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

WCPFC-SC17-2021/ST-IP-05

J. Macdonald[1], P. Williams[1], C. Sanchez[1], E. Schneiter[1], S. Prasad[1], M. Ghergariu[1], M. Hosken[1], A. Panizza[1], T. Park[1], S.K. Chang[2], S. Nicol[1]

[1] Oceanic Fisheries Programme, Pacific Community (SPC), Nouméa, New Caledonia
[2] National Sun Yat-sen University, Kaohsiung City, Taiwan

1. BACKGROUND

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

Following these discussions, SC13 recommended that the WCPFC Scientific Services Provider 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.

In 2018, the Fifteenth Regular Session of the WCPFC approved Project 90 to be conducted over three years (2019-2021) (Anon. 2018). 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 Scientific Services Provider 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 occurring over the 12 months to July 2020, and set out the work plan for 2020-2021.

Project 90 was not discussed substantively at SC16, due to the online meeting format necessary under COVID-19 related travel restrictions. The project was, however, listed as Topic 5 on the *Online Discussion Forum*, which was created to facilitate discussion on certain agenda items omitted from the abbreviated agenda but requiring acknowledgment by SC16 for their progression. Two comments were received relating to Project 90. Both were in support of the project's continuation in 2021, with no objections raised.

This Information Paper provides an update on Project 90 activities over the 12 months to July 1 2021, and outlines planned activities for the next year of the project.

2. PROJECT 90 WORK TO DATE

2.1 Overview

Table A1 in ANNEX 1 reports progress on Project 90 up to July 1 2021. In summary, the key work conducted to date has involved:-

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) commencement 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 for key tuna species, under Activity 3.2 (see Table A1);
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) establishment of a dialogue with the Solomon Islands Ministry of Fisheries and Marine Resources (MFMR) and the Solomon Islands National Observers programme (SBOB) in response to a June 2021 request to SPC regarding alternative employment opportunities for Solomon Islands' observers currently unable to work due to ongoing travel restrictions;
viii) development of a new sampling plan to address the request outlined in vii). The draft plan involves onboard observer collection of GG:WW conversion factor data and other biological data on the Solomon Island domestic purse seine and longline fleets; and

ix) creation of processes and R code for the rapid exchange of length and weight data with WCPFC members and other international fisheries agencies.

Table A1 in ANNEX 1 also sets out what SPC aimed to achieve under Project 90 in the past 12 months (red text), and what of this has been achieved (underlined red text). Further, we outline work still to do during the next phase of the project (green text).

2.2 In detail

i) - iv) Since the 2020 update to SC16 [SC16-ST-IP-06], considerable progress has been made under Activities 1.2 and 1.5, with CF database tables updated, corrected and quality-checked (see Table A1). As flagged in the 2020 report, the 'range check' tables that define likely length and weight ranges per species, and detect outliers entered in the observer and logsheet data have been revisited, with the inclusion of new 'Reference' and 'Comments' fields.

v) Port sampling activities continued in the Philippines, in partnership with SOCSKSARGEN Federation of Fishing & Allied Industries (SFFAII) and the Bureau of Fisheries and Aquatic Resources ministry (BFAR). It is noteworthy that this work was able to proceed despite ongoing COVID-19 restrictions, and SFFAII/BFAR are to be commended for coordinating these sampling campaigns. Notably, a new contract was signed between SPC and SFFAII in January 2021, ensuring the continuation of this important collaboration on port sampling activities for the purposes of biological sample collection, tag recovery and conversion factor data collection.

Through this field work, collection of length and weight data for very small tunas continued, building on the dataset established in early 2020 (see Macdonald et al. 2020, and Activity 3.2 in Table A1). Length and weight data collection for larger (i.e. > 100 cm UF) yellowfin and bigeye tuna caught in the Philippines' handline and longline fisheries also continued this past year. Based on this data gathering effort, SPC has updated the region-specific L:W CFs (i.e. UF:WW) derived for small and larger skipjack, yellowfin and bigeye tunas, and the L:L CFs (i.e. SD:UF, PS:UF, PS:SD) derived for large yellowfin and bigeye.

From March 2021 onwards, and initiated through the new contract outlined in **v)**, SFAAII/BFAR began collecting high-priority, coupled GG and WW data from large yellowfin and bigeye (n = 351 and n = 17, respectively, to July 19 2021), together with further US and UF length measurements (i.e. US = from upper jaw (or snout or nose) to anterior base of 2nd dorsal fin; UF = upper jaw to fork in tail). Given the paucity of data available on these measurements across the region, this new information represents a major contribution to the CF database. As data accumulates over the coming 12 months, the CF equations for GG:WW and US:UF for yellowfin and bigeye tuna will be updated and reported to SC18. These CFs are key inputs into the tuna stock assessment models, and increasing the sample sizes for these relationships is critical in building confidence in their use within the assessments.

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). A trial of the scales aboard a New Caledonian-flagged longline vessel is planned over the coming months. Upon confirming the utility of these scales for this type of data collection, additional sets 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) Further, in response to a June 2021 enquiry from the Solomon Islands MFMR regarding the possibility of alternative work opportunities for Solomon Island fisheries observers, SPC, through WCPFC Project 90, has drafted an initial sampling plan for at-sea collection of GG and WW measurements on yellowfin and bigeye. This proposal would facilitate placements and employment opportunities for fisheries observers currently stranded on land, and concurrently extend the coverage of GG:WW CF data collection outside the Philippines. SPC believes that the Solomon Islands, in particular the domestic purse seine fleet operating out of Noro, may be ideally placed to trial this approach. This proposal has been positively received by SBOB, and SPC is in the process of contacting the fishing industry regarding the feasibility of conducting a trial.

ix) In January 2021, SPC and colleagues at the National Sun Yat-sen University, Taiwan (NSYSU) entered into an agreement regarding an exchange of bigeye tuna length and weight measurements covering all SPC and Taiwanese data holdings across the Western and Central Pacific Ocean (WCPO), and subsequent collaboration on the statistical analyses of these data (see Figure 1).

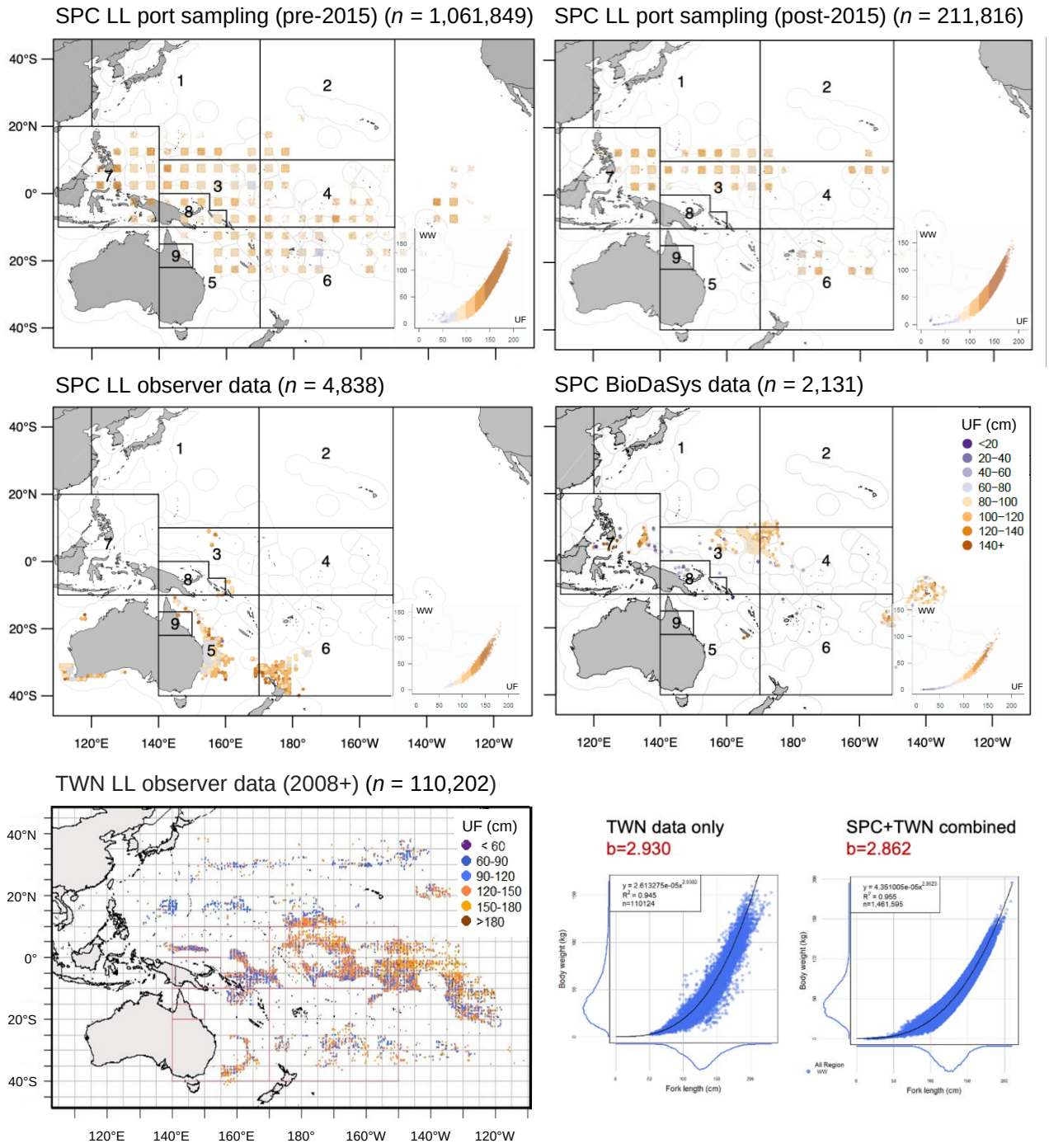

Figure 1. Spatial coverage of bigeye fork length (UF) (cm) and whole weight (WW) (kg) records from SPC and Taiwanese (TWN) data sources compiled in the data exchange between SPC and NSYSU. Shown are longline (LL) records from SPC port sampling and observer collections, records from bigeye processed for biological samples, as recorded in SPC's 'BioDaSys' database, and records from Taiwanese observers from 2008 onwards. Actual or inferred location of capture are shown, colour coded by length bin. Variation in derived length-weight relationships for TWN data only, and for all SPC and TWN data combined are shown at bottom-right.

A primary objective of this work is 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), as noted in the Summary Report for SC16: "Further biological samples should also be collected to produce more representative samples of reproductive parameters and length-weight and weight-weight conversion factors." The data were successfully compiled and exchanged under a 'Letter of Agreement' arrangement between SPC and NSYSU, and it is envisaged that the results of the analyses 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 this work continues.

3. SUMMARY AND WORK PLAN FOR 2021-2022

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

1. the population and enhancement of the CF database is ongoing, with activities outlined in Table A1 (in underlined green text) the focus over the coming 12 months;
2. work on enhancing the data, including the addition of new CFs as they are calculated/published and further detail on the sources of information for CF entries will continue in the coming year, in conjunction with ongoing quality control activities. These includes the refinement of a 'confidence' score for assessing the reliability of each CF;
3. efforts to collect high-priority GG:WW conversion factor data on yellowfin and bigeye will continue across the region through a variety of existing and new initiatives, as detailed in section 2.2. As data accumulates over the coming 12 months, the GG:WW and US:UF equations for these tunas will be updated and reported to SC18;
4. work will continue on the statistical analysis of the bigeye length and weight data in collaboration with NSYSU, with results reported to SC18.
5. Finally, we note that the ongoing COVID-19 situation has hampered broader plans for CF data collection through several Pacific Islands national observer programmes, and we hope that these initiatives can proceed as soon as COVID-19 travel restrictions ease.

4. RECOMMENDATIONS

1. SC17 is invited to review and comment on the progress made on Project 90 activities at this stage.
2. SPC notes that Project 90 has been selected as a topic for discussion in the online forum in the lead up to SC17, and we look to this forum to table and enhance the priorities and activities proposed in Table A1, and Sections 2 and 3 above.

5. REFERENCES

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ANNEX 1 –Project 90 progress to July 1 2021

Table A1. Breakdown by activity and current status

Black text details ongoing priorities. Red text details what SPC set out to achieve in the 12 months since SC16, what of this has been achieved to date (underlined red text), and how this has (or has not) been achieved (*italicized red text*). Other new work completed is shown in green text, and work anticipated over the coming 12 months in underlined green text.

Activity #	Activity description	Progress to July 1 2021
1.1	Identify the priority gaps in conversion factor data for the WCPFC key tuna species, key shark species, and key billfish species	i. Length–Weight (UF:WW) data for oceanic tunas less than 30 cm. ii. Weight–Weight (WF:WW) for adult yellowfin and bigeye tuna to provide a better understanding in weight loss between fresh/ice and (flash) frozen tuna. iii. Length–Length conversion factor data for adult yellowfin and bigeye tuna from the longline or handline fisheries (to obtain conversion factors that could be applied to frozen fish without tails). iv. The following conversion factor data to be collected from WCPFC key shark species, where relevant:- o Length–Weight (at least, obtaining UF:WW and TL:WW of individual shark); o Length–Length measurements (combinations of UF, TL, SD and PC of individual shark); o Weight–Weight measurements (where possible and with permission, at least WW:TT, WW:FN). v. The following shark species/fishery combination are to be targeted for data collection: o Blue shark in the longline fishery; o Silky shark in the purse seine fishery (only dead individuals can be sampled before they are discarded); o Oceanic whitetip shark in the purse seine fishery (only dead individuals can be sampled before they are discarded); o Mako shark (at species level) in the longline fishery; o Thresher shark (at species level) in the longline fishery; o Hammerhead shark (at species level) in the longline fishery; o Whale shark : Length–Length (PD:TL; PD:UF; only dead individuals noting 'best handling practices' should avoid mortalities; also, the challenges in obtaining measurements of large individuals will require some innovative thought (e.g. the potential for observers using laser measurement devices). Length–Weight conversion factors for whale shark are very important, but considered unrealistic at this stage. This goal was carried over from 2020-21, but minimal progress made due to low observer coverage. vi. For billfish species, Length–Length and Length–Weight conversion factor data for south Pacific swordfish and striped marlin (broken down by sex) have been identified as priorities, noting that conversion factor data for other billfish species will be collected as the opportunity arises.
1.2	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	i. The conversion factor (CF) database has been established, and some of the available conversion factor data entered (e.g. data compiled and presented in Clarke et al. 2015). ii. A web-based system to enter CF data has been established and an online portal for viewing and disseminating conversion factor data has been established and quality checked, with new features added to extract Length : Weight relationships for target species (see: www.spc.int/ofp/preview/login.php?redirect=species_conv_factor.php). iii. Update, refine, populate and quality check the CF database, including conducting a gap analysis. Further work is planned over the coming months to resolve the gaps in 'Source', '*n*', 'r^2', and 'Comments' fields of current records. Refinement of a 'confidence' score for assessing the reliability of each CF is scheduled as part of this work. iv. Further conversion factor information to be added, as it becomes available from data collection through Project 90, or submitted to the WCPFC.

		SPC recommends that purse seine observers should now attempt to collect BP measurements for whale sharks where practicable. *This has not been possible given the low observer coverage in place over the past 12 months.*
1.3	Produce a list of species of special interest (SSIs, excluding key shark species) that require conversion factor data	i. The following conversion factor data to be collected from the SSIs (excluding key shark species) where possible:- o Manta/Mobulids : Length–Weight (TW:WW; only dead individuals noting 'best handling practices' should avoid mortalities; also, the challenges in weighing/measuring large individuals will require some thought). o Marine mammals : Length–Length (CF measurements to be determined; only dead individuals noting 'best handling practices' should avoid mortalities; also, the challenges in obtaining measurements of large individuals will require some innovative thought (e.g. the potential for observers using laser measurement devices). Length–Weight conversion factors for marine mammals are very important, but considered unrealistic at this stage. *Discussion has continued on avenues for obtaining these measurements; however, no implementation has occurred in the past 12 months.* ii. No other priorities proposed at this stage, acknowledging that compiling interactions in numbers is generally preferred, and the weights of most non-shark SSIs are rarely required.
1.4	Produce a list of commercially important bycatch species (not covered in the items above)	i. The following conversion factor data to be collected from mahi mahi, wahoo and opah in the longline fishery, as the initial priority:- o Length–Weight: (UF:WW); o Weight–Weight: (GG:WW; GX:WW; FW:WW); o Length–Length: (UF:PF).
1.5	Include more information on source of data for each conversion factor (e.g. reference of study, sample size, R^2, minimum/maximum size of sample, etc.) in tables of conversion factors, which will inform the need for more data collection.	i. The conversion factor database has been established. ii. As also mentioned under Activity 1.2 iii), continual refinement of the CF tables is considered high priority. A contractor is currently being sought to help address work under this activity, and we hope to have made substantive improvements to these fields by mid-2022. These improvements will be reported to SC18.
1.6	Produce a list of the remaining bycatch species that require conversion factor data.	i. Length–Weight (UF:WW, TL:WW) for common bycatch that are typically discarded at sea, or are kept for crew consumption (but not generally commercially viable), including: barracuda species, lancetfish species, pomfret species.
1.7	Produce standard protocols for conversion factor data collection to be collected by observers and port samplers.	i. The protocols and conversion factor data collection forms exist for observers, but have yet to be reviewed and updated to cater for the data collection requirements under Project 90 Activities 1.1 through 1.6. ii. The protocols and conversion factor data collection forms for port samplers have yet to be designed and established. *Both sets of forms described in i) and ii) have now been designed, reviewed and updated.*
2.1	Explore the use of EM tools to capture multiple length measurements from fish e-measured by EM Analysts.	i. One CCM currently generating data from an E-Monitoring (EM) system has been informally approached to collect Length–Length conversion factor data (using the EM digital measuring tool) from bigeye and yellowfin tuna to compare with existing conversion factor formulae for these species. ii. This work will inform the feasibility of EM to collect certain Length–Length conversion factor data for other species. *Further discussions have taken place with other CCMs, but no formal trials have taken place to date.* This is an area of active research in the Oceanic Fisheries Programme and we expect progress in the coming 12 months.
3.1	Systematically collect representative samples of length measurements of bycatch species to support future estimation of catches in the WCPO	i. This activity is currently undertaken through observers, although it acknowledges the potential of EM to augment the available observer size data for bycatch species, particularly large individuals and live key shark species, which are difficult to measure. The EM trials outlined for Activity 2.1 will feed into this.
3.2	Systematically collect Length–Length, Length–Weight and Weight–Weight conversion factor data of WCPFC key species and other species (non-shark SSIs and other bycatch species) to better inform future estimation of catches in the WCPO.	i. The collection of conversion factor data is included as an activity on SPC-led tagging cruises. ii. The following monitoring areas have been identified for conversion factor data collection in the first instance:- o A port with unloadings of both small oceanic tuna and large yellowfin tuna (for Activities 1.1–i and 1.1–iii); *See below with regard to the collaboration with SFFAII.*

		○ Longline fisheries with observer coverage in three Pacific Island countries (for Activities 1.1–ii through 1.1–vi which are relevant to the longline fishery; Activity 1.4); ○ Purse seine fisheries with observer coverage in three Pacific Island countries (for Activities 1.1–iv through 1.1–v, which are relevant to the purse seine fishery; Activity 1.3). iii. Initial informal discussions have occurred with the relevant CCMs, but formal arrangements are not yet established. *The long-running collaboration on port sampling, tag recovery and CF data collection between SPC, SOCSKSARGEN Federation of Fishing & Allied Industries (SFFAII) and the Bureau of Fisheries and Aquatic Resources ministry (BFAR) in the Philippines continue. Since March 2021, a new contract between the parties is now resulting in the collection of high priority GG:WW and US:UF data for yellowfin and bigeye landed in General Santos.* We envisage that this work will continue this year in the face of ongoing COVID-19 related restrictions, ultimately leading to sufficient data to help derive reliable CFs to support SPC's tuna stock assessments. iv. The selection and testing of suitable equipment (e.g. motion compensating scales, where required) has yet to be undertaken. *The abovementioned scales were successfully trialed during the 2019 WP5 tagging cruise though FSM, and are currently housed in Noro, Solomon Islands.* In response to a recent (i.e. June 2021) request from the Solomon Islands MFMR regarding alternative work options for fisheries observers, SPC has drafted up a sampling plan (centring on the Solomon Islands domestic purse seine and longline fleets) that will make use of these motion compensating scales to expand the collection of GG:WW data to different size classes of yellowfin and bigeye, and outside Philippines' waters. After receiving in principal support from SBOB, SPC is currently in the process of contacting the fishery industry to assess the feasibility of the plan. Furthermore, SPC has now procured a new motion compensating scale, soon to be housed at SPC headquarters, Nouméa, Once arrived and deployed, this will facilitate better engagement of local fishing companies in Project 90 activities, for example, through the further expansion of valuable GG:WW CF data collection programme to longline-caught yellowfin and albacore tunas in New Caledonian waters. v. Anticipate expanding the collection of conversion factor data, once a review of any issues/constraints with the initial data collection has been completed (i.e. in late 2020). *This is occurring where possible throughout the WCPO, with a current focus on the Philippines.* vi. Pursue the potential for EM to obtain conversion factor data. *This is occurring. See Activity 2.1 above.* vii. Continue the collection of new length – weight, length – length and weight - weight data on key tropical tunas derived from port sampling in the Philippines. Sampling targets: ○ small (i.e. < 40 cm UF) skipjack, yellowfin and bigeye tuna captured in ring net and/or manually-hauled purse seine sets; and ○ large (i.e. > 100 cm UF) yellowfin and bigeye captured by the handline fishery.