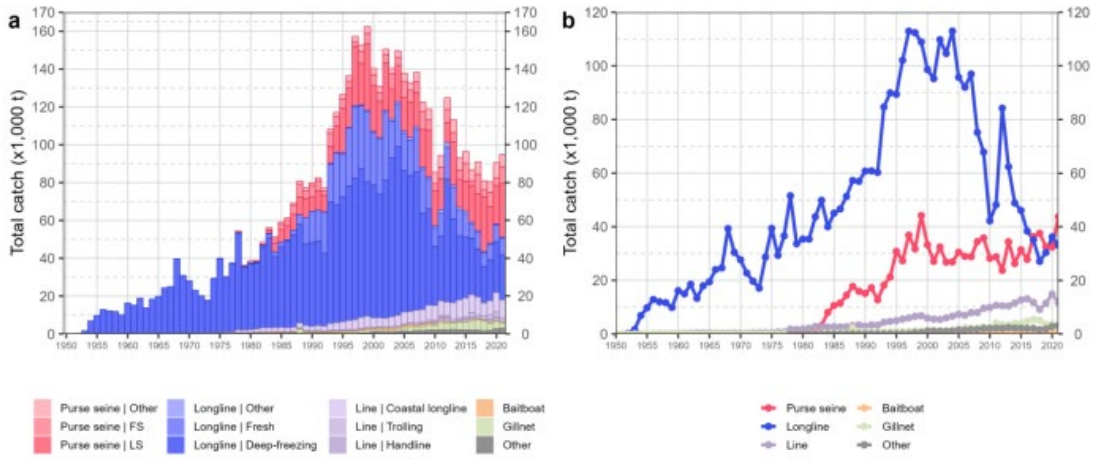


Fig. 2. Annual time series of (a) cumulative nominal catches (metric tonnes; t) by fishery group and (b) individual nominal catches (metric tonnes; t) by fishery group bigeye tuna during 1950-2021. FS = free swimming school; LS = schools associated with drifting floating

objects;Purse seine; Other: coastal purse seine, seine if unknown school associated type, ring net; Longline, Other; swordfish and sharks –

TTRAG's summary of information relevant to TACC decisions

The implications of any given TACC decision (i.e. maintaining, increasing or decreasing the TACC) for the Bigeye tuna stock at both regional and subregional levels will be dependent on and informed by a number of factors:

- A new stock assessment undertaken in 2022, determined that IOTC bigeye tuna as overfished and is subject to overfishing.
- The current WTBF TACC of 2000 t is much higher than recent historical catch levels (t in 2022/23 season or 1.1% of TACC). If caught, the TACC would represent ~2.3% of total IOTC catch.
- Australia's TACC for bigeye tuna, if fully caught, represents (~2.3%), which is a small fraction of the total fishing mortality on this stock, particularly compared to historic catches by other IOTC fleets. Australia's catches to date will have made a negligible contribution to current status of the stocks that are overfished or subject to overfishing.
- There is little information available to determine if a 2000 t catch in the WTBF is "locally sustainable" i.e. would lead to local depletion. Data for the domestic fleet, Japanese and Taiwanese longliners operating in the area of the WTBF and the Indian Ocean area around the Australian EEZ (latitudes 5^{o}S to 49^{o}S and longitudes 100^{o}E to 139^{o}E) show that there were significant catches recorded in this area prior to the year 2000.
- The catch in this area in the decades preceding 2000t this regularly exceeded 1,000 t and occasionally exceeded 1500 t.
- TACC levels should be reviewed if the fishery was to significantly expand, using and assessing catch and CPUE information from the expanding fishery, alongside information on stock status and structure.
- TTRAG recognises that other considerations (whole of government position in allocation discussions) may be taken into account when setting the TACC, noting there are no specific measures to limit catches of bigeye, however, at the Commission meeting in 2022 the IOTC adopted a Resolution 23/04 *On establishing catch limits for bigeye tuna in the IOTC area of competence (*the bigeye resolution). The bigeye resolution imposes an annual TAC for bigeye tuna of 80,583t in 2024 and 2025 in line with the MP for the species. The TAC is 15 per cent below the 2021 catch (94,803t). Note 15 per cent is the maximum change permitted under the MP.
- The bigeye resolution applies specific catch limits on those CPCs with recent 5-year average catches (2017-2021) above 2000t *(Indonesia, Seychelles, EU, Sri Lanka, Japan, China and Iran. The Resolution also requests that Taiwan, Province of China, limit its annual bigeye catch to 11,488t in 2024 and 2025)*. The reductions for each CPC range from 7.7 to 18.7 per cent.
- All other CPCs are encouraged to maintain catch and effort at their recent 5-year average levels (2017-2021), without prejudice to their development aspirations. If catch of one of these CPC's exceeds 2000t, in either 2024 or 2025, the resolution commits the IOTC to consider establishing a binding catch limit to the CPC from the management period commencing in 2026, if an allocation scheme has not yet been agreed and implemented by the Commission.
- Australia's average catch of bigeye tuna in the WTBF for 2017-2021 is around 39t. The current TAC for bigeye tuna in the WTBF is 2000t.
- The Department of Agriculture, Fisheries and Forestry (the Department) and AFMA agree that the resolution requires Australian catches of bigeye to remain equal to or below the current TAC of 2000t.

TTRAG's TACC recommendation: 2,000t

Striped Marlin (STM)

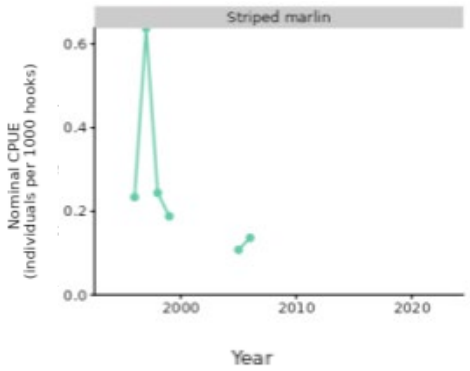
Current TACC: 125t WTBF catch in 2022 quota year (CDR based): 0.5t 2021 catch* in IOTC Area: 2,969t (average catch 2017 – 2021: 2,946t)

*Based on data supplied by the IOTC status summary for species of tuna and tuna like species. 2022 catch data for IOTC are not due to be submitted by CPCs until 30 June 2023 and not finalised until 30 December 2023.

Indicators

A summary of the main indicators is found in the table below.

Indicator	Comment	
Stock	Mamoozadeh, McDowell & Graves (2018) evaluated genetic variation in striped marlin populations sampled from the eastern and western Indian Ocean, and across the Pacific Ocean. Their results suggest that there could be genetically distinct east and west stocks of striped marlin in the Indian Ocean. However, the sample size from the eastern Indian ocean was small (eight fish) and no samples were collected from the central Indian Ocean, making it difficult to delineate a border between potential stocks. Therefore, striped marlin is currently considered to be a single distinct biological stock for assessments in the Indian Ocean.	
IOTC[1] Stock status (based on most relevant regional stock assessments)	**Last Assessment**: 2021 Overfished: Yes Subject to overfishing: Yes The stock assessment was conducted based on two different models: JABBA, a Bayesian state-space production model (age-aggregated); and SS3, an integrated model (age-structured) (using data up to 2019). Both models were generally consistent with regards to stock status and confirmed the results from 2012, 2013, 2015, 2017 and 2018 assessments, indicating that the stock is subject to overfishing ($F>F_{MSY}$) and is overfished, with the biomass being below the level which would produce MSY ($B<B_{MSY}$) for over a decade. Next Assessment:2024 – full assessment	
Present IOTC Management Arrangements	Resolution 18/05 established overall catch limits for billfish (3,260t for striped marlin), but there is no mechanism to allocate catches or enforce catch limits.	
	IOTC	**WTBF**
Catch	Current or increasing catches have a very high risk of further decline in the stock status. The 2019 catches (3,001t)	Catches of striped marlin in the WTBF have been relatively low (<50t) since the mid - 1980s and very low (<5t) in recent years, with <1t taken in 2020 and 2021.

CPUE is the Nominal catch-per-unit-effort (CPUE from retained catch) in individuals per thousand hooks for key species of tuna and billfish in the WTBF over 1998-2022. Species panel are ordered from highest to lowest maximum CPUE. CPUE is only shown when at least 50 individuals were retained for the calendar year.		 Tremblay Boyer et.al 2023

Management advice from the IOTC Scientific Committee Meeting

No further management advice has been provided by IOTC Scientific Committee since TTRAG met in 2022.

1. **Management advice.** Current or increasing catches have a very high risk of further decline in the stock status. The 2019 catches (3,001 t) available at the time of the stock assessment are lower than MSY (4,601 t) but the stock has been overfished for more than a decade and is now in a highly depleted state. If the Commission wishes to recover the stock to the green quadrant of the Kobe plot with a probability ranging from 60% to 90% by 2026 as per Resolution 18/05, it needs to provide mechanisms to ensure the maximum annual catches remain between 900 t – 1,500 t (Table 3). The following key points should also be noted:
2. **Maximum Sustainable Yield (MSY):** estimates for the Indian Ocean stock are highly uncertain and estimates range between 4,120 - 5,160 t. However, the current biomass is well below the BMSY reference point and fishing mortality is in excess of FMSY at recent catch levels.
3. **Provisional reference points:** although the Commission adopted reference points for swordfish in Resolution 15/10 on target and limit reference points and a decision framework, no such interim reference points have been established for striped marlin.

4. **Main fisheries (mean annual catch 2017-2021):** striped marlin are caught using gillnet (59.5%), followed by longline (27%) and line (11.7%). The remaining catches taken with other gears contributed to 1.7% of the total catches in recent years **(Fig. 3).**
5. **Main fleets (mean annual catch 2017-2021):** the majority of striped marlin catches are attributed to vessels flagged to I. R. Iran (30.1%) followed by Pakistan (25.5%) and Indonesia (17.1%). The 22 other fleets catching striped marlin contributed to 27.1% of the total catch in recent years.

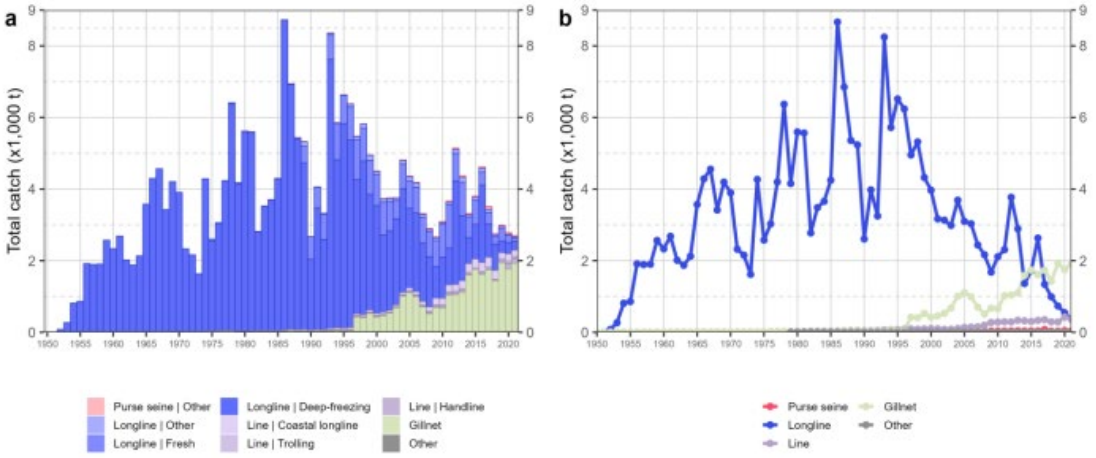


Fig. 3. Annual time series of (a) cumulative nominal catches (metric tonnes; t) by fishery group and (b) individual nominal catches (metric tonnes; t) by fishery group for striped marlin during 1950-2021. Longline, Other; swordfish and sharks – targeted longlines; Other: all remaining fishing gears.

TTRAG's summary of information relevant to TACC decisions

The implications of any given TACC decision (i.e. maintaining, increasing or decreasing the TACC) for the striped marlin stock at both regional and subregional levels will be dependent on and informed by a number of factors:

- IOTC stock assessments have determined that IOTC Striped Marlin is both overfished and subject to overfishing, and that reductions in fishing mortality are required to recover the stock.
- The current WTBF TACC of 125 t is much higher than recent historical catch levels (0.5t in 2022/23 season or <1% of TACC and <0.02% of IOTC catch). If caught, the TACC would represent ~4.8% of total IOTC catch.
- Given historic catch levels, it is unlikely the WTBF has contributed to the current poor stock status. Australia's TACC for striped marlin, if fully caught, represents (~4.8%), which is a small fraction of the total fishing mortality on this stock, particularly compared to historic catches by other IOTC fleets. Australia's catches to date will have made a negligible contribution to current status of the stocks that are overfished or subject to overfishing.
- There is little information available to determine if a 125 t catch in the WTBF is "locally sustainable" i.e. would lead to local depletions. TACC levels should be reviewed if the fishery was to significantly expand, using and assessing catch and CPUE information from the expanding fishery, alongside information on stock status and structure.
- TTRAG recognises that other considerations (whole of government position in allocation discussions) may be taken into account when setting the TACC level.

TTRAG's TACC recommendation:

125t

Yellowfin Tuna (YFT)

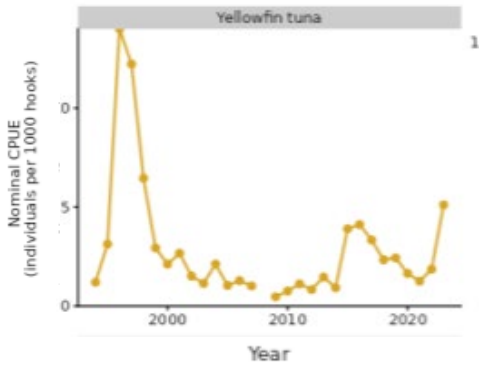
Current TACC: 2,000t WTBF catch in 2022 quota year (CDR based): 19t 2021 catch* in IOTC Area: 416,235t (average catch 2017 – 2021: 435,225)

*Based on data supplied by the IOTC status summary for species of tuna and tuna like species. 2022 catch data for IOTC are not due to be submitted by CPCs until 30 June 2023 and not finalised until 30 December 2023.

Indicators

A summary of the main indicators is found in the table below.

Indicator	Comment	
Stock	The stock structure of yellowfin tuna in the Indian Ocean is uncertain, but the species is a single biological stock for assessments. A recent ocean-wide genetics and otolith microchemistry study revealed evidence for genetic differentiation north and south of the equator in the Indian Ocean (Davies et al. 2020)	
IOTC[1] Stock status (based on most relevant regional stock assessments)	**Last Assessment**: 2021 Overfished: Yes Subject to overfishing: Yes The stock assessment was conducted using SS3, an integrated model (age-structured) (using data up to 2020). Results were generally consistent with regards to stock status and confirmed the results from 2012, 2013, 2015, 2017 and 2018 assessments, indicating that the stock is subject to overfishing ($F>F_{MSY}$) and is overfished, with the biomass being below the level which would produce MSY ($B<B_{MSY}$) for over a decade. Next Assessment:2024 – full assessment	
Present IOTC Management Arrangements	Resolution 21/01 On an interim plan for rebuilding the Indian Ocean yellowfin tuna stock establishes specific catch limits for yellowfin for all IOTC members. The interim catch limits agreed in 2021 sought to restrict catch to the then long-term estimate of catch at MSY (C_{MSY}) of 403,000t. However, the new stock assessment endorsed by the Commission in May 2022 now estimates C_{MSY} at 349,000 t.	
	IOTC	**WTBF**
Catch	Catches of yellowfin tuna remained stable between the mid-1950s and the early-1980s, ranging between 30,000t and 70,000t, with longliners and gillnetters as the main gear types being used. Landings of yellowfin tuna increased throughout the 1990s, fluctuating around 400,000t until 2002 after which landings increased further up to a peak of 525,000t in 2004.	Historical catches of yellowfin tuna in the WTBF have varied widely from peaks of around 800 t in 1984 and 1995 to less than 15t in 1991 and 1992. Since the early 2000s, declining effort in the WTBF has resulted in reduced catches of yellowfin tuna. Catches have not exceeded 100t since 2004.

CPUE is the Nominal catch-per-unit-effort (CPUE from retained catch) in individuals per thousand hooks for key species of tuna and billfish in the WTBF over 1998-2022. Species panel are ordered from highest to lowest maximum CPUE. CPUE is only shown when at least 50 individuals were retained for the calendar year.		 Tremblay Boyer et.al 2023

Management advice from the IOTC Scientific Committee Meeting

No further management advice has been provided by IOTC Scientific Committee since TTRAG met in 2022.

For each catch scenario, the probability of the biomass being below the SB_{MSY} level and the probability of fishing mortality being above FMSY were determined over the projection horizon using the delta-MVLN estimator (Walter & Winker 2020), based on the variance-covariance derived from estimates of SB/SB_{MSY} and F/F_{MSY} across the model grid.

- If catches are reduced to 60% of 2020 levels there is >50% probability of being above SB_{MSY} levels by 2023.
- If catches are reduced to < 80% of 2020 levels, there is a >50% probability of being above SB_{MSY} in 2030.
- If catches are reduced to less than 80% of 2020 levels, there would be a >50% probability of ending overfishing ($F<F_{MSY}$) by 2023 and also by 2030.The probability of breaching the biological limit reference point ($0.4SB_{MSY}$) with 2020 catches is 7% by 2023 and 64% by 2030. The probability of breaching the F limit reference point ($1.4\ F_{MSY}$) with 2020 catch is 52% by 2023 and 78% by 2030.

The Commission has an interim plan for the rebuilding the yellowfin stock, with catch limitations based on 2014/2015 levels (Resolution 21/01 which superseded 19/01, 18/01 and 17/01). Some of the fisheries subject to catch reductions have achieved a decrease in catches in 2021 in accordance with the levels of reductions specified in the Resolution; however, these reductions were offset by increases in the catches from CPCs exempt from and some CPCs subject to limitations on their catches of yellowfin tuna. The following key points should also be noted:

1. **Maximum Sustainable Yield (MSY):** estimate for the Indian Ocean stock is 349,000 t with a range between 286,000-412,000 t. The 2017-2021 average catches (435,225 t) were above the estimated MSY level. Although catch in 2021 reduced by 3% compared to the 2020 level, the last year catch remained substantially higher than the median MSY.

2. **Interim reference points:** Noting that the Commission in 2015 agreed to Resolution 15/10 on target and limit reference points and a decision framework, the following should be noted:

3. **Fishing mortality:** 2020 fishing mortality is considered to be 32% above the interim target reference point of F_{MSY}, and below the interim limit reference point of $1.4*F_{MSY}$.

4. **Biomass**: 2020 spawning biomass is considered to be 13 % below the interim target reference point of SB_{MSY} and above the interim limit reference point of $0.4*SB_{MSY.}$

5. **Catch data uncertainty:** the overall quality of the nominal catches of yellowfin tuna shows some large variability between 1950 and 2020. In some years, a large portion of the nominal catches of yellowfin tuna had to be estimated, and catches reported using species or gear aggregates had to be further broken down. The data quality was particularly poor between 1994 and 2002 when less than 70% of the nominal catches were fully or partially reported, with most reporting issues coming from coastal fisheries. The reporting rate has generally improved over the last decade however detailed information on data collection procedures, which determines the quality of fishery statistics, is still lacking.

6. **Main fisheries (mean annual catch 2017-2021):** yellowfin tuna are caught using line (35.4%), followed by purse seine (33.6%) and gillnet (18.3%). The remaining catches taken with other gears contributed to 12.7% of the total catches in recent years **(Fig. 4).**

7. **Main fleets (mean annual catch 2017-2021):** the majority of yellowfin tuna catches are attributed to vessels flagged to I. R. Iran (12.2%) followed by EU (Spain) (11.3%) and Sultanate of Oman (10.4%). The 35 other fleets catching yellowfin tuna contributed to 66.1% of the total catch in recent years.

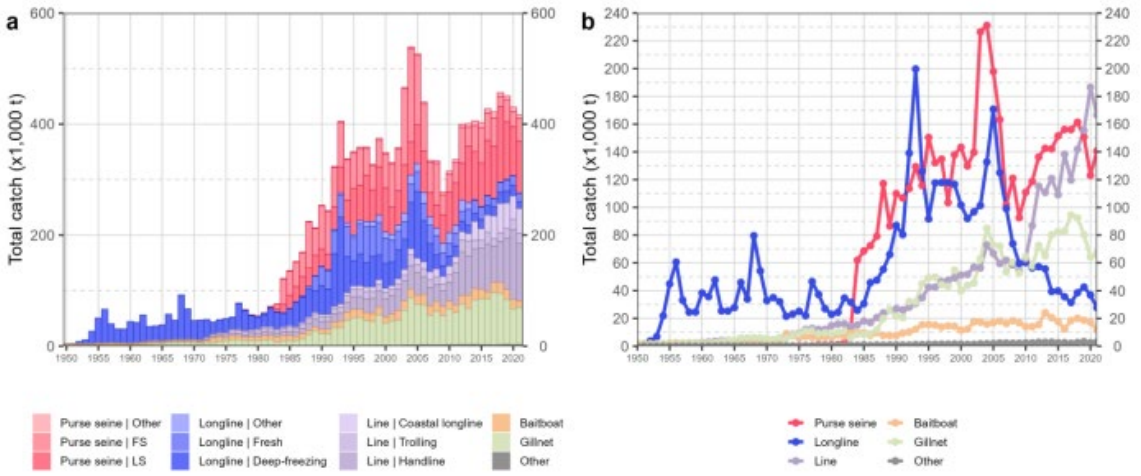


Fig. 4. Annual time series of (a) cumulative nominal catches (metric tonnes; t) by fishery group and (b) individual nominal catches (metric tonnes; t) by fishery group yellowfin tuna during 1950-2021. FS = free swimming school; LS = schools associated with drifting floating objects; Purse seine; Other: coastal purse seine, purse seine if unknown school associated type, ring net; Longline, Other; swordfish and sharks – targeted longlines; Other: all remaining fishing gears.

Additional Information

- Resolutions are binding on the Commission Members, unless there is a specific objection on the part of a Member. Resolutions are generally adopted by consensus, however, can also be adopted by a two-thirds majority of Members present and voting. Note: Australia did not object to this Resolution.
- Resolutions remain active unless the Resolution specifically states otherwise.
- Resolution 21/01 – On an Interim Plan for Rebuilding the Indian Ocean Yellowfin Tuna Stock in the IOTC Area of Competence entered into force on 17 December 2021 and the measures within became effective from 1st January 2022.
- Resolution 21/01 does state in paragraph 2 that the measures contained within the Resolution are considered as interim measures and will be reviewed by the Commission no later than at its annual Session in 2022. This does not mean the Resolution, or the measures contained expire.
- The 2022 and 2023 Commission meeting discussed new proposals to further restrict yellowfin tuna catch, however, there was no consensus and the proponents agreed to withdraw it, noting their disappointment in the lack of agreement on Management Measures for a stock assessed to be overfished and subject to overfishing by the SC.

TTRAG's summary of information relevant to TACC decisions

The implications of any given TACC decision (i.e. maintaining, increasing or decreasing the TACC) for the yellowfin tuna stock at both regional and subregional levels will be dependent on and informed by a number of factors:

- IOTC stock assessments have determined that IOTC Yellowfin Tuna is both overfished and subject to overfishing, and that reductions in fishing mortality are required to recover the stock. It should be noted again that the IOTC uses different limit reference points to that defined in the Commonwealth Harvest Strategy Policy.
- The adoption of Resolution 21/01 an interim rebuilding plan for Yellowfin Tuna is designed to apply to all contracting parties and co-operating non-contracting parties and not prejudice any future formal allocations. It is important to note this resolution does not establish an allocation but is designed to restrict the catch of Yellowfin Tuna in the Indian Ocean region. The resolution effectively states a floor in the measure which states if you reported catches of Yellowfin Tuna in 2014 of less than 5000 t and the average catch of the period 2015-2019 was below 2000 t then catches under the resolution 21/01 should not exceed 2000 t.
- Resolutions remain active unless the Resolution specifically states otherwise. Therefore, to adopted interim resolution Australia is required to reduce the WTBF Yellowfin Tuna TACC to 2000 t.
- The current TACC for yellowfin tuna in the WTBF (2,000 t) is 0.6% of the maximum sustainable yield (MSY) for Indian Ocean yellowfin tuna, estimated to be 349,000 t in 2021. Total catches by IOTC member countries have exceeded this level in every year since 2010. There has been no updated MSY estimate since 2021, due to ongoing issues with the data inputs to the stock assessment. A review of the assessment is due in 2023 which, if the issues are resolved and a new stock assessment accepted, may result in updated advice on sustainable catches for Indian Ocean yellowfin tuna in 2024.
- The current WTBF TACC of 2,000 t is much higher than recent historical catch levels (19 t in 2022/23 season or <1% of TACC). If caught, the TACC would represent ~1.2% of total IOTC catch.
- Australia's TACC for yellowfin tuna, if fully caught, represents (~1.2%), which is a small fraction of the total fishing mortality on this stock, particularly compared to historic catches by other IOTC fleets. Australia's catches to date will have made a negligible contribution to current status of the stocks that are overfished or subject to overfishing.
- TTRAG recognises that other considerations (whole of government position in allocation discussions) may be taken into account when setting the TACC level.

TTRAG's TACC recommendation:

2,000t