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Project 90 update: Better data on fish weights and lengths for scientific analyses

WCPFC-SC18-2022/ST-IP-04

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EXECUTIVE SUMMARY

Project 90 developed from discussions at SC13 around the need for accurate 'conversion factor' data for targeted and bycatch fish species captured across the western and Central Pacific Ocean (WCPO). The project is now in its third year, its original objective to design and co-ordinate the systematic collection of representative length measurements for bycatch species, and Length-Length (L:L), Length-Weight (L:W) and Weight-Weight (W:W) conversion factors for tunas, billfish and bycatch species.

This Information Paper updates SC18 on activities occurring during the 12 months to 23 July 2022, and outlines planned actions for the coming year. Through dedicated, collaborative efforts on conversion factor data collection across the region arising through Project 90 and associated sampling programmes, we have amassed a total of 37,710 conversion factor measurements on skipjack, 26,099 measurements on yellowfin, 7,429 on bigeye, 340,479 on albacore and 2,816 measurements on bycatch species over the past eight years. With COVID-19 restrictions on travel and observer coverage across the region beginning to ease, opportunities to augment conversion factor data collection through the national observer and port sampling programmes are once again becoming available. Therefore, efforts to boost numbers of measurements across the broadest possible spatial area, addressing key data gaps, such as the W:W conversion factors for large yellowfin and bigeye tunas, will be a focus of the 2022-23 workplan. This workplan will be implemented through a variety of initiatives as detailed in this paper.

We invite SC18 to:

1. review and comment on the progress made on Project 90 activities at this stage; and
2. note that Project 90 has been selected for inclusion in the *Online Discussion Forum* at SC18, and SPC looks to that forum to table and enhance the priorities and activities proposed in this paper.

1. BACKGROUND

WCPFC Project 90 arose from discussions at SC13 regarding regional estimates of purse seine and longline bycatch (Peatman et al. 2017; 2018a,b), and the need for accurate 'conversion factor' data for targeted and bycatch species.

Following these discussions, SC13 recommended that the WCPFC Scientific Services Provider (SPC) be tasked with:

a) designing and co-ordinating the systematic collection of representative length measurements for bycatch species; and
b) designing and co-ordinating the systematic collection of Length-Length (L:L), Length-Weight (L:W) and Weight-Weight (W:W) conversion factor data on all species.

These recommendations have shaped the design and evolution of tasks undertaken within Project 90 since its commencement in 2019. Williams and Smith (2018) detail the rationale behind Project 90, with the draft plan for the project documented in ANNEX 3 of that report, and the agreed plan documented in ANNEX 1 of the first-year progress report presented to SC15 (SPC-OFP 2019).

SC15 recommended that the SPC proceed to coordinate the activities proposed for Project 90 over the reporting period August 2019 to July 2020 as listed in ANNEX 2 of SPC-OFP (2019), and report on progress to SC16. Accordingly, Macdonald et al. (2020) [SC16/ST-IP-06] updated SC16 on Project 90 activities up until July 2020, with Macdonald et al. (2021) [SC17/ST-IP-05] providing the most recent annual update on project status to SC17.

Project 90 was not discussed substantively at SC16 and SC17, due to these meetings being held online as a result of COVID-19 related travel restrictions. However, we note that Project 90 was included in the *Online Discussion Forum* at both meetings, and is slated for inclusion again this year at SC18. This online forum was created to facilitate discussion on certain agenda items omitted from the abbreviated agenda but requiring acknowledgment by the SC for their progression. Comments received to date on these fora have been supportive of the project's continuation, with no objections raised.

This Information Paper provides an update on Project 90 activities over the 12 months to 23 July 2022, and outlines planned activities for the coming year.

2. PROJECT 90 WORK TO DATE

2.1 Overview

In summary, the key work conducted in Project 90 to date has included:

i) The establishment, refinement and regular updating of the CF database and associated tables, and the incorporation of new CFs as they are developed and/or published.
ii) Scoping and gap analysis to determine the priority areas for collecting CF data under Project 90.
iii) Engagement with CCMs regarding data requirements for generating accurate CFs.
iv) Development and refinement of a web-based tool for accessing SPC's CF database, available with login at: www.spc.int/ofp/preview/login.php?redirect=species_conv_factor.php.
v) Initiation and continuation of port sampling activities in the Philippines from late 2019 onwards, targeted towards the systematic collection of L:L, L:W and W:W CF data, biological samples and tag recovery information for key tuna species under *Activity 3.2* in Table A1 in Macdonald et al. (2021). This data has contributed importantly to the CF database for tropical tunas (i.e. skipjack, yellowfin, bigeye), augmenting other CF data collected across the region (including for albacore) (see Tables 1, 2, and 3).
vi) Purchase of a 'WPL Industries' motion-compensated scales to augment collection of gilled-and-gutted (GG) to whole weight (WW) CF data across the region.
vii) Continuation of the dialogue with the Solomon Islands Ministry of Fisheries and Marine Resources (MFMR) and the Solomon Islands National Observers programme (SBOB) established in 2021 in

response to a June 2021 request to SPC regarding alternative employment opportunities for Solomon Islands' observers unable to work due to COVID-19 related travel restrictions.

viii) Development of a new sampling plan to address the request outlined in **vii)**. The draft plan was circulated in 2021 and has evolved to include onboard-observer and port-based collection of GG:WW CF data and other biological samples for yellowfin and bigeye tuna in the Solomon Islands, targeting size classes captured by the domestic purse seine fleet. As of 15 July 2022, SPC has engaged an external contractor to undertake this work in collaboration with MFMR and SBOB. The contractor will be based initially in Noro and will commence work following the 6th Western Pacific tuna tagging cruise (WP6) that will take place between mid-September and mid-October 2022.

ix) Creation of processes and R code for the rapid exchange of length and weight data with WCPFC members and other international fisheries agencies through Letter(s) of Agreement (LOA), noting also the recent establishment of the WCPFC public domain size data (https://www.wcpfc.int/public-size-data).

x) Commencement in 2022 of a collaborative, comparative study of length measurements recorded by electronic monitoring systems (EM), onboard observers and port samplers for tunas and billfish captured by longliners in French Polynesia.

xi) Efforts to improve links between the data collected as part of Project 90 and other SPC-OFP projects.

2.2 In detail

i) - iv) Following the major updates and additions made to SPC's CF database entries during 2020 and 2021, work related to points **i) - iv)** over the past 12 months has focused on acquiring new data to improve existing conversion factors and developing training materials to enhance accuracy of length and weight measurements taken by observers onboard vessels and samplers working in port.

New data for improving CFs for tropical tunas has come primarily from the ongoing collaboration with SOCSKSARGEN Federation of Fishing & Allied Industries (SFFAII) and the Bureau of Fisheries and Aquatic Resources ministry (BFAR) in General Santos, Philippines [discussed further under point **v)** below]. Examples of new training materials include the publication of the updated Longline Observer Guide (2021) (Fukofuka et al. 2021) and Purse Seine Observer Guide (2021) (SPC-OFP 2021a), as well as the production of 17 video tutorials demonstrating best-practice biological sampling and data recording techniques on tunas, mahi mahi, wahoo and billfish, as well as how to maximise accuracy in length and weight measurements. This series of videos is designed for observers, fisheries officers, fishing captains, crew and port samplers, and as informative technical material for high school and university science students. The videos will soon be available for viewing on the Pacific Marine Specimen Bank website (www.spc.int/ofp/PacificSpecimenBank).

v) Port sampling activities continue in partnership with SFFAII and BFAR in the Philippines. Through the contributions of L:W, L:L and W:W measurements at General Santos Port in addition to other CF data collected across the region, as at 21 July 2022, we have now amassed a total of 37,710 CF measurements on skipjack, 26,099 measurements on yellowfin, 7,429 on bigeye, 340,479 on albacore (all L:W measurements, coming mostly from Fiji) and 2,816 measurements on other bycatch species over the past eight years (see Tables 1-3 for breakdowns by CF type). The opportunity to obtain L:L and L:W CFs on very small tunas (< 25 cm fork length) captured by the small-scale purse seine and ringnet fisheries, and W:W CFs from large, handline-caught yellowfin and bigeye, is unique to the Philippines, highlighting the importance of this continued collaboration.

Table 1. Numbers of individual fish Length-Length (L:L) CF measurements collected between 2019 and 2022, by species.

Number of L:L CF measurements					
Year	Skipjack	Yellowfin	Bigeye	Albacore	Others
2019	4	17	0	0	0
2020	0	2,192	431	0	0
2021	0	2,362	267	0	0
2022	0	843	60	0	0

Notes: where length is upper jaw to caudal fork (UF) and other CF length measurements have been taken.
Source: Port sampling.

Table 2. Numbers of individual fish Length-Weight (L:W) CF measurements collected between 2015 and 2022, by species.

Number of L:W CF measurements					
Year	Skipjack	Yellowfin	Bigeye	Albacore	Others
2015	44	5	10	27,678	158
2016	1,754	50	2	56,914	113
2017	5,379	5,750	4,976	48,333	55
2018	864	8	0	17,042	50
2019	3,593	317	50	78,735	1,003
2020	13,241	6,811	780	45,556	1,015
2021	10,571	4,621	598	55,570	325
2022	2,256	1,679	181	10,651	97

Notes: Where length is upper jaw to caudal fork (UF) and weight is whole weight only (WW).
Source: Port sampling.

Table 3. Numbers of individual fish Weight-Weight (W:W) CF measurements collected between 2019 and 2022, by species.

Number of W:W CF measurements					
Year	Skipjack	Yellowfin	Bigeye	Albacore	Others
2019	4	17	0	0	0
2020	0	20	0	0	0
2021	0	840	54	0	0
2022	0	567	20	0	0

Notes: Where weight is whole weight (WW) and other CF processed weights have been taken.
Source: Port sampling.

A new contract was recently signed between SPC and SFFAII in February 2022, ensuring the continuation of this important collaboration for the purposes of CF data collection (under Project 90), biological sample collection (under Project 35b), and tag recovery (under Project 42). Regarding the latter, this year's contract focusses on the following priority gaps in CF data for the key tropical tuna species:

- Weight-Weight CF data for large (i.e. > 70 cm UF) yellowfin and bigeye tuna. The primary focus is on adding to the GG:WW CF for these larger specimens.
- Length–Weight data for small yellowfin tuna < 20 cm UF, and small bigeye tuna < 30 cm UF.
- Length–Length conversion factor data for large (i.e. > 70 cm UF) yellowfin and bigeye tuna.

vi) To augment collection of GG:WW CF data across the broader region, SPC has recently purchased a set of motion-compensated scales for use onboard vessels. This addresses work scheduled under

Activity 3.2 iv) in the 2020-2021 work plan (see Table A1 in Macdonald et al. 2021). The scales arrived in Nouméa in late 2021, but were not calibrated correctly, and were subsequently sent back to the manufacturer for re-calibration. The scales arrived back in Nouméa in early July 2022. This calibration issue has delayed the planned 2021 trial of the scales aboard a New Caledonian-flagged longline vessel. This trial is now scheduled for late 2022.

Upon confirming the utility of these scales for this type of data collection, additional sets of scales will be purchased, and a data collection programme designed for regional roll out, possibly integrated with the national observer programmes. It is anticipated that such a programme could commence as soon as COVID-19 travel restrictions ease, with financial support coming from the Pacific-European Union Marine Partnership (PEUMP) programme.

vii-viii) In response to a June 2021 enquiry from the Solomon Islands MFMR and SBOB regarding the possibility of alternative work opportunities for Solomon Island fisheries observers, SPC, through WCPFC Project 90, drafted a sampling plan for at-sea and in-port collection of W:W CF measurements on yellowfin and bigeye. This proposal would facilitate placements and employment opportunities for fisheries observers, and concurrently extend the coverage of GG:WW CF data collection for large tunas outside the Philippines. Dialogue between SPC and MFMR/SBOB has continued into early 2022, and the sampling plan has evolved to reflect this. The current plan involves the collection of new GG:WW measurements and biological samples for yellowfin and bigeye onboard domestic purse seiners, and in Noro port. SPC will utilise an external consultant to work with MFMR/SBOB in-country to roll out the plan from mid-October 2022 onwards. The GG:WW measurements will target the largest size captured by the purse seine fleet classes (i.e. > 80 cm UF) to allow maximum transferability of the resulting GG:WW CFs to longline fisheries operating across the WCPO – for which this CF is most relevant and data are most urgently needed. An analysis by SPC has shown that sufficient yellowfin and bigeye in 80+ cm UF range exist in the catches to justify the consultancy (see Figure 1). For yellowfin, 4555 out of 26944 (i.e. ~17%) individuals measured were 80 cm UF or greater. For bigeye, 99 out of 334 (i.e. ~30%) individuals measured were 80 cm UF or greater.

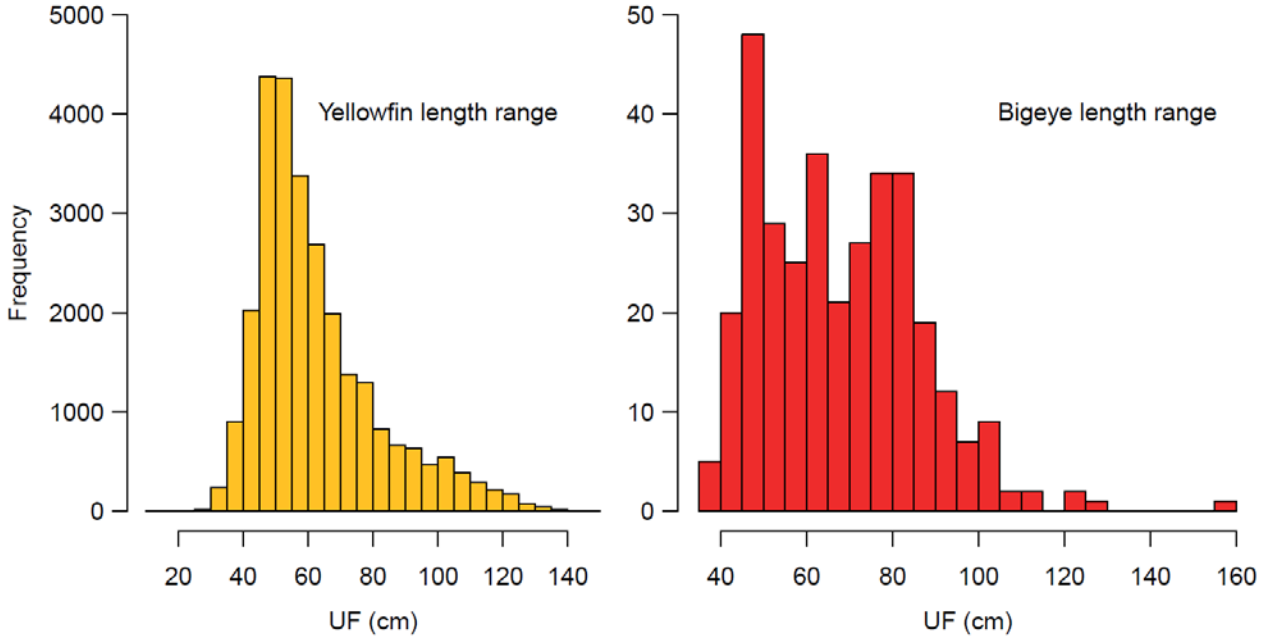

Figure 1. Length frequencies of yellowfin and bigeye captured and measured by observers onboard Solomon Island's purse seiners between 1 January 2020 and 19 March 2022.

ix) In January 2021, SPC and colleagues at the National Sun Yat-sen University, Chinese Taipei (NSYSU) entered into an agreement regarding an exchange of bigeye tuna length and weight measurements covering all SPC and Chinese Taipei data holdings across the subsequent collaboration on the statistical analyses of these data (see Macdonald et al. 2021 for details). A primary objective of this work was to explore

spatial and temporal variability in bigeye tuna growth parameters across the WCPO, thereby addressing a key recommendation of the 2020 bigeye tuna stock assessment (Ducharme-Barth et al. 2020). The data were successfully compiled and exchanged under a 'Letter of Agreement' arrangement between SPC and NSYSU. Although data analysis is still ongoing (as at 15 July 2022), it is envisaged that the results will have direct relevance for future regional stock assessments for bigeye tuna. Initial findings were presented at the WCPFC Pre-Assessment Workshop (PAW) in March 2021, and R code and a pipeline for data extraction and sharing among WCPFC members and external research agencies has been developed as part of this work. This pipeline is available from SPC upon request. This work is also relevant to the recent establishment of the WCPFC public domain size data (https://www.wcpfc.int/public-size-data).

x) An exciting new project commenced in late 2021 involving SPC, French Polynesia's Direction des Resources Marines (DRM) and The Nature Conservancy (TNC) (with Satlink/DOS as the Technical Service providers) to compare EM-based length measurements made on longline-caught tunas and billfish.

By way of background, the use of EM technology to record the activities of horizontal tuna longline vessels has been implemented in Pacific Island Countries and Territories since 2014. A key biological parameter which can be recorded by EM is the length of specimens caught and landed on deck. To date, length data generated from EM has not been used to inform stock assessments for WCPO fisheries as there are currently no formal standards for its use for that purpose. With increasing amounts of EM length data becoming available, and WCPFC members' requests to consider the use of EM length data for scientific analyses, there is a need to conduct specific research on EM length measurements to allow scientists to better understand and interpret the data.

In essence, the project involves a comparison of length measurements recorded by EM, onboard observers and port samplers on the same individual fish (see Hosken et al. 2022 for full details on the design). The project has gone through an extensive design and development phase and was officially launched in February and March 2022 on five domestic longline vessels operating in French Polynesian waters. The first observer and port sampling length data for the trip of the FV *Fetu Ura* on 8 to 28 March are now available, and here we present an initial analysis of 77 albacore captured during that trip and measured using both methods (see Figure 2).

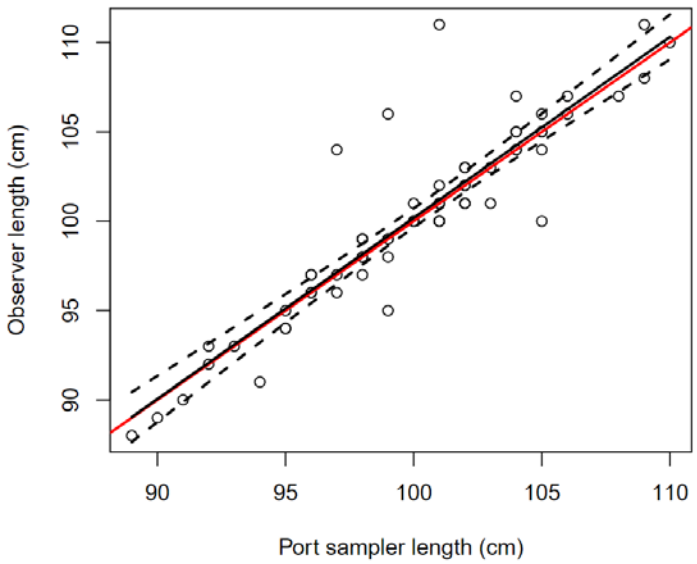

Figure 2. Comparison of fork length (UF) measurements (in cm) for 77 albacore measured by observers onboard FV *Fetu Ura* during its 8 to 28 March trip, and the same fish measured by port samplers after off-loading in Papeete Port.

The red line in Figure 2 represents the 1:1 line, which shows what would be expected if there was perfect agreement between observer and port sampler length measurements. The black solid line is the mean prediction from a linear regression fitted to the data, and the dotted lines are the 95% confidence intervals around it. We see a tendency towards slightly smaller port sampler measurements compared with observer measurements made on the same individual fish, and also a few outlying values with higher observer lengths compared to port sampler lengths.

We can use a *t*-test to see if the black linear regression line differs significantly from the red 1:1 line. This *t*-test returned a *p*-value of 0.824, indicating that the data do not deviate significantly from the 1:1 line. This indicates that measurements from observers and port samplers match fairly well, with no evidence of bias across the measured lengths.

We note that this analysis is only preliminary and will be expanded as more data filters in. It will be very interesting to see if the pattern observed in Figure 2 holds for the EM data for this trip, and if we see variation in the results across different trips, vessels, observers, port samplers and EM analysts.

xi) Over the past 12 months, we have attempted to forge stronger links between Project 90 and a range of SPC-OFP projects. These include:

- **a.** the work undertaken as part of the EM length measurement comparison, outlined in **x)** above;
- **b.** ongoing work on developing candidate ecosystem indicators for the WCPO (SPC-OFP 2021b) [SC17/EB-IP-09];
- **c.** biological data and sample collection for the WCPFC Pacific Marine Specimen Bank (PMSB) conducted as part of WCPFC Project 35b (SPC-OFP 2022a) [SC18/RP-35b-01];
- **d.** tag recovery activities undertaken as part of WCPFC Project 42 (SPC-OFP 2022b) [SC18/PTTP-01]; and
- **e.** publication of the new Longline Observer Guide (2021) (Fukofuka et al. 2021) and Purse Seine Observer Guide (2021) (SPC-OFP 2021a) which now include protocols for collecting length and weight measurements from individual fish. These measurements contribute directly to improving the accuracy and coverage of SPC's CF database.

3. SUMMARY AND WORK PLAN FOR 2022-2023

Whilst good progress has been made in relation to the CF work under Project 90 over the past 12 months, SPC notes that:

1. The population, updating and enhancement of the CF database is an ongoing priority.
2. Efforts to collect high-priority GG:WW CF data on yellowfin and bigeye will continue across the region through new initiatives in the Solomon Islands, and the continuation of the port sampling programme in General Santos under the new 2022 SFFAII contract.
3. Work will continue on the statistical analysis of the bigeye length and weight data in collaboration with NSYSU.
4. Work will continue on the analysis of data for the EM length comparison study in French Polynesia as new data come to hand.
5. The importance of accurate CF data was highlighted during discussions at the recent FAO Coordinating Working Party on Fisheries Statistics (CWP), and a suggestion was put forward of developing some global CF data standards. Work conducted to date within Project 90 for WCPO species was mentioned, and the other tuna RFMOs (particularly IOTC) were interested and had in fact started to undertake some similar work.
6. Developing a web-based tool for plotting CF relationships for selected species that links to SPC's CF database and is accessible on the WCPFC web site will form a new work item for 2022-2023.
7. Finally, we note that with COVID-19 restrictions gradually easing, opportunities for CF data collection through PICTs' national observer programmes are once again becoming available. Therefore, efforts to obtain CF data for target and bycatch species across the broadest possible spatial region will be a focus of Project 90 activities over the coming 12 months.

4. RECOMMENDATIONS

We invite SC18 to:

1. review and comment on the progress made on Project 90 activities at this stage; and
2. note that Project 90 has been selected for inclusion in the *Online Discussion Forum* at SC18, and SPC looks to that forum to table and enhance the priorities and activities proposed in this paper.

5. ACKNOWLEDGEMENTS

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