



**SCIENTIFIC COMMITTEE
SEVENTEENTH REGULAR SESSION**

ELECTRONIC MEETING
11 – 19 August 2021

[PROVISIONAL] Terms of Reference for Proposed Projects in 2022

WCPFC-SC17-2021/GN-IP-07 (Rev.02)

Secretariat

Proposed Template

Project XX	YYY
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Scope	
Timeframe	
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Project 35B	WCPFC Tuna Tissue Bank (TTB)
Objectives	The objective of the project is to maintain the WCPFC TTB with particular emphasis on WCPO bigeye, yellowfin, albacore and skipjack tunas, and swordfish, and, to facilitate transmission of samples to specified researchers with due cognizance of the WCPFC TTB Access Protocol.
Scope	<p>The scope of ongoing work will include, but not limited to, the following:</p> <ol style="list-style-type: none"> 1. Maintain and develop: <ul style="list-style-type: none"> ○ the public SPC webpage (www.spc.int/ofp/PacificSpecimenBank) informing interested parties of the tissue bank, including the rules of procedure to access samples from the tissue bank; ○ a web-accessed database holding non-public data; ○ a relational database that catalogues the samples to include fishery/sampling metadata; and ○ the Brisbane (CSIRO) storage site, including sorting specimens on arrival and reconciling with quarantine data, entering data describing specimens received into BioDaSys, storing specimens systematically so that they can be retrieved when requested and the laboratory and storage materials needed to complete curation. 2. Tissue sample utilisation and a record of outcomes/outputs will also be detailed in the relational database. 3. Subject to approval by the WCPFC Executive Director: <ul style="list-style-type: none"> ○ metadata will be made available to institutions or organizations responsible for providing scientific advice in fisheries through the web-accessible component of the database, and subsequently, and ○ SPC-OFP will facilitate the transmission of requested samples to specified researchers/organisations, and the return of unused and/or processed samples to the relevant storage facility. 4. Australia has provided access to their quarantine and sample storage infrastructure through CSIRO. Under current funding, samples are curated at the Brisbane site on an ongoing basis. CSIRO have committed to the in-kind contribution of maintaining space and transfer of specimens. The specific work is to: <ul style="list-style-type: none"> ○ Sort specimens on arrival and reconcile with quarantine data;

	<ul style="list-style-type: none"> ○ Enter data describing specimens received into BioDaSys; ○ Store specimens systematically so that they can be retrieved when requested; and ○ Laboratory and storage materials to complete curation. <p>5. As agreed at the annual project steering committee meeting (SC16RP-P35b-03), in addition to maintaining and operating the WCPFC Tuna Tissue Bank in 2021, the Scientific Services Provider will:</p> <ul style="list-style-type: none"> ○ continue to support initiatives to increase rates of observer biological sampling, noting that this contribution is essential to the ongoing success of WCPFC’s work; ○ provide a background paper with suggested revisions to the access protocols for the TTB that would eliminate any ambiguity associated with depositing or withdrawing samples from the TTB; and ○ pursue the proposed enhancement work listed in Section <i>Work Plan 2020-2021</i> in the <i>Report of the Tuna Tissue Bank Steering Committee</i> (WCPFC-SC16-2020/RP-P35b-03).
Timeframe	January – December 2022
Budget	USD 103,204

Project 42	Pacific Tuna Tagging Programme (PTTP)
Objectives	To assist operations and activities related with the PTTP including new tag releases, tag recovery, and preparation of the 2021 PTTP Steering Committee meeting.
Scope	<p>Conduct elements in the work plan as identified in the Report of the PTTP Steering Committee (SC16-RP-PTTP-02), including, but not limited to:</p> <ul style="list-style-type: none"> • Subject to the decision by the PTTP Advisory Committee meeting on 16 February 2021, support for the agreed tag-release cruise(s) for conventional and archival tagging and biological sampling in the western and central equatorial Pacific during 2021, targeting the agreed tropical tuna species. While the exact composition of tags to be deployed will be confirmed prior to the cruise (via the PTTP Cruise Planning Advisory Committee), the design of the PTTP requires the use of the following tag types and suppliers: <ul style="list-style-type: none"> ○ Hallprint™ conventional tags for all tagged fish; ○ Wildlife Computers™ and Lotek™ tags for archival and satellite tagged marine organisms. ○ Vemco™ and Lotek™ acoustic transmitters (and receivers). SPC should consult with the WCPFC Science Manager on alternatives if these tags are not available; • Maintain and enhance as appropriate the tag recovery network and pay tag rewards including via cash or t-shirt (Attachment B for the current reward rates). Where appropriate, engage third-parties, such as WCPFC member fisheries authorities, industry associations and other fisheries service providers to act as agents for tag recovery. Third-party agents should be reimbursed for tag rewards dispensed plus any costs and expenses incurred in assisting with tag recovery; • Conduct PTTP data verification with VMS and Logbook, and cannery data;

	<ul style="list-style-type: none"> • Continue consolidation of the web-tagging database, recapture information and tagging database frameworks; • Conduct data analyses on tag reporting and seeding, fishing and natural mortality, tagging mortality, movement and tag simulation; • Facilitate conduct of quarterly PTTP Cruise Planning Advisory Committee meetings in 2021; • Support for the development and implementation of a work plan for 2022 tagging activities as outlined in the 2020 PTTP report to SC16; and • Preparation of PTTP Steering Committee meeting in conjunction with SC17 and production of the PTTP Progress Report and the 2021 Steering Committee Report.
Timeframe	January – December 2022
Budget	USD 730,000

Project 60	Improving Purse Seine Species Composition					
Objectives	To improve the collection and representative nature of species composition data caught by purse-seine fisheries in the WCPO in order to improve the stock assessments of key target species in the WCPO.					
Scope	<p>The scope of work will include, but not limited to, the following items below:</p> <p>1) General Tasks:</p> <ol style="list-style-type: none"> a) Continue to identify key sources of sampling bias in the manner in which species composition data are currently collected from WCPO purse seine fisheries and investigate how such biases can be reduced; b) Review a broad range of sampling schemes at sea as well as onshore; develop appropriate sampling designs to obtain unbiased species composition data by evaluating the selected sampling procedures; extend sampling to include fleets, areas and set types where no representative sampling has taken place; verify, where possible, the results of the paired sampling against cannery, unloading and port sampling data; c) Review current stock assessment input data in relation to purse-seine species composition and investigate any other areas to be improved in species composition data, including the improvements of the accuracy of collected data; d) Update standard spill sampling methodology if required; and e) Analyse additional data collected to evaluate the benefits of spill sampling compared to corrected grab-sampling. <p>The ability to deliver this work in 2021 will depend on the duration and extent of COVID-19 travel restrictions. However, where those restrictions hamper physical implementation, technical and practical preparations for subsequent implementation will be pursued in 2021.</p> <p>2) Review the following activities for Project 60, with reporting the outcomes to SC17:</p> <table border="1" data-bbox="516 1759 1388 1831"> <thead> <tr> <th>Activity</th> <th>Priority</th> </tr> </thead> <tbody> <tr> <td>1. Paired grab-spill trips (target: 4 to 6):</td> <td>High</td> </tr> </tbody> </table>		Activity	Priority	1. Paired grab-spill trips (target: 4 to 6):	High
Activity	Priority					
1. Paired grab-spill trips (target: 4 to 6):	High					

	<ul style="list-style-type: none"> Targeting fleets with likely availability of comprehensive landings slips data (to be provided on a voluntary basis). Additional data should allow for improved estimates of bias correction factors, and provide a more powerful dataset for testing for species and/or school association specific correction factors 	
	2. Continue to explore opportunities for collaboration with members, specifically undertaking comparisons of observer samples, and potentially model-based, species composition estimates, with accurate unloadings / landings / cannery data	High
	3. Simulation model <ul style="list-style-type: none"> Exploration of potential bias from between-brail variability in size Inform need for set and/or species-specific correction factors 	High
	4. Investigation of video-based sampling for estimation of species and size compositions	Medium
	5. Cost-benefit analysis of alternative sampling approaches for long-term estimation of species compositions (i.e. at-sea sampling vs port sampling)	Low
	<p>3) Continue to incorporate the following changes (as outcomes from Project 60) into the process for generating the aggregated purse seine species catch estimates:</p> <ul style="list-style-type: none"> Multinomial-model based correction factors be used to correct existing and future grab sample data, rather than the estimates of ‘availability’; The beta-response models be used to generate catch estimates; and, Observer samples are stratified by flag when used to directly estimate species compositions. 	
Timeframe	1 January 2022 to 31 December 2022	
Budget	Carry over 2021 budget of \$40K to 2022	
References	SC17-ST-IP-04	

Project 65	Peer review of stock assessment modelling (bigeye and yellowfin tuna)
Objectives	<ol style="list-style-type: none"> Undertake, in consultation with the stock assessment team (SPC), following the guidelines described in <i>Process for the Independent Review of Stock Assessments</i> (Attachment K, SC12 Summary Report), a peer review of the 2020 YFT stock assessment in the Western and Central Pacific Ocean (WCPO). Based on the review work provide recommendations for improving the assessment, including data inputs, modelling approaches and treatment of uncertainty. In conjunction with the SPC assessment scientists, identify improvement options that are feasible for application to the 2023 YFT assessment.

<p>Scope</p>	<p>The key areas for consideration by the peer review panel based on the recommendations of the stock assessment report and follow-up considerations of the assessment team are listed below:</p> <ol style="list-style-type: none"> 1. Model inputs, commenting on the adequacy and appropriateness of data sources and data inputs to the stock assessment, with particular attention to: <ol style="list-style-type: none"> a. Growth: review the approach to estimation of growth parameters and consider the implications of potential regional variations in growth. b. Tagging data: review the approach used to treat tagging data as model inputs, and how the tagging data are used within the modelling. c. Size composition: review the approach for pre-treatment of size composition data (i.e., re-weighting) and how size composition is weighted for the likelihood function. d. Natural mortality: review the approach used to determine M-at-age and implications of alternative M assumptions. e. Data inputs: identify and provide recommendations on the key areas for improvement in data collection (both fishery data and biological information) 2. Model configuration, assumptions and settings, with particular attention to: <ol style="list-style-type: none"> a. Model complexity: review the appropriateness of the model complexity, including spatial and fishery structure, in relation to data inputs and other available information. b. Selectivity: review selectivity assumptions and settings. c. Uncertainty: review the approach used to represent uncertainty in model-derived management quantities, considering structural, model and input data uncertainty 3. Model diagnostics, with particular attention to: <ol style="list-style-type: none"> a. Review the suitability of the diagnostics used and reported for the assessment. b. Consider the diagnostics provided for the 2020 YFT assessment and provide guidance on follow-up work where the diagnostics suggest issues, i.e., data conflicts. 4. Recent MULTIFAN-CL model developments, with particular attention to: <ol style="list-style-type: none"> a. new MULTIFAN-CL features in relation to their application to the 2023 scheduled YFT assessment. 5. Future research areas, with the identification of priorities to improve future assessments <p>While these key topics will be a focus of the peer review, other aspects of the assessment and data inputs may become focus areas as the review progresses.</p>												
<p>Timeframe</p>	<table border="1"> <thead> <tr> <th data-bbox="431 1577 651 1619">Activity</th> <th data-bbox="651 1577 1057 1619">Output</th> <th data-bbox="1057 1577 1401 1619">Timeframe</th> </tr> </thead> <tbody> <tr> <td data-bbox="431 1619 651 1713">Review of the WCPO yellowfin assessment report</td> <td data-bbox="651 1619 1057 1713">Summary paper of general comments for any pre-workshop modelling information/data required by the review</td> <td data-bbox="1057 1619 1401 1713">At least 2 months prior to workshop</td> </tr> <tr> <td data-bbox="431 1713 651 1782">Pre-workshop meeting. (Online)</td> <td data-bbox="651 1713 1057 1782">Plan for the workshop developed</td> <td data-bbox="1057 1713 1401 1782">At least 1 month prior to the workshop</td> </tr> <tr> <td data-bbox="431 1782 651 1848">Review workshop at Noumea, New</td> <td data-bbox="651 1782 1057 1848">Completion of 5 day + travel in-person modelling workshop in</td> <td data-bbox="1057 1782 1401 1848">TBA (COVID travel dependent) pre or post</td> </tr> </tbody> </table>	Activity	Output	Timeframe	Review of the WCPO yellowfin assessment report	Summary paper of general comments for any pre-workshop modelling information/data required by the review	At least 2 months prior to workshop	Pre-workshop meeting. (Online)	Plan for the workshop developed	At least 1 month prior to the workshop	Review workshop at Noumea, New	Completion of 5 day + travel in-person modelling workshop in	TBA (COVID travel dependent) pre or post
Activity	Output	Timeframe											
Review of the WCPO yellowfin assessment report	Summary paper of general comments for any pre-workshop modelling information/data required by the review	At least 2 months prior to workshop											
Pre-workshop meeting. (Online)	Plan for the workshop developed	At least 1 month prior to the workshop											
Review workshop at Noumea, New	Completion of 5 day + travel in-person modelling workshop in	TBA (COVID travel dependent) pre or post											

	Review outcomes of modelling workshop	Draft workshop report to SPC for review and response	With 2 weeks of the end of the modelling workshop
	Finalise peer review Final report provided to SPC for addition of SPC report responses		TBA – either by end June 2022 if workshop is in March 2022, or by January 2023 if workshop is in October 2022
	Report finalised	Deliver report to WCPFC for posting	TBA - Depending on timing of workshop, prior to SC18 (July 2022) or 2023 SPC-Pre-
Budget	USD 50,000		
References	SC17-SA-WP-06		

Project 68	Estimation of seabird mortality across the WCPFC Convention Area
Objectives	<ul style="list-style-type: none"> • Fulfil the requirement under the WCPFC seabird CMMs to estimate the total number of seabirds being killed per year in WCPFC fisheries. • Assess mortality per year over the ten years since the first WCPFC seabird CMM, as requested under CMM2006-02, CMM 2007-04 and CMM 2012-07, and assess whether there is any detectable trend. • Provide advice to the Scientific Committee on what data improvements are needed to enable better analyses to be made
Rationale	<p>Monitoring and enumerating the total number of seabirds being killed per year in WCPFC fisheries is a requirement under WCPFC’s seabird CMMs. Project 68 has generated estimates of seabird mortalities in WCPO longline and purse seine fisheries for the time period 2015 to 2018 (Peatman et al., 2019). There have also been a number of global and regional assessments of risk to seabirds from tuna longline fisheries (e.g. Abraham et al., 2019; Birdlife South Africa, 2019; Ochi et al., 2018). Analyses of seabird bycatch have generally had to contend with incomplete or imbalanced observer coverage of key fleets as well as varying levels of species identification of seabird captures, leading to uncertainties in capture rates of seabird species.</p> <p>Peatman et al. (2019) recommended that further work include assessing the risk to seabird populations resulting from estimated seabird mortalities of WCPFC fisheries. To date there have been limited assessments of risk of WCPFC fisheries to north Pacific albatrosses, or the more equatorial seabird populations. This gap of coverage could be addressed by carrying out a WCPFC-wide risk assessment, potentially to a subset of seabird populations depending on the data available.</p>
Assumptions	<ul style="list-style-type: none"> • There is additional seabird bycatch data available to warrant revisiting assessments of risk to seabird species from WCPFC fisheries in the southern hemisphere. • There is sufficient data held by WCPFC for estimating mortality and risk from WCPFC fisheries for northern hemisphere and equatorial seabirds. • CCMs and other partners and stakeholders are able to contribute data and expertise to the conducting of risk assessments for seabirds in the WCPFC jurisdiction.

	<ul style="list-style-type: none"> • IATTC is able to assist for straddling populations of seabirds
Scope	<ul style="list-style-type: none"> • Identify the limitations in the data available. <ul style="list-style-type: none"> ○ Document what information is available on species that overlap with the WCPFC fisheries, their population status, any tracking data (or already established spatial distributions that are more complex than binary presence absence) and any estimates on their biological parameters such as Rmax (the theoretical maximum breeding rate). ○ Document current observer data to assess the level of coverage in each fishery, both spatially and temporally. • Estimate seabird mortalities (where feasible) and risks associated with interactions with WCPFC fisheries (where feasible). • Describe the methods used to estimate total mortalities including treatment of data gaps. • Provide advice to the Scientific Committee on the suitability of risk assessment approaches given the data available. • Generate advice on what further level of seabird assessment at species or species-group level can be conducted, given the amount and quality of data currently available.
Timeframe	2022 - Data Compilations and Gaps Analysis 2023 - Risk Assessments 2024 - Reporting to WCPFC Scientific Committee
Budget	USD 75,000
References	Abraham, E., Richard, Y., Walker, N., Gibson, W., Ochi, D., Tsuji, S., Kerwath, S., Winker, H., Parsa, M., Small, C., Waugh, S., 2019. Assessment of the risk of surface longline fisheries in the Southern Hemisphere to albatrosses and petrels, for 2016. Report prepared for the 13th Meeting of the Ecologically Related Species Working Group (ERSWG13) of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT-ERS/1905/17). Birdlife South Africa, 2019. Report of the Final Global Seabird Bycatch Assessment Workshop. WCPFC-SC15-2019/EB-WP-07. Ochi, D., Abraham, E., Inoue, Y., Oshima, K., Walker, N., Richard, Y. & Tsuji, S., 2018. Preliminary assessment of the risk of albatrosses by longline fisheries. WCPFC-SC14-2018/EB-WP-09 Peatman, T., Abraham, E., Ochi, D., Webber, D. and Smith, N., 2019. Project 68: Estimation of seabird mortality across the WCPFC Convention Area. WCPFC-SC15-2019/EB-WP-03.

Project 90	Better data on fish weights and lengths for scientific analyses
Objectives	This project has three objectives The first component aims to identify gaps, address those gaps which can be resolved with existing information, and develop the sampling plan and protocol to resolve additional gaps, through the following activities (but not limited to):

	<ul style="list-style-type: none"> • identify the priority gaps in <u>conversion factor data</u> for the WCPFC key tuna species, key shark species, and key billfish species • expand the conversion factors to cover the WCPFC key shark species for groups: mako, thresher and hammerhead shark, after gap analysis against existing conversion factors • produce a list of species of special interest (SSIs, excluding key shark species) that require conversion factor data • produce a list of commercially important bycatch species (not covered in the items above) • include more information on source of data for each conversion factor (e.g. reference of study, sample size, R2, minimum/maximum size of sample, etc.) in tables of conversion factors which will inform the need for more data collection • produce a list of the remaining bycatch species that require conversion factor data • produce standard protocols for conversion factor data collection to be collected by observers and port samplers, • prioritize this list so that the most important work is achieved, and • <u>present the findings at SC15 for review, acknowledging that some observer providers will voluntarily collect conversion factor data prior to SC15.</u> <p>The second component relates to investigating potential innovative methods to obtain <u>length-length conversion factor</u> data, including:</p> <ul style="list-style-type: none"> • explore the use of EM tools to capture multiple length measurements from fish e-measured by EM Analysts. <p>The third component relates to collecting the conversion factor data:</p> <ul style="list-style-type: none"> • systematically collect representative samples of length measurements of bycatch species support future estimation of fish bycatch in the WCPO; and • systematically collect length:length, length:weight and weight:weight data on all species to better inform future estimation of fish catch and bycatch estimates in the WCPO.
Note	<p>Although these three objectives are distinct, they have been combined into a single project to avoid any possible duplication of effort and, as there will likely be combined tasking of Pacific Island observers and port-samplers, in future data collection arising from the project.</p> <p>The project acknowledges that flag state CCMs with national port sampling and observer programmes may also want to collect conversion factor data using the standard protocols established under this project; these initiatives would be an invaluable contribution to the project.</p> <p>The project will also involve the work in transferring the conversion factor information compiled from other sources, such as the information presented in Clarke et al. (2015) <i>Report of the Pacific Shark Life History Expert Panel Workshop, 28-30 April 2015; SC11-EB-IP-13</i>, and conversion factor data compiled from the Australia domestic longline fishery.</p> <p>Project 90 implementation acknowledges that issues of observer safety, overall workload and work conditions are paramount. The development of the data</p>

	<p>collection protocols for conversion factor measurements through observers should take into account the challenges with on-board observer activities, including, but not limited to;</p> <ul style="list-style-type: none"> - Potential difficulty in measuring large specimens on small boats; - Evaluating the feasibility of weighing fish at sea. For example, consideration of the following: <ul style="list-style-type: none"> • Ensure any weighing equipment does not hinder the fishing operation. • Simplifying the process of any onboard weight measurements; • To what extent the assistance of the crew will be expected, and • Avoiding duplicate weighing of specimens by keeping and weighing removals. - Note that any sharks which fishers are not allowed to retain will not be in the observer protocol for this project.
<p>Rationale</p>	<p>Estimates of bycatch are currently collected through the ROP in units of number, weight or both. In order to convert from numbers to weight, and vice versa, it is necessary to have information on both the size of caught individuals, and appropriate length:weight relationships for the species in question. This conversion between numbers and weight allows analyses of bycatch data to use the full observer dataset, rather than a subset with a consistent unit of measurement, therefore maximising the utility of the bycatch data recorded by observers. Furthermore, <u>bycatch length data</u> allows for consideration of the life-stages of individuals. This information could be of particular interest when considering bycatches of SSIs. There are currently insufficient, or unrepresentative, length samples for species caught in purse seine and longline fisheries, with the exception of bigeye, yellowfin and bigeye in purse seine catches, which are sampled through observer grab samples. This project would fill this data gap.</p> <p>The project is not constrained to bycatch species alone. The 2020 stock assessment reports for bigeye and yellowfin presented to SC16 both noted that the conversion factor used to convert longline caught bigeye and yellowfin individuals ("gilled-and-gutted" weight to whole weight) was based on less than 100 samples from longline vessels operating in the Solomon Islands and the Federated States of Micronesia. As this conversion factor is applied to all longline caught fish not processed using the Japanese style of gilling (and removing the operculum), gutting, and tailing the fish, small changes to this conversion factor could have a significant effect on the stock assessments. These reports highlighted the importance of allocating resources to collect additional samples across a number of fleets in the region to improve this conversion, as far as possible across the extent of the WCPO. To this end, an extension of Project 90 into 2022 is sought, with a budget of USD75,000 estimated. This is to support the additional activities required by observers to undertake this work across the region and fleets, as well as cover material costs expected to arise. In 2021, limited additional resources carried from other WCPFC SC projects (specifically Project 81) will be used to provide a proof of concept of the weight-weight conversion approach, and to allow better estimation of the potential costs involved in the 2022 programme. Note that these activities will apply to all relevant stocks, while the timeline aims to allow improved conversion factors to be applied within the next bigeye and yellowfin stock assessments scheduled for 2023.</p>

	<p>At least SEVEN (7) Pacific Island member countries with observer programmes have expressed interest in participating in conversion factor data collection, as long as funding support is available to cover any reasonable request for the additional work required by observers and port samplers.</p> <p>Accordingly, this project addresses objectives arising from discussions at SC13 about the results of regional estimates of purse seine and longline bycatch (Peatman et al., 2017; Peatman et al., 2018a; Peatman et al., 2018b). As a result of the discussions in 2017, SC13 recommended that the Scientific Services Provider be tasked with:</p> <ul style="list-style-type: none"> • designing and co-ordinating the systematic collection of representative samples of length measurements of bycatch species; and • a project to design and co-ordinate the systematic collection of length:length, length:weight and weight:weight data on all species to better inform bycatch estimation.
Assumptions	<p>Achievement of the objectives is subject to the following assumptions:</p> <ul style="list-style-type: none"> • sufficient data are available to support the sampling design analyses; • sampling designs can be developed which are statistically robust and would support future estimation of fish bycatch in the WCPO; • current observer equipment (e.g. callipers) is suitable for the length sampling protocols; • suitable and cost-effective equipment can be sourced for robust weight data collection; • data collection can be integrated into existing sampling events in-port and at-sea; • resources are available within selected countries to undertake this work; and • the sub-regional DCC observer conversion factors form will be the basis for data collection. • Regional observers, as well as other approaches (e.g. port and market sampling) are able to undertake the additional activities required to develop weight-weight conversion factors across the region.
Scope	<p>The proposed work programme comprises:</p> <ul style="list-style-type: none"> • data compilation activities; • subsequent statistical analysis activities to design future sampling approaches; • evaluation of designs for practical field application; • trials of selected sampling approaches in the field along with trials of equipment required to complete the sampling designs; • finalisation of future sampling protocols; • development of associated training standards; • incorporation of training into trainer trainings and biological sampling trainings as required; • ongoing co-ordination of sample collection and data submission; and • reporting on designs and progress with implementation and data collection. <p>It is intended that a preliminary report would be prepared for SC15 and more comprehensive reports for SC16, SC17 and SC18, with a final report at SC19.</p>
Timeframe	57 months (from January 2019 through September 2023)
Budget	2019 US\$60,000

	<p>2020 US\$30,000 2021 US\$20,000 + USD\$7,000 (transferred from Project 81) 2022 US\$75,000</p> <p>Note that this funding is intended to cover the work of the Scientific Services Provider in the design and co-ordination of this work. This will cover the analytical components identified in the scope of the project. It will also cover trials of methodologies identified at-sea and in-port.</p> <p>The funding in 2019 includes the costs to cover the additional work for selected observers from some observer providers, which will inform the process for refining the budget for this project in subsequent years.</p> <p>The 2019 funding also includes the costs to investigate and purchase 1-2 weighing devices in the initial implementation phase.</p> <p>The additional funding in 2021 will contribute to the estimated costs required to scope activities for the weight-weight conversion data collection, which will inform the process for refining the budget for this project in 2022.</p> <p>The estimated budget for 2022 will support the additional work of observers to undertake the data collection on weight-weight conversions, as well as the work of other groups within the region.</p> <p>It does not cover the costs of CCMs in implementing the protocols or the purchase of related equipment. This will require co-funding or additional funding depending on the designs selected in the design and testing phase and may require additional requests for funding from SC15.</p>
References	<p>Peatman, T., Allain, V., Caillot, S., Williams, P., and Smith, N. 2017. Summary of purse seine fishery bycatch at a regional scale, 2003-2016. SC13-ST-WP-05. Thirteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Rarotonga, Cook Islands, 9-17 August 2017.</p> <p>Peatman, T., Bell, L., Allain, V., Caillot, S., Williams, P., Tuiloma, I., Panizza, A., Tremblay-Boyer, L., Fukofuka, S., and Smith, N. 2018a. Summary of longline fishery bycatch at a regional scale, 2003-2017. SC13-ST-WP-02. Fourteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Republic of Korea, 8-16 August 2018.</p> <p>Peatman, T., Allain, V., Caillot, S., Park, T., Williams, P., Tuiloma, I., Panizza, A., Fukofuka, S., and Smith, N. 2018b. Summary of purse seine fishery bycatch at a regional scale, 2003-2017. SC13-ST-IP-04. Fourteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Republic of Korea, 8-16 August 2018.</p> <p>Ducharme-Barth, N., Vincent, M., Hampton, J., Hamer, P., Williams, P. and Pilling, G. 2020. Stock assessment of bigeye tuna in the western and central Pacific Ocean. WCPFC-SC16-2020/SA-WP-03 [REV3].</p> <p>Vincent, M., Ducharme-Barth, N., Hamer, P., Hampton, J., Williams, P. and Pilling, G. 2020. Stock assessment of yellowfin tuna in the western and central Pacific Ocean. WCPFC-SC16-2020/SA-WP-04 [REV3].</p>

Project 108	Silky shark stock assessment in the WCPO
Objectives	Undertake a stock assessment of silky sharks in the western Pacific Ocean
Rationale	<p>This stock was last assessed in 2018 (SC14-SA-WP-08) using data from 1980-2016. That assessment was the first attempt to assess this stock. SC14 noted that given the inherent uncertainty in the assessment, the estimates of stock status should be considered indicative only. Although these estimates are not considered a reliable basis for management decision-making, they represented progress since the 2013 assessment. As this species is unproductive and susceptible to overfishing, major objective of this assessment is therefore to establish and examine key areas of uncertainty and the impacts on estimates of stock status.</p> <p>Since the last assessment, more catch and effort data as well as observer data are available. The observer data will be an important component of this assessment as since CMM 2013-08 came into force, silky sharks in the WCPO have had a non-retention policy and the catch data should therefore be absent from July 2014.</p> <p>This project is designed to assess the stock status of silky sharks in the western Pacific Ocean using the most informative approach with respect to the available data, if possible an integrated assessment. The assessment should assess the stock status against conventional stock assessment metrics as much as is possible as well as those suggested in the WCPFC 2021-2025 Shark Research Plan (SC16-EB-IP-01 rev1).</p>
Assumptions	<ul style="list-style-type: none"> • Much of the existing fisheries and biological data are readily available. • Assessment personnel are available to undertake this work.
Scope	<ul style="list-style-type: none"> • Reviewing the previous assessment in the WCPO to assess and improve on methods to increase the understanding of data strengths and weaknesses, and update stock status. • Update WCPO longline catch estimates and abundance indices using recent observer data. • In the absence of any agreed reference points, present the stock status in terms of the metrics outlined in the 2021-2025 Shark Research Plan. • Prepare a report containing the above results for SC19. • If the data are too poor to undertake a full quantitative assessment, then a medium data assessment may be appropriate
Timeframe	18 months (March 2022 – August 2023)
Budget	1 FTE (\$94,000) Travel to SC19 (\$6,000) Total \$100,000

Project 17X1	Billfish research plan 2023 - 2027
Objectives	Develop a WCPFC research plan for billfish for 2023-2027.
Rationale	At the WCPFC SC16 meeting there were a number of projects proposed on swordfish and striped marlin for work required to meet the management needs of these species.

	<p>Much of this work is required as there is a lack of understanding of stock structure and factors influencing billfish catch, which is needed for mitigation studies as well as CPUE standardization. In addition, for some species there is a need to collect and analyses basic biological information as well as characterize the fisheries catching them.</p> <p>A number of these proposed projects were considered by SC16 in a series of online for a (namely Discussion Forum, 10, 12 and 14) and again at SC17 where these issues were discussed in Forum Topics 25. With competing priorities for work for the available budget as well as personnel resources, and to co-ordinate work so that project results align in a meaningful manner, a number of Forum participants recommended that a billfish research plan be developed to collate the available data, and prioritise the work required to fill the data gaps for WCPO billfish.</p> <p>This work was postponed for 1-year and should now be included in the SC17 workplan.</p> <p>This work will:</p> <ul style="list-style-type: none"> • Review the assessment schedule within the existing Stock Assessment Schedule and consider the data needs of these assessments; • Develop a workplan for to ensure the data needs of the planned assessments are met prior to the assessment year; • Note the recommendations from recent project outcomes to inform the WCPFCs billfish management needs; • Propose the direction that the work over the next five years should take; and • Develop a prioritised draft schedule of work for consideration by SC18.
Assumptions	SPC or another regional body has the personnel and budget available to undertake this work.
Scope	<ol style="list-style-type: none"> 1. This document will focus on the WCPFC billfish species including the marlins, swordfish, sailfish and shortbilled spearfish. 2. Collate the available data in a series of summary plots and tables. 3. Develop a research plan. 4. Develop a draft list of prioritised projects for the 2021-2026 period.
Budget	Personnel \$45,000 Travel to SC18 (\$10,000) Total \$55,000

Project 17X2	SWP mako shark stock assessment in the WCPO
Objectives	Undertake a stock assessment of SWP mako sharks in the western Pacific Ocean
Note	Depending on the priorities of the SC for the work to be undertaken by the Scientific Services Provider (SSP), this project may be undertaken within the service agreement with the SSP or alternatively as a standalone project with a separate funding allocation. This will need to be decided by the SC17 considering the other priorities.
Rationale	This stock has not been previously assessed due to concerns around data quantity and quality. However, the WCPFC 2021-2025 Shark Research Plan (SC16-EB-IP-01 rev1) (SRP) notes that there are data from longline fleets going back to 1990, observer data from 1995-2019 and length samples from 1995-2019. The SRP also

	<p>notes that a data rich assessment could be attempted, and a medium data assessment is possible.</p> <p>The recent SWPO blue shark assessment (WCPFC-SC17-2021/SA-WP-03) indicates that a mako assessment which would have similar data issues, could be possible. However, the SRP notes that there are species identification issues between mako and porbeagle sharks which would need to be resolved during the catch reconstruction phase of the project. The SWPO blue shark assessment (WCPFC-SC17-2021/SA-WP-03) noted that model assumptions and formulation can have important implications for reconstructed catch estimates and recommend that increased effort to re-construct catch histories for sharks from a range of sources be attempted. This work should take into account and improve on the work undertaken in WCPFC-SC17-2021-SA-IP-18.</p> <p>This project is designed to assess the stock status of SWP mako sharks in the western Pacific Ocean using the most informative approach with respect to the available data, if possible, an integrated assessment. The assessment should assess the stock status against conventional stock assessment metrics as much as is possible as well as those suggested in the WCPFC 2021-2025 Shark Research Plan (SC16-EB-IP-01 rev1).</p>
Assumptions	<ul style="list-style-type: none"> • Much of the existing fisheries and biological data are readily available. <p>Assessment personnel are available to undertake this work.</p>
Scope	<ul style="list-style-type: none"> • Reviewing the other shark assessment in the WCPO to assess and improve on methods to increase the understanding of data strengths and weaknesses, and update stock status. • Develop WCPO longline catch estimates and abundance indices using recent observer data. • In the absence of any agreed reference points, present the stock status in terms of the metrics outlined in the 2021-2025 Shark Research Plan. • Prepare a report containing the above results for SC18. <p>If the data are too poor to undertake a full quantitative assessment, then a medium data assessment may be appropriate.</p>
Timeframe	December 2021 – August 2022
Budget	<p>Personnel \$95,000 Travel to SC18 (\$10,000) Total \$105,000</p>
References	<p>Neubauer, P.; Large, K., & Brouwer, S. (2021a). Stock assessment for south Pacific blue shark in the Western and Central Pacific Ocean (tech. rep. No. WCPFC-SC17-2021/SA-WP-03).</p> <p>Neubauer, P.; Large, K.; Brouwer, S Kai, M., Tsai, W.-P., & Liu, K.-M. (2021). Input data for the 2021 South Pacific Blue Shark stock assessment (tech. rep. No. WCPFC-SC17-2021/SA-IP-18).</p>

Project 17X3	Preparing western and central Pacific tuna fisheries for application of close-kin-mark-recapture methods to resolve key stock assessment uncertainties.
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<p>Objectives</p>	<ul style="list-style-type: none"> • Complete the base research needed for the application of close-kin-mark-recapture methods to WCPFC stocks to reduce the uncertainty in stock assessments. • Complete close-kin-mark-recapture feasibility studies for South Pacific albacore, Pacific bigeye and South-west Pacific Swordfish. • Develop and trial ‘Standard Operating Procedures’ for the cost effective and reliable collection of tissue samples necessary for close-kin-mark-recapture applications to WCPFC stocks. • Use trial samples to investigate and validate connectivity hypotheses via non-close-kin methods • Develop capacity within WCPFC to implement and evaluate close-kin-mark-recapture applications to WCPFC stocks. • Provide advice to the Scientific Committee on what data improvements are needed to enable best use of CKMR methods.
<p>Rationale</p>	<p>A significant challenge for several WCPFC stocks assessments is estimating the absolute spawning biomass with the necessary precision to assist management decision making. Close-Kin-Mark-Recapture (CKMR) (Bravington et al 2016 a & b) is likely the most practical solution to resolve this issue. In addition, it can give us other information on population structure, connectivity, natural mortality and other key inputs as additional benefits. The successful application of CKMR is dependent on adequate background understanding of a species’ biology and logistical considerations. Validating that understanding (e.g. about spatial connectivity) and evaluating the logistical feasibility is a necessary first step for implementing CKMR. The WCPFC South Pacific albacore stock has been identified by the Scientific Committee as a first candidate for CKMR (see reports of the SC15, SC16 and SC17-SA-IP-14). The approach has also been identified for potential application to bigeye tuna (see IATTC 2021 SC report) and an option for addressing stock assessment uncertainties associated with South-west Pacific Swordfish (SC17).</p> <p>CKMR takes advantage of modern genotyping methods to identify pairs of close relatives (e.g. parent-offspring, half-brother-sister) among large collections of tissue samples (i.e. biopsies). The number of kin-pairs found, and the way they are distributed in space and time, can be embedded into a population dynamics model and used to estimate important demographic parameters such as absolute adult abundance, mortality rates, and connectivity (Bravington et al 2017); the fundamental idea is that every animal was born with exactly one living mother and one living father, which it "marks" genetically. Unlike conventional mark-recapture, CKMR biopsies can be taken just from dead animals, e.g. fishery catches; and unlike conventional fisheries data, CKMR can estimate absolute abundance directly, without needing to rely on catch rate data (Davies et al, 2020).</p> <p>Key requirements and logistical considerations of CKMR are:</p> <ul style="list-style-type: none"> • CKMR requires information on the likely age of each juvenile and adult, so that kinship probabilities can be back-dated to juvenile birth and the likely fecundity of the potential parent at that time. Age estimates do not have to be perfect, but if the precision is poor then the model becomes unable to estimate abundance or other demographic parameters reliably (the parameters all become statistically confounded). • That sample tissues are of adequate quality to allow high-quality genotyping sufficient for kinship determination, and for age/length/sex determination (depending on what other associated measurements are available). • That the number of samples collected, and their spread across adult and juvenile cohorts, is adequate to give statistically clear results (i.e. to contain enough kin-pairs). • The fisheries sampled give adequate coverage of the managed population and sampling would be widespread enough to detect any spatial sub-structuring. <p>Epigenetic age estimation just from biopsy tissue is expected to provide an alternative to large-scale otolith reading. This technology has emerged rapidly in the last couple of years and is highly automated and less expensive than otolith-reading (Mayne et al 2020, 2021). The DNA</p>

	<p>already prepared and extracted for CKMR can be re-used directly for epigenetic ageing. The main necessity for each new species is a one-time calibration against known-age samples that have associated biopsy tissue. One key question about epigenetic age is its precision; age estimates do not have to be perfect for CKMR, but the precision for each species will affect sample size requirements. There is currently no validated ageing process for swordfish to calibrate epigenetic age. An important task will be to value add to the existing WCPFC bomb radio-carbon work to validate ageing by extending the analyses to swordfish.</p> <p>CKMR estimates of absolute abundance are also robust to spatial structure in populations provided the sampling program for either the juveniles or adults (preferably both) is adequately well-mixed and/or spatially representative. Spatial structure would be detectable when sampling is well-spread, through the spatial distribution of parent-offspring-pairs (POPs) and Half-Sibling Pairs (HSPs), in comparison to unrelated pairs. . If there is no (or demographically irrelevant) spatial structure then there should be little or no spatial pattern in the detected POPs. Assumptions and hypothesis associated with spatial structure and connectivity can also be readily tested using alternate methods on the same samples collected for CKMR. Population genetics of tissue samples and isotope and chemical analyses of tissue and skeletal samples are able to be undertaken routinely during CKMR sample collection to validate the connectivity assumptions behind sampling designs. There are a number of other side benefits to these validation experiments. The routine application of population genetics aids the description of localised patterns in genetic variation which has direct benefits for MCS activities by providing a probabilistic framework for determining the origin of catch.</p> <p>Genome assembly (mapping the location of original chromosomes on the genome from which the DNA sequences originated from), formerly a difficult and expensive task for a new species, is a powerful tool that is becoming more readily available. For a modest one-off expenditure, possession of a genome-assembly enhances the efficiency of CKMR (more information content per sample collected). It is not essential for CKMR however, for large populations, the use of genome assembly can improve the precision of identifying half-sibling pairs and thereby increase the total number of kin pairs identified with sufficient confidence for population modelling for a given sample size. There is also scope for additional information for population dynamics modelling, including the ability to determine the sex of the individuals sampled for CKMR, improved understanding of connectivity and adaptive potential and variation, which is increasingly important for understanding how stock biomass will respond under climate change and other changes to environmental conditions.</p> <p>Given the many interrelated benefits of modern genotyping methods undertaking the base research needed for its application in the WCPFC would facilitate the maximum utility of samples collected. In addition, WCPFC is well placed to commence CKMR through its strategic investment in establishing the Tuna Tissue Bank and the associated network for sample collection and archiving.</p>
<p>Alignment with Stock Assessment Timeframes</p>	<p><u>South Pacific Albacore</u> – The next SPA assessment is tentatively scheduled for 2024. Completion of base research in 2022 would provide preliminary results in time for the next stock assessment: epigenetic ageing could be used to age the catch of one or more fisheries in preparation for the 2024 assessment; population genetics and sample chemistry could be used to determine structure and connectivity between WCPO and EPO (if any). CKMR estimates would be expected to be integrated in the 2027 scheduled assessment.</p> <p><u>Bigeye tuna</u> – IATTC has identified CKMR as a potential option for its assessment of bigeye tuna in the EPO. A feasibility study for its application (Pacific wide) would be prepared in time for the 2023 WCPFC assessment of bigeye where the SC could make an informed decision on the merits of future implementation.</p> <p><u>South-west Pacific Swordfish</u> – Similar to SPA the assessment for SWPS is constrained by an uninformative index of abundance and uncertainty in the spatial connectivity within the spatial domain of the assessment. A feasibility study for application of CKMR would be prepared in time for the 2024 WCPFC assessment where the SC could make an informed decision on the merits and priority of implementation.</p>

Assumptions	<ul style="list-style-type: none"> • WCPFC and CMM port and observer sampling opportunities resume in 2022. • CCMs are able to participate in capability training. • Epigenetics is a viable option for high volume ageing. • IATTC continues to prioritise bigeye tuna for CKMR design and application. 																																																	
Scope of Work	<ul style="list-style-type: none"> • Calibrate and evaluate the precision of epigenetic ageing as tool for rapid and cost- effective ageing for high volume applications, with priority for South Pacific Albacore. • Assemble genomes for priority target species • Trial sample collection SOPs and train port samplers and observers • Establish sampling network and commence large-scale tissue sample collection (target 10,000 SPA samples) • Validate connectivity assumptions through genomic and indirect methods (elemental, isotope and/or fatty acid) • Provide advice to the Scientific Committee on the suitability of CKMR approaches given the data available. 																																																	
Timeframe	<p>Note this is a three year project, substantially funded through partner agencies (see budget) but with a small contribution requested from WCPFC (~US\$40k) to cover the epigenetic ageing approach for three stocks.</p> <table border="1" data-bbox="407 873 1414 1398"> <tr> <td data-bbox="407 873 561 1031">2022</td> <td data-bbox="561 873 1414 1031"> Calibration of epigenetic ageing for south pacific albacore and bigeye tuna Completion of south pacific albacore CKMR feasibility study Capability training for WCPFC Draft SOPs Provision of Advice to SC </td> </tr> <tr> <td data-bbox="407 1031 561 1188">2023</td> <td data-bbox="561 1031 1414 1188"> Completion of Pacific bigeye feasibility study Completion of genome assembly for south pacific albacore and yellowfin Capability training for WCPFC Trial and implementation of SOP for SPA Provision of Advice to SC </td> </tr> <tr> <td data-bbox="407 1188 561 1398">2024</td> <td data-bbox="561 1188 1414 1398"> Completion of validation and verification experiments Completion of feasibility study for south west Pacific swordfish Calibration of epigenetic ageing for swordfish (including bomb radiocarbon dating to verify age estimates). Completion of genome assembly for bigeye Implement SOP for SPA (target collection of 10,000-15,000 samples) Provision of Advice to SC </td> </tr> </table>	2022	Calibration of epigenetic ageing for south pacific albacore and bigeye tuna Completion of south pacific albacore CKMR feasibility study Capability training for WCPFC Draft SOPs Provision of Advice to SC	2023	Completion of Pacific bigeye feasibility study Completion of genome assembly for south pacific albacore and yellowfin Capability training for WCPFC Trial and implementation of SOP for SPA Provision of Advice to SC	2024	Completion of validation and verification experiments Completion of feasibility study for south west Pacific swordfish Calibration of epigenetic ageing for swordfish (including bomb radiocarbon dating to verify age estimates). Completion of genome assembly for bigeye Implement SOP for SPA (target collection of 10,000-15,000 samples) Provision of Advice to SC																																											
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<i>Swordfish Age validation</i>			40,000		10,000	50,000																																												

	<i>Genome (albacore)</i>		20,000 ¹			20,000
	<i>Genome (bigeye)</i>			20,000		20,000
	<i>Genome (yellowfin)</i>				20,000 ²	20,000
	SOPs		40,000 ³	100,000		140,000
	Feasibility					
	<i>South Pacific albacore</i>		10,000 ⁴	10,000		10,000 ⁴
	<i>Pacific bigeye</i>		10,000	10,000	10,000	5,000
	<i>SW Pacific swordfish</i>		10,000	10,000		5,000
	Capability		10,000	10,000		10,000
	Validation		30,000 ⁵	70,000		100,000
	Advice		10,000			5,000
	Total	33,000⁶	140,000	270,000	10,000	71,000
References	<ol style="list-style-type: none"> 1. Bravington, M.V., Skaug, H.J. and Anderson, E.C. (2016a). Close-Kin Mark-Recapture. <i>Statistical Science</i> 2016, Vol. 31(2), 259–274. DOI: 10.1214/16-STS552 2. Bravington, M.V., Grewe, P.M. and Davies, C.R. (2016b). Absolute abundance of southern bluefin tuna estimated by close-kin mark-recapture. <i>Nature Communications</i> 7:13162. https://doi.org/10.1038/ncomms13162 3. Mark V. Bravington, J. Paige Eveson, Peter M. Grewe, and Campbell R. Davies 2017. SBT Close-Kin Mark-Recapture with Parent-Offspring and Half-Sibling Pairs: update on genotyping, kin-finding and model development. Working paper prepared for the Extended Scientific Committee for the Twenty Second Meeting of the Scientific Committee, Yogyakarta, Indonesia, 28 August -2 September, 2017. CCSBT-ESC/1709/12. 4. Campbell Davies, Mark Bravington, Paige Eveson, Matt Lansdell, Jordan Aulich and Peter Grewe 2020. Next-generation Close-kin Mark Recapture: Using SNPs to identify half- sibling pairs in Southern Bluefin Tuna and estimate abundance, mortality and selectivity. Final Report to FRDC, June 2020. 5. Benjamin Mayne, Oliver Berry, Campbell Davies, Jessica Farley and Simon Jarman (2019). A genomic predictor of lifespan in vertebrates. <i>Scientific Reports. Sci Rep</i> 9, 17866. https://doi.org/10.1038/s41598-019-54447-w 6. Mayne, B., Espinoza, T., Roberts, D., Butler, G. L., Brooks, S., Korbie, D., & Jarman, S. (2021). Nonlethal age estimation of three threatened fish species using DNA methylation: Australian lungfish, Murray cod and Mary River cod. <i>Molecular Ecology Resources</i>, 00, 1–9. https://doi.org/10.1111/1755-0998.13440 					

Project 17X4	<p>Further development of ensemble model approaches for presenting stock assessment uncertainty</p> <p>Responsibility: SPC</p>
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¹ Australian funded SPC and CSIRO joint activity to assemble SPA genome

² Australian funded CSIRO activity to assemble YFT genome

³ Supported activity under the Pacific-European-Union-Marine-Partnership project

⁴ SPC and CSIRO joint activity to draft feasibility study

⁵ SPC – Jed Macdonald

⁶ =USD40,000

	TOR - To be confirmed pending SC support for a project between SPC and US (NOAA scientists)
Objectives	
Note	
Rationale	
Assumptions	
Scope	
Timeframe	
Budget	
References	

Project 17X5	Towards Providing Scientific Advice for Southwest Pacific Blue shark
Objectives	Present a new procedure leading to the selection of the models to be included in the final grid used for providing management advice for Southwest Pacific blue shark.
Rationale	<p>In the 2021 Southwest Pacific blue shark assessment developed in Stock Synthesis 90% of model runs indicate that fishing mortality at the end of the assessment period was below FMSY and 96% of model runs show that the biomass is above SBMSY. However, due to several issues in the data inputs and model results, the SC recommended a workplan to improve the Southwest Pacific blue shark assessment. Therefore, in this project, three different processes will be conducted: i) a re-examination of the input data, ii) development of an objective criteria for evaluating the performance of the proposed models to be included in the final grid used for the management advice, and iii) evaluation of dynamic reference point for blue shark.</p> <p>A potential objective criteria include the use of model diagnostics to determine the robustness of estimates for management advice in integrated stock assessment models. A variety of diagnostics have been proposed based on model convergence, likelihood, runs tests, retrospective analysis, and prediction skill. Any of these or/and a combination of them could also potentially be used as metrics for weighting model scenarios in an ensemble. In addition, the project will consider recent developments on weighting grid axes <i>a priori</i>, such as through development of principled joint priors.</p> <p>This project will focus on evaluating the performance of each model based on a number of diagnostics, such as the following four properties: model convergence and stability, fit to the data, model consistency, and prediction skill.</p> <p>Model convergence and stability: the analysis should assess the final gradient (it should be relatively small; $<1e4$), and check that the Hessian matrix is definite. Apply the jitter procedure to verify the stability of the model to evaluate whether the model has converged to a global solution rather than a local minimum.</p> <p>Goodness-of-fit: will evaluate whether residuals patterns of the CPUE and length-frequency distributions were normally distributed or/and had temporal trends.</p>

	<p>Model consistency: Retrospective analysis can be used to check the consistency of model estimates, for example, the invariance in SB and F as the model is updated with new data in retrospect.</p> <p>Prediction skill: Hindcasting analysis could be done to evaluate the model prediction skill of the CPUE. When conducting hindcasting, a model is fitted to the first part of a time series and then projected over the period omitted in the original fit. Prediction skill can then be evaluated by comparing the predictions from the projection with the observations.</p>
Scope	<ul style="list-style-type: none"> • Re-examination of the input data used in the Southwest Pacific blue shark stock assessment, specifically catch histories in relation to observed CPUE trends in model fisheries. • Develop the above mentioned diagnostics for the models included in the grid and prepare a report containing the results for SC20. • Evaluate the use of dynamic reference point for blue shark.
Timeframe	December 2021 – August 2022
Budget	Personnel \$30,000 Travel to SC18 (\$10,000) Total \$40,000
References	Carvalho, F., Winker, H., Courtney, D., Kapur, M., Kell, L., Cardinale, M., Schirripa, M., Kitakado, T., Yemane, D., Piner, K. R., Maunder, M. N., Taylor, I., Wetzel, C. R., Doering, K., Johnson, K. F., and Methot, R. D. (2021). A cookbook for using model diagnostics in integrated stock assessments. <i>Fisheries Research</i> , 240:105959.