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PROGRESS AGAINST THE 2023-2030 BILLFISH RESEARCH PLAN – 2026

WCPFC-SC22-2026-SA-IP23

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Introduction

The Billfish Research Plan ([Brouwer and Hamer 2023](#)) (Project 112) was adopted by SC19 and endorsed by WCPFC20 in 2023. The current Billfish Research Plan (BRP) is the 1st phase of the WCPFC's BRP. When reviewing the BRP SC19 recommended that it be extended to 2030. The 2023-2030 BRP is a living document that can evolve based on the information needs and priorities of the WCPFC. The plan has short annual reviews to evaluate the progress and ensure that the next years' work remains relevant and required. This paper presents the 2026 BRP annual review for discussion by ISG-Billfish at SC22.

Purpose and tasks of the BRP

The purpose of this document is to review progress against the BRP tasks to facilitate future planning of WCPFC billfish stock assessments and research. The project list is included in Table 1. In addition, Table 2 is provided to update the Scientific Committee's assessment schedule for billfish. It was previously suggested that data rich assessments be attempted for blue marlin; striped marlin; and swordfish, with standardised CPUE analyses and fishery characterisations for black marlin, sailfish and shortbill spearfish. At SC19 the ISG-Billfish suggested that prior to beginning any assessment or analysis of these species it is important to develop conceptual models for these species and identify the most appropriate assessment approaches. A workshop to review stock assessment methods for billfish is planned under *Project 130 "Joint bycatch assessment workshop for billfish and sharks"*.

For SC22 one scheduled project was completed, assessment of Pacific blue marlin (SC22-SA-WP-10). A number of projects are being reported on at SC22 that involve general work including billfish data collection or stock assessment planning: WCPFC Projects 117, 118 & 126: biological sampling plans for tuna, billfish & sharks (SC22-SA-IP-20); P130: Joint bycatch assessment workshop for billfish and sharks (SC22-SA-IP-21); and Project 35b: WCPFC Pacific Marine Specimen Bank (SC22-RP-P35b-01). As part of the routine sampling programme of the Pacific Marine Specimen Bank (PMSB) billfish samples are collected in the region. However, the number of fish sampled was low in 2025 (42 swordfish, 12 blue marlin, 8 striped marlin, 6 short-billed spearfish, 3 black marlin) and the samples collected were otolith, spines, gonads, blood, muscle, liver, and stomach (see paper WCPFC-SC22-2026/RP-P35b-01). Some of the billfish samples from the PMSB have been used in a mercury study to assess the level of contamination of different species of marlins and established that the blue and black marlins demonstrated methylmercury detoxification capabilities (SC22-RP-P35b-03).

One project (Stock assessment project 6 - Assessment approaches for WCPO black marlin, sailfish and shortbill spearfish) was not started. Given the difficulty in running billfish assessments and the planned '*Joint bycatch assessment workshop for billfish and sharks* (SC22-SA-IP-21)' in early 2027, it is suggested that this work be postponed until after the workshop. This will include low and high information stocks as well as multi-model approaches (low and high information for the same stock) and Bayesian assessment methods as has been done in some recent shark assessments. The review will be Pacific wide and include participation from IATTC and ISC. This will include bycatch assessments for billfish and sharks. The focus will be pan-Pacific but could also invite experts from other tuna RFMOs, and independent scientists with relevant technical expertise.

There is a planned low information assessment/data characterisation for black marlin, sailfish and shortbilled spearfish in 2027. This characterisation would provide useful insights into the information available for these species prior to any consideration of a model-based assessments in future. This has been included in Table 1(7) as a new project for the ISG-Billfish consideration.

Recommendations to SC21

1. SC22 ISG-Billfish review the assessment work plan and project list for the 2026/27 year and make recommendations to SC22 for any changes the SC may want to consider.
2. SC22 ISG-Billfish consider the value of a data characterisation for black marlin, sailfish and shortbilled spearfish in 2027.
3. SC22 ISG-Billfish review the project specifications and make any changes for SC22's review.
4. Note the pending Project 130 'Joint bycatch assessment workshop for billfish and sharks' and that the results from that workshop will need to be considered by future stock assessments and research prioritization. ISG-Billfish is recommended to consider and provide advice on the agenda for the Project 130 workshop.

References

Brodziak, J. 2024. Rebuilding Plan Scenarios for the Western and Central North Pacific Ocean Striped Marlin Stock in 2024. SC20-SA-IP-15.

Brouwer, S. and Hamer, P. 2023. Billfish research plan 2023 – 2027. SC19-SA-WP-16.

Brouwer, S. and Hamer, P. 2024. Progress against the 2023 – 2027 billfish research plan - 2024. SC20-EB-IP-09.

Holdsworth, J. C. 2024. Striped marlin catch and CPUE in the New Zealand sport fishery, 2019-20 to 2021-22 SC20-SA-IP-17.

ISC. 2024. Western and Central North Pacific Striped Marlin Assessment Consensus Peer Review SC20-SA-WP-12.

Neubauer, P., Castillo-Jordán, C., Day, J. and Hamer, P. 2025. Exploring the potential for observer CPUE for southwest Pacific swordfish (*Xiphias gladius*) and striped marlin (*Kajikia audax*). WCPFC-SC21-SA-IP-13.

SPC-OFP. 2024. WCPFC Billfish Biological Sampling Plan. SC20-SA-IP-13.

Relevant recent publications from outside of the WCPFC

Reference	Comment	Relevance to WCPFC
Global analyses of sailfish (<i>Istiophorus platypterus</i>) using next-generation sequencing reveal multiple populations. Smith, L.M. and others (2025) ICES Journal of Marine Science, Vol. 82, Issue 12, December 2025, fsaf232 DOI: 10.1093/icesjms/fsaf232	Applied SNP genotyping to sailfish samples globally. Previously considered a single wide-ranging species, the study now confirms sailfish comprise multiple genetically distinct populations, with significant implications for RFMO stock definitions.	Relevant to WCPFCs understanding of sailfish stock structure.
Abundance indices for black marlin (<i>Istiompax indica</i>) derived from 50 years of diarized daily catch-effort data from the charter fishery off the Great Barrier Reef, Australia. Pepperell, J.G. and others (2025) ICES Journal of Marine Science, Vol. 82, Issue 10, October 2025, fsaf182 DOI: 10.1093/icesjms/fsaf182	Analyses of 50 years of recreational charter logbook data from the northern Great Barrier Reef to develop catch-per-unit-effort (CPUE) indices for black marlin. Provides a rare long-term dataset for a species with very limited commercial fishery observer coverage.	Relevant to WCPFC with a long-term data set but from a small region of the WCPO.
Applying a joint-species spatio-temporal model to guide the reduction of bycatch in longline fisheries with a case study on swordfish in the Southwestern Pacific Ocean. Hsu, J. and others (2025) ICES Journal of Marine Science, Vol. 82, Issue 10, October 2025, fsaf175 DOI: 10.1093/icesjms/fsaf175	Employs spatio-temporal modelling to identify where and when swordfish bycatch occurs in SW Pacific longline fisheries targeting tuna. Proposes evidence-based spatial and seasonal management strategies to reduce incidental mortality.	Relevant to WCPFC considers spatial distribution of swordfish, and bycatch hotspots.
Seasonal availability and catchability of sailfish, <i>Istiophorus platypterus</i> , in the tropical eastern Pacific Ocean off the coast of Guatemala. Ehrhardt, N. and others (2025) ICES Journal of Marine Science, Vol. 82, Issue 9, September 2025, fsaf152 DOI: 10.1093/icesjms/fsaf152	Analyses one of the world's highest-productivity sailfish sport fisheries off Guatemala. Examines how complex seasonal oceanographic regimes including upwelling, river runoff, and thermal fronts drive availability and catchability of sailfish, with application to CPUE standardisation.	Some relevance for CPUE standardisation but localised study may not be broadly applicable across the Pacific.
SNP genotyping reveals a mixed-stock fishery for striped marlin, <i>Kajikia audax</i> , in the central North Pacific Ocean. Martinez, J.L. and others (2025) ICES Journal of Marine Science, Vol. 82, Issue 9, September 2025, fsaf156 DOI: 10.1093/icesjms/fsaf156	At least four genetically distinctive stocks of striped marlin have been delineated in the Pacific and Indian Oceans. This study uses SNP genotyping to show that fishing grounds in the central North Pacific draw from multiple stocks simultaneously, complicating single-stock management approaches currently used by WCPFC and ISC.	Relevant to WCPFC considers spatial distribution and should be taken into account in future assessments.
Foraging ecology of swordfish in the California Current Large Marine Ecosystem during an ecosystem regime shift. Preti, A. and others (2025) ICES Journal of Marine Science, Vol. 82, Issue 8, August 2025, fsaf139 DOI: 10.1093/icesjms/fsaf139	Investigates diet composition and feeding behaviour of swordfish in the California Current during and after the 2014–2016 marine heatwave. Examines how warm-water regime shifts restructure prey communities and alter trophic roles of apex predators.	Low relevance to WCPFC
Estimation of the two-stanza growth curves with age determination uncertainty for Pacific blue marlin (<i>Makaira nigricans</i>) in the western and central North Pacific Ocean. Chang, Y.-J. and others (2025) ICES Journal of Marine Science, Vol. 82, Issue 8, August 2025, fsaf134 DOI: 10.1093/icesjms/fsaf134	Addresses a longstanding bottleneck in Pacific blue marlin stock assessment. Develops two-stanza von Bertalanffy growth curves that account for uncertainty in age determination - critical for size-structured stock assessment models.	Relevant to WCPFC should be taken into account in future assessments.
Swordfish horizontal movements in relation to stock structure within the Eastern North Pacific. Sepulveda, C.A. and Aalbers, S.A. (2025) ICES Journal of Marine Science, Vol. 82, Issue 7, July 2025, fsaf098 DOI: 10.1093/icesjms/fsaf098	Reports electronic tag tracking data from 181 swordfish tagged off California, Mexico, and Hawaii (2002–2022), with Argos transmissions received through January 2025. Results indicate swordfish do not exclusively adhere to current WCNP/EPO stock boundaries, with the US West Coast emerging as an important shared foraging ground.	Relevant to WCPFC should be taken into account in future assessments.
Evaluating the importance of mesopelagic prey to three top teleost predators in the northwest Atlantic Ocean. Willis, C. and others (2025) ICES Journal of Marine Science, Vol. 82, Issue 3, March 2025, fsaf028 DOI: 10.1093/icesjms/fsaf028	Examines the dietary reliance of large pelagic predators on the ocean's twilight zone (200–1000m). Mesopelagic prey organisms may represent an underestimated energy pathway for highly migratory species including billfish.	Low relevance to WCPFC
Argos satellite transmitters enable billfish research at finer scales. Arostegui, M.C. and others (2025) ICES Journal of Marine Science, Vol. 82, Issue 1, January 2025, fsaf001 DOI: 10.1093/icesjms/fsaf001	Evaluates advances in Argos satellite tag technology applied to billfish, demonstrating improvements in location accuracy, data transmission, and tag attachment that enable finer-resolution movement studies across multiple billfish species.	Relevant to WCPFC should be considered if planning satellite tagging work.

Pacific sailfish (<i>Istiophorus platypterus</i>) in the Eastern Pacific Ocean, association with ocean currents and seasonal effects of upwelling using real-time Argos locations. Clyde-Brockway, C.E., Patel, S.H., Blanco, G., Friederichk, S.J., Morreale, S. and Paladino, F.V. (2025) <i>Frontiers in Fish Science</i>, 2:1476026 January 2025 DOI: 10.3389/frish.2024.1476026	Tracks Pacific sailfish in the Eastern Tropical Pacific using real-time Argos satellite tags. Identifies associations between sailfish distribution and oceanographic features including the Costa Rica Dome upwelling system. Provides data relevant to both recreational fisheries management and conservation planning in Central American waters.	Low relevance to WCPFC - localised study.
Insights into the Movements and Habitat Use of Blue Marlins (<i>Makaira nigricans</i>) in the Southwestern Atlantic Ocean. Published April 28, 2025 <i>Fishes</i>, 10(5):201 DOI: 10.3390/fishes10050201	Pop-up archival satellite tags (PSATs) deployed on 21 blue marlins in the Southwest Atlantic Ocean (2006–2021). Results show blue marlin spent an average of 57% of time in shallow waters. Contributes to understanding of vertical habitat preferences and fishery interaction in the Atlantic, with comparative relevance for Pacific populations.	Low relevance to WCPFC - localised study. Relevant if CPUE studies are done using longline data.
Population structure of the swordfish, <i>Xiphias gladius</i>, across the Indian Ocean using next-generation sequencing. Published May 2025 <i>ICES Journal of Marine Science</i>, Vol. 82, Issue 5, fsae179 DOI: 10.1093/icesjms/fsae179	Uses SNP data to assess population structure of swordfish across the Indian Ocean. Results indicate consideration of management strategy refinement may be warranted based on evidence of discrete northern and southern genetic groupings. Highlights need for expanded sampling to confirm temporal stability.	Low relevance to WCPFC - localised study. But does support the potential for sub-population structures within large ocean basins.

Table 1: The 2021-2030 billfish work as agreed at SC19 and updated for 2026.

1. Stock assessment				
Title	Priority	Start year	End year	Comments
Assessment 1) North Pacific striped marlin stock assessment	High	2023	2023	Completed (2023) - assessment accepted by SC19 (SC19-SA-WP-11 and SC20-SA-WP-12). Projections provided for 2025 (SA-WP-04)
Assessment 2) Southwest Pacific striped marlin stock assessment	High	2024	2025	Completed (2024) – evaluated but rejected by SC20 (SC20-SA-WP-03 and SC20-SA-IP-06) Revised assessment tabled at SC21 (SA-WP-06 and SA-WP-07) other relevant papers (SA-IP-13, SA-IP-14 and SA-IP-15).
Assessment 3) North Pacific swordfish stock assessment	High	2023	2023	Completed (2023) – assessment accepted by SC19 (SC19-SA-WP-09).
Assessment 4) Southwest Pacific swordfish stock assessment	High	2025	2025	Completed tabled for SC21 review (SC21-SA-WP-05) other relevant papers (SC21-SA-IP-11, SC21-SA-IP-12, SC21-SA-IP-13 and SC21-SA-IP-14).
Assessment 5) Pacific blue marlin stock assessment	High	2026	2026	Completed (2026) (SC22-SA-WP-10)
Assessment 6) Assessment approaches for WCPO black marlin, sailfish and shortbill spearfish	Medium	2027	2027	Project 130: Joint bycatch assessment workshop for billfish and sharks (SC22-SA-IP-21). Workshop planned for February 2027.
Assessment 7) Data characterisation of black marlin, sailfish and shortbilled spearfish.	TBD	2027	2027	Proposed new project.

2. Biology				
Title	Priority	Start year	End year	Comments
Biology 1) Development of a statistically robust sampling plan for the collection of fisheries dependent biological samples (by sex), including but not limited to age, size frequency data, and genetic samples for WCPO swordfish (north and south).	High	2024	2025	Completed (2024)- (SC20-SA-IP-13) Additional work in 2025 (SC21-SA-WP-14)
Biology 2) Biology of South Pacific striped marlin, blue marlin, black marlin, shortbill spearfish	High	2025	2028	Project initiated under WCPFC project 125 - update report expected at SC22 (SC22-SA-IP-19, SC22-SA-IP-20 and SC22-RP-P35b-01, SC22-RP-P35b-03). SC21-SA-WP-11 presented in 2025.

and sailfish in the WCPO from longline fisheries.				
Biology 3) Southwest Pacific swordfish epigenetics and stock structure.	High	2025	2027	This project has been re-purposed as Southwest Pacific swordfish epigenetics and stock structure.

Table 2: Billfish stock assessment table. Note this includes all assessment types from data rich to low information assessment models. The assessment type will be determined by the SC ISG-Billfish for each successive year. Billfish assessments are currently scheduled 5-yearly, but 4-yearly for swordfish. A = Assessment; L/C = Low information assessment or characterisation; X = Scheduled work moved; U = Assessment tabled but not accepted. Note: for SW Pacific swordfish there may be utility in moving the assessment to a 2-year body of work. This table will be reviewed by the Joint bycatch assessment workshop for billfish and sharks.

Species	Stock	Last assessment	2022	2023	2024	2025	2026	2027	2028	2029	2030
Striped marlin	N Pacific	2023		A				A			
	SW Pacific	2025			U	A					A
Swordfish	N Pacific	2023		A					A		
	SW Pacific	2025				A					<i>Start finish 2031?</i>
Blue marlin	Pacific	2021					A				
Black marlin	WCPO	Never						Data characterisation			
Sailfish	WCPO	Never									
Shortbill spearfish	WCPO	Never									

Appendix 1 – Recommendations from the most recent stock assessments

Appendix 1 includes the recommendations and research considerations from the most recent billfish assessments presented at SC21, southwest Pacific striped marlin and swordfish. These are included for reference by the ISG-Billfish when considering research priorities.

Stock assessment	Recommendations
Revised 2024 Stock Assessment of Striped Marlin in the Southwest Pacific Ocean Part 1: Integrated Assessment in Stock Synthesis. Castillo-Jordan <i>et al.</i> SC21-SA-WP-06	1) Implement other methods to try and estimate the size of the striped marlin population in the SWPO, the most appropriate proven method would be Close Kin Mark Recapture, building on the work of WCPFC Project 100c. Implementing a CKMR study could also provide improved information on population structure. Explore other methods that might provide a basis for developing a prior on the absolute population size. 2) As is routinely recommended from striped marlin assessments, there is a need for improved understanding of critical biological processes such as growth, movement, early life history and population structure across the entire south Pacific, and especially at finer resolution within the southwest Pacific region of this assessment. Importantly, given these models are age structured, and with the fast growth of striped marlin to maturity and maximum size, it is very difficult to obtain reliable age structure from the length or weight data. Age structured models really need age data for species with growth characteristics like marlin and indeed tunas. Investing in collecting regular age composition data is critical to improving the confidence in the current age structured model estimations. Noting otolith collections are minimal for this species due the difficulty in accessing fish (often headed at sea) and extraction of the otoliths (tiny otoliths in a very big head), exploring epigenetic aging is recommended, not only for striped marlin, but also swordfish. 3) Explore a Bayesian approach to the integrated stock assessment. 4) Continue to utilize the observer data which has the advantage of additional covariates to develop abundance indices, as these will become more valuable over time. 5) Conduct a workshop on assessment approaches and challenges for bycatch species, including billfish and sharks, to consolidate and share learnings and modeling approaches from this assessment revision and the multimodel approaches now used for shark assessments.
2025 Stock Assessment of Striped Marlin in the Southwest Pacific Ocean: Part II Data-moderate Approach. Ducharme-Barth <i>et al.</i> SC21-SA-WP-07	Future assessment efforts should progressively build toward full age-structure through a systematic approach: • delay-difference models, • age-structured production models, and • then fully integrated age-structured models. This development should occur within a Bayesian framework to inform parameter estimates where prior information exists or can be derived using prior pushforward approaches (Kim & Neubauer, 2025). The transition should be guided by careful evaluation of whether increased model complexity is supported by available data and whether it improves the reliability of management advice. A crucial part of the assessment process is careful scrutiny of the representativeness of the

	available data, and matching the modeling approach to the information content in the data available.
Stock assessment of swordfish in the southwest Pacific Ocean: 2025. Day <i>et al.</i> SC21-SA-WP-05	1) Increase the biological sampling of otoliths to build greater coverage of conditional age-at-length data and application of otolith-based methods to explore population structure (i.e. otolith chemistry). Increase the quantity of tissue samples collected for expanded genetic studies. Age data are some of the most informative data for this model and the current age dataset is limited spatially and temporally. More age data would likely be very informative for this model. 2) Collection of appropriately sampled close kin mark recapture data. This potential data source and modelling tool could potentially offer far more information to inform this assessment than all of the other data sources, that seemingly are unable to give a great deal of confidence in the assessment of the population scale. 3) Robust age validation procedures to enhance accuracy and confidence in the conditional age-at-length data. 4) Duplicate readings of otoliths should be obtained to enable age reading error to be estimated. 5) Further research and data collections to inform growth parameters, and any regional variation across different Pacific regions is essential to refine the assessment. 6) Continued and increased collection of key representative size composition data could help improve the model outcomes. 7) Explore the influence of environmental factors on recruitment. By exploring these connections, we can gain valuable insights into population dynamics and identify potential vulnerabilities to environmental changes. 8) Review the length and weight composition data and explore further models to standardise these composition inputs to assessments. 9) Collaborative work with colleagues from the EU to diagnose potential problems with the current EU CPUE index. 10) Additional exploration of alternative abundance indices, CPUE or otherwise. 11) Regional agreements on standard length and weight measurements to be applied to best inform the stock assessment. Minimising the use of conversion factors will minimise the propagation in any errors associated with conversion factors. 12) Full review of conversion factors used in the assessment, and consideration of the development of regional or flag-based conversion factors. Conversions from processed length or weight to the standardised units used in the assessment (whole weight and lower jaw-fork length) are important. 13) A review of data collection preferences for stock assessment purposes would be helpful, especially composition data. Long term data collection programs are useful, but typically age data is more useful than length data, which is more useful than weight data. 14) Investigation into stock structure and connectivity with adjacent regions in the northeast corner of the assessment region.

Appendix 2 – Draft project specs for 2027 projects for evaluation and completion by SC22 ISG-Billfish

Part A: Administrative Summary	
1. Project Title	Data characterisation of black marlin, sailfish and shortbilled spearfish
2. Organization	Submitted by the BRP
3. Administrative Contact	TBD - SPC
4. Principal Investigator (PI) and CV	TBD - SPC
5. Commencement and Completion Date	1 March 2027 - 31 August 2027
6. Project Budget Summary	Overview of major cost categories: - Project budget - \$30,000 - Travel to SC23 \$10,000 - Operating Costs (e.g., equipment, supplies) - NA - Other Costs (e.g., sub-contracts, dissemination) - NA
Part B: Project Proposal Description	
1. Project Title	As above
2. Background and Need	See Rationale
3. Objectives and Benefits	See scope of work
4. Note	Prior to any form of assessment there is value in evaluating and characterising the data available and overall trends in those data. These analyses will inform the type of assessment that may be possible prior to the assessment being planned.
5. Rationale	There has been little to no focused evaluations on these three species. These species are reported in logsheets and by observers, but the level of catch and trends in catch and effort have not been evaluated there is also little information on the extent of the biological data. Some data characterisations were undertaken as part of the original BRP (SC19-2023/SA-WP-16), these data should be evaluated in more detail and there would be value updating that analysis specifically for these three species.
6. Assumptions	- Sufficient existing fisheries and biological data are readily available from the WCPO or other sources. - Personnel are available to undertake this work.
7. Scope of Work	- Reviewing the previous work in the WCPO to assess and improve on methods and update the information on stock trends. - Present a characterisation of the fisheries catching these species. - Prepare a report containing the above results for SC23.
8. Activity Schedule	Access the SPC data (March 2027) Undertake the analysis (April-June 2027) Compile the report and submit to SC23 (June/July 2027)

9. Project Outcomes	Report document and presentation to SC23.
10. Forms of Results	Report document and presentation to SC23.
11. Methods	TBD
12. Data Management Plan / Data Sets Required	SPC held set level logsheet and observer data.
13. Other Related Projects	NA
14. Collaborations	TBD
15. Project Staff and CVs	TBD
16. Risks of Project Not Achieving Objectives	SPC staff or consultant availability
17. Timeframe	As above
18. Budget	As above
19. References	SC21-SA-IP-18