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Report of the Pacific Tuna Tagging Programme Steering Committee

WCPFC-SC15-2019/RP-PTTP-01

PTTP Steering Committee

Preliminaries

Background

The Pacific Tuna Tagging Programme (PTTP) is a joint research project being implemented by the Oceanic Fisheries Programme (OFP) of the Pacific Community (SPC). The goal of the PTTP is to improve stock assessment and management of skipjack, yellowfin and bigeye tuna in the Pacific Ocean. The objectives of the PTTP, originally specified in WCPFC Regional Tagging Project Steering Committee (2006) were revised in 2016 (PTTP Steering Committee, 2016) and are:

1. To obtain data that will contribute to, and reduce uncertainty in, WCPO tuna stock assessments including estimation of overall and local exploitation rates, extent of mixing and appropriate spatial strata for use in assessments.
2. To obtain information to better understand the interactions between tropical tuna species and major fishing gears to support development of mitigation measures (where appropriate) and better interpret fisheries data (e.g., CPUE).

Under these objectives, information collected includes age-specific rates of movement and mixing, movement between this region and other adjacent regions of the Pacific basin, species-specific vertical habitat utilisation by tunas, and the impacts of FADs on behaviour.

The PTTP Steering Committee was established by SC2 to provide guidance and oversight in the development of firstly the project document (WCPFC Regional Tagging Project Steering Committee, 2006) and subsequently of operational plans, implementation and analytical work. The 13th meeting of the PTTP Steering Committee was held at the 15th Regular Meeting of the WCPFC Scientific Committee, Pohnpei, FSM on 13th August 2019. The current donors to the project are the European Union, the Republic of Korea, the Pacific Community (SPC), the WCPFC and ISSF.

Review and adoption of agenda

The provisional agenda was adopted.

PTTP Progress Report (SC15-RP-PTTP-02)

Since SC14, PTTP activities have included one Central Pacific voyage, CP13, in the waters of Marshall Islands, FSM, Nauru, Tuvalu and the nearby International Waters, continued implementation and refinement of tag recovery processes and tag seeding, data preparation for use in the 2019 stock assessment for skipjack tuna, and analysis of electronic tagging data for an EU funded WCPFC project (Scutt Phillips et al. 2019). Research voyage WP5 preparations began in late 2018 and the vessel departed Noro, Solomon Islands, 22nd July 2019.

Research voyages

CP13 focussed on data collection for studies on tuna movements, exploitation rates and FAD association dynamics. To improve coverage of bigeye tuna tagging data from the west part of the WCPO (west of the 180 meridian), the study area covered the 165E and 180 TAO mooring lines and nearby waters. The Hawaii-based FV Gutsy Lady 4 was chartered by SPC, and left Majuro on the 16th of July for a total duration of 39 days. The European Union and the WCPFC jointly funded the cruise. TriMarine also supported the

cruise by providing positions of drifting FADs in the neighbourhood of the cruise. IRD/Marbec research unit and ISSF also contributed to the cruise in providing scientific personnel.

In addition to routine archival and conventional tag release activities, acoustic tagging experiments were also undertaken during the CP13 cruise as part of an EU-funded project on juvenile bigeye and yellowfin tuna bycatch mitigation. Eight drifting FADs were equipped with VR4 Global (Vemco, Amirix, Canada) satellite linked acoustic receivers. Pressure sensitive acoustic tags (V13P) were implanted in the three major tuna species with a priority for bigeye to collect information on vertical behaviour of tuna at dFADs, improve interpretation of echo sounder buoy data, and examine the residency of tuna at dFADs and species-specific vulnerability. Table 1 summarizes the number of fish tagged per species and tag type.

Table 1: Numbers of tags deployed by tag type and species

Tag type	FAL	OCS	BET	SKJ	YFT	TOTAL
Archival			53	-	51	**104**
Archival and sonic tag			11	-	15	**26**
Acoustic depth tag			97	14	42	**153**
Yellow conventional			450	65	335	**850**
MiniPat satellite tag	9	5			1	**15**
Total fish tagged	**9**	**5**	**611**	**79**	**444**	**1148**

Tag recoveries

The release numbers and recovery percentages to date of conventional and archival tags made during the 13 Central Pacific (CP) voyages, the PNGTP, and Phase 1 and 2 of the PTTP are detailed in Table 2.

Table 2: CP, PNGTP and total PTTP tag release numbers, and % of recoveries to date (July 2019) of conventional and archival tags.

		Release numbers				Recapture rate (%)			
Project	**Tag Type**	**SKJ**	**YFT**	**BET**	**Total**	**SKJ**	**YFT**	**BET**	**Total**
CP	Archival	32	323	808	**1,163**	0	6.2	18.8	**14.8**
	Conventional	841	2,913	39,086	**42,840**	4.2	12.7	28.5	**26.9**
PNGTP	Archival	0	68	12	**80**	NA	27.9	58.3	**32.5**
	Conventional	80,444	27,065	2,915	**110,424**	20.3	18.6	21.3	**19.9**
Total PTTP	Archival	129	738	996	**1,863**	3.1	11	18.8	**14.6**
	Conventional	272,511	109,551	48,438	**430,500**	17.6	16.7	27	**18.4**

As at 21 June 2019, a total of 79,625 tagged tuna had been recaptured and the data reported to SPC. There is a notable reduction in bigeye conventional tag recovery rate from CP9 onwards. These changes from ~30+% up to voyage CP8, fall to 14% for CP9, between 3 to 16% for CP10 to CP12, and currently only 2.1% for last year's CP13 cruise. From CP10 to CP13 there are significant changes in the distribution of tag releases and subsequent fishing activity which may explain the differences in recapture rates. During these voyages, release methods changed with 45 to 95% of releases made on dFADs, as opposed to 100% at TAO buoys, as in previous voyages. This has also changed the species composition of tag releases, with fewer bigeye being tagged on dFADs compared to tagging on TAO buoys. It may be that fish have more

time and a greater propensity to disperse from dFADs before fishing recommenced following the FAD closure period, thus reducing the tag recapture rate.

Delays in obtaining recovery information for WP4 tags, reported as recovered but not returned to SPC, have caused significant issues incorporating tagging data into the 2019 stock assessment for WCPO skipjack. While some delays are inevitable, it highlights the importance of an efficient tag recovery system that promptly reports tags for timely inclusion in stock assessments and other analyses.

Across the WCPO, many previously full-time Tag Recovery Officers (TROs) have now taken on other duties at their respective local fisheries agencies. Following the signing of a MoU between PNG NFA and SPC, new TROs have now been appointed in Lae and Port Moresby. From July 2018 to July 2019, 252 tags were recovered by NFA and rewards were paid. New grant agreements have been signed with MIMRA, with five contracts for TROs renewed. Negotiations with Kiribati MFMRD to re-establish a full time TRO position in Tarawa are still in progress. Negotiation with MFMR to sign a new Grant agreement for the Noro office, Solomon Islands is also in progress, as well as the recruitment of a full time TRO in the Philippines.

Increased tagging programme awareness raising efforts prior to and at the end of research voyages have been undertaken, including the PIRFO website aimed at observers. The messaging application "Slack" has been recently introduced to enhance the TROs network, allowing rapid exchanges of information between the officers, feedback on tag recovery information, and any issues encountered with the TROtag Database. The TROtag manual was updated and tutorial videos were developed to provide training on how to enter tag information in the database, alongside the use of "Slack" as a means of information sharing.

SPC receives recovery information from TROs on a semester basis. The establishment of new TRO positions has provided greater opportunity for collection of tags during unloading, transhipments and processing in canneries, with more complete and reliable capture information. Major unloading and processing facilities, as well as transhipping vessels in port, have been visited by TROs over the last 12 months, except for Tarawa, where TRO positions have not yet been re-established. SPC staff continue to enter tag recovery information into TagDager and undertaking the necessary validation processes.

In order to retrieve whole tagged fish released with strontium chloride or with an archival tag, a new reward system has been developed. On board purse seine vessels, observers are rewarded USD 50 to place the fish aside, to keep the fish frozen at all times, to coordinate the collection of biological samples onshore and to collect associated data. On-board longline vessel tagged fish are now purchased whole at a rate of USD 10 /kg. New Posters were created during early 2019 to disseminate this information, and are currently under translation for circulation across the tag recovery network.

Biological sampling during tagging voyages

The PTTP continues to collect biological samples as part of long-term projects to characterize tuna biology and ecology, and trophic status of the WCPO pelagic ecosystem. A total of 6478 stomach samples have been collected since the beginning of the PTTP, mainly from skipjack, yellowfin, bigeye and albacore tuna, including samples from 223 fish (primarily bigeye and yellowfin) obtained during CP13.

Additionally, the tagging research voyages provide a large volume of biological samples for the WCPFC Tuna Tissue Bank (total of 22,750 samples to date). A total of 8,076 fish have been sampled from which 7,868 samples have been analysed to date. For the WCPFC Tuna Tissue Bank as a whole, these tagging research voyage samples represent 25.7% of the total fish sampled, 25.7 % of the total samples collected,

and 32 % of the analyses processed from the tissue bank. Tagging research voyages continue to provide a key contribution to the WCPFC Tuna Tissue Bank and add to the value of the cruises (SPC-OFP, 2017).

Tag database and data capture improvements

Along with the tagging website (www.spc.int/tagging), there is a new dedicated web application (The Web Tagging Data System) allowing access to the tagging database (TagDager) which helps to verify and process new tagging data (http://www.spc.int/tagging/webtagging). Note this is only available to approved and authorised users. The purpose of the web tagging data system is to:

- identify fake recoveries: e.g. lost tags, tags used for training or publicity, or tags already recovered;
- access release information (vessel, release date, latitude & longitude of release, species, length);
- help to validate "date found";
- estimate "date caught" when date found is only provided;
- search release information relative to tags seeded;
- provide full access to the TagDager DB from any authorised users connected to the web; and
- visualisations & data access to CP13 sonic tagging data, available on the SPC webtagging site.

These improvements will assist tag quality and significantly reduce the risk of attempted tag reward fraud. The TROtag database used by the Regional TROs has been enhanced with additional financial components, and allows better traceability of payment and faster financial reconciliation. Furthermore, a beta version of a mobile tuna tagging application to facilitate the collection of information by TROs has now been developed. Although not complete, the framework for linking directly to SPC tag recovery coordinators and the TagDager database is in place, including the ability to upload images of physical tags. Continued development is anticipated, before an eventual roll-out to selected TROs for trial.

Tag seeding

To date nearly 55% of seeded tags have been returned to SPC. In addition to allowing estimation of tag reporting rates, tag seeding data also allow the error rate in tag return information to be determined (see Peatman et al., 2016). From February 2007 to July 2019, a total of 572 tag seeding kits (seeding tags, applicators, guide books and data forms) for a total of 14,335 tags have been given to observer coordinators and TROs in Tonga, Ecuador, PNG, Solomon Islands, Fiji, FSM, Marshall Islands, Kiribati, New Zealand and American Samoa for deployment on purse seine vessels by senior observers. Trials with both steel head and plastic barb tags to test the effect of tag type showed no significant effect of tag type in seeding experiments. The use of steel head tags for tag seeding has now been discontinued and those tags will continue to be used until depleted. This will ensure consistency with conventional tag types used throughout the PTTP, and may reduce the chances of tag seeding experiments being compromised.

To aid in the implementation of tag seeding experiments, training is provided as part of the PIRFO observer upgrade training courses. Tag Recovery Officers in the ports of Pohnpei, Honiara, Rabaul, Madang, Pago Pago, Port Moresby and Majuro continue to liaise closely with observer coordinators, observer debriefers and observers to implement tag seeding experiments and to recover the tag seeding logs for deployed kits. Tag seeding debriefing materials are used by both TROs and local debriefers. Of the 572 kits distributed to observer coordinators, 429 have been given to observers for deployment, of which 358 tag seeding datasheets have been received for observer trips.

The accurate reporting of vessel name is particularly important for validation of location and time of recapture using VMS and log book data. Vessel name was reported incorrectly for 806 tags, was absent from the recovery information for 145 tags, and was correct for 3110 tags.

Tag data analyses

Data from tag seeding experiments have been used to estimate prior distributions for reporting rates for use in MULTIFAN-CL assessments of tuna stocks in the Western Central Pacific Ocean. These prior distributions are used to minimise bias in assessments resulting from the non-reporting (or detection) of tag recoveries, and as such are a critical input to the MULTIFAN-CL models.

Reporting rate (RR) prior parameters have been updated for the 2019 skipjack assessment (Peatman et al., 2019 SC15-SA-IP-06). The approach to calculating the prior parameters has been revised, with substantial increases in penalty parameters. A significant reduction in tag reporting was detected for tag seeding experiments in 2015. However, it is difficult to explore this in detail given the relatively low numbers of seeding experiments in recent years. In this context, a power analysis was undertaken to explore the number of seeding experiments required to detect step-changes in reporting rates, and provide guidance on the number of tag seeding experiments moving forwards. Current levels of tag seeding are insufficient to allow detection of modest increases or reductions in tag reporting rates (+ /- 15 %) within three years. Increasing the number of seeding experiments, and improving the coverage of fleets, will be essential if tag seeding experiments are to be an effective component of the PTTP in future.

The Ikamoana tag simulation tool (Scutt Phillips et al. 2018) was used to examine potential movement of tagged skipjack tuna from two locations near to planned releases during this year's upcoming WP5 trip. Simulated tag releases were undertaken using behavioural forcing from SEAPODYM (Senina et al. 2016), under historical environmental and fishing effort scenarios, assuming releases of 40cm fork length skipjack during September 2012 (an ENSO neutral period). Following simulation results, additional tag recovery effort is planned in the Philippines to increase recovery rates around the maritime continent area.

Since SC14, two albacore tags have been reported after being washed ashore in New Zealand. This increases the total reported tags, but not the number of informative recoveries, which remain at 31 (1%) for the project. Following a recovery in New Caledonia during 2017, the reward for white tags from albacore tuna tagged with oxytetracycline has been increased to US$250, and conventional tags to $US20, for recoveries in New Caledonia and French Polynesia.

The CP13 cruise also involved extensive tagging of fish using acoustic telemetry 'sonic' tags. These fish were released at drifting FADs equipped with acoustic receivers as part of the WCPFC EU funded project WCPFC Mitigating bycatch of bigeye tuna and yellowfin tuna juveniles by purse seine fisheries. These tag releases provided very high quality presence and depth data, whenever fish are in the presence of the acoustic receiver through which data are transmitted. Further details are provided in Scutt Phillips et al. (2019, SC15-EB-WP-08). Fish detected at a second receiver, following their initial association with the FAD of release, may be considered as fishery-independent mark-recapture data. Larger scale adoption of these experiments could provide mark-recapture type data for estimating mortality rates and movement.

A number of fish tagged with both archival and sonic tags were released during CP13 as part of the WCPFC EU funded project Mitigating bycatch of bigeye tuna and yellowfin tuna juveniles by purse seine fisheries. Four archival tags have been recaptured and returned from this project already, of which two of those are from double-tagged bigeye tuna. These data allow examination of fine-scale vertical behaviour throughout time-at-liberty, accurate times and positions of fish whilst associating with sonic receivers, and estimates of horizontal movement from light-based geolocation which can be constrained using these known periods of association (Scutt Phillips et al. 2019, SC15-EB-WP-08).

Two double tagged bigeye tuna were recaptured following CP13, one released at 89cm FL (AgTag) and the other at 72cm FL (AuTag). Both fish associated with their FAD of release, for 11 and 7 days, respectively, as confirmed by detections from the attached sonic receiver. Both fish were then at liberty for 3 and 4 months respectively, with AgTag briefly passing a second sonic receiver attached to another FAD in the

area, before being recaptured. Horizontal geolocation estimates were calculated using Wildlife Computers GPE3 algorithm, and overlaid with the known positions of each individual fish while associating with receiver equipped FADs. In both cases, geolocation algorithms failed to capture any of the known horizontal movements from the sonic tag confirmed positions while fish associated with receiver equipped FADs, highlighting the challenges of light-based geolocation for tropical tunas in equatorial waters. The fish showed sustained departures from the drifting FAD of release, typically followed by a return in the second half of the night or just before dawn. Both fish also exhibited a slow disassociation with their FADs of release, with day- and night-time departures becoming longer over a period of 3-4 days, though fish always returned before dawn, before permanent abandonment of the FAD (SC15-EB-WP-08).

2019-2022 Work Plan

Issues arising from 2018-19

The PTTP continues to be a highly successful programme and with the significant commitment from the Commission to ongoing funding, the successful CP13 and the WP5 voyage now underway, this programme, already recognised as an ongoing high priority, is a real strength of WCPFC's science for the medium term. However, there remain significant issues facing the success of any tuna tagging research programme in the region.

1. The ongoing difficulty in maintaining an effective tag recovery network remains apparent, which has had implications for this year's WCPO skipjack tuna stock assessment (SC15-SA-WP-05). This reinforces the need to improve and maintain an effective recovery network, despite the introduction of other responsibilities, such as biological sample collection, for TROs across the region.
2. The past year continued the trend of low numbers of tag seeding kit deployments for observers. As highlighted by an information paper on tag seeding analyses (SC15-SA-IP-06), the current levels of deployments are far below those required to likely detect changes in reporting rate. Furthermore, tag seeding analyses suggest reduced reporting of conventional tags in recent years, although this is uncertain due to the recent drop in tag seeding experiments.
3. Providing external validation of movement estimates from within MULTIFAN-CL and SEAPODYM remains difficult. Continued tag-related analyses and development of tools such as the Ikamoana tuna movement simulator provide a framework to examine the effects of mixing and movement, and optimise future tagging voyages.
4. A strong case for identifying a long-term multi-purpose tagging platform in the WCPO remains. Integrating WCPFC biological sampling and other tuna ecosystem research into the design, areas of research that face the same cost pressures, makes the case even stronger. Investigations have continued in 2019, with direct support from New Zealand, and a feasibility study will be advertised in order to provide expert advice on the operations, cost and procurement of such a vessel. Issues of increasing charter costs of commercial vessels, alongside a decreasing number of appropriate platforms, continues to make this a critical concern.

Work plan

The proposed PTTP work plan for the period 2019-2022 was discussed by the PTTP SC and is set out in Table 1. The 2019 work-plan is well advanced, including successful negotiations around access to a pole and line vessel for WP5. The work-plan recognises the decisions of SC in 2016 to normalise the tagging programme (WCPFC SC, 2017), the decisions of SC in 2017 where this rolling medium-term research work-plan was endorsed (WCPFC-SC 2017) and the decisions of SC in 2018 to normalise the tagging research plan as part of the ongoing high priority science work of WCPFC (WCPFC SC, 2018).

Table 1: Indicative PTTP workplan for the period 2019-2022.

ACTIVITIES		2019	2020	2021	2022
TAGGING					
1.	**Pole and line tagging research voyage** Target is skipjack, with secondary target of yellowfin. Following SC recommendations to implement a skipjack tagging experiment every second year, a pole and line research voyage is scheduled for 2019 and biennially thereafter. Note also critical component of biological sampling in support of Project 35b.	A charter arrangement has been concluded with NFD for use of the Soltai 105 Pole & Line vessel to implement 62-day WP5 research voyage		Plans to be refined after assessing viable available options	
2.	**Dangler/troll tagging research voyage** Target is bigeye, with secondary target of yellowfin. Following SC12 recommendation to implement a bigeye tagging experiment every second year, a dangler/troll experiment is scheduled for 2020 and biennially thereafter. Note also critical component of biological sampling in support of Project 35b.		Focus in the Central Pacific to continue view of bigeye across the WCPO	Dependent on outcome of obtaining a suitable pole and line vessel, it may be appropriate to undertake a second consecutive year of dangler/troll research	Focus in the Central Pacific to continue view of bigeye across the WCPO
TAG RECOVERY					
3.	Establish new TRO positions where required.				
4.	Ongoing support of TROs in PNG, Philippines, Thailand and key Pacific Island locations.				
6.	Review and revise tag rewards scheme.				
DATA MANAGEMENT					
7.	PTTP data verification with VMS and Logbook, and cannery data.				
8.	Consolidation of the web tagging database framework.				
9.	New tools to consolidate collection of recapture information.	Tuna Tagging Application is in development			
DATA ANALYSES					
10.	Tag reporting and seeding.	Purpose: Estimation is a direct scalar for fishing mortality. Tasks: Routine update of analyses, reporting to SC.			
11.	Fishing and natural mortality.	Purpose: Provide external validation to estimates from within MFCL and identify fishing mortality changes in response to expansion of the WCPO fisheries. Tasks: Routine update of analyses, reporting to SC.			
12.	Movement.	Purpose: Provide external validation to estimates from within MFCL and SEAPODYM. Tasks: Routine update of analyses, reporting to SC.			
13.	Ikamoana tag-simulation analyses.	FSM/Palau tag release scenarios undertaken to inform recovery effort	Undertake tag release simulations to inform MFCL tag mixing period	Optimal design for 2021 skipjack-focused research voyage	
PLANNING					
14.	Review and update research plan	Ongoing annual task for rolling plan.			

Other Regional or Sub-regional Tagging Projects

Japan

Japan advised it is continuing its tagging research, and two tagging cruises were foreshadowed to the Steering Committee, with the aim of releasing 500 archival tags during 2019-2020, with 300 releases planned in tropical areas of the western Pacific on smaller fish, and 200 off eastern Japan on larger skipjack. Assistance in recovery of tags was requested.

IATTC

The IATTC undertook a tuna tagging cruise aboard a chartered live-bait pole and line fishing vessel during an 85 day charter period of March 6 through May 30, 2019 in the subtropical to Equatorial Eastern Pacific Ocean, with financial support from the European Union.

Unfortunately, the tagging cruise was relatively unsuccessful. This resulted from no concentrations of skipjack, bigeye, or yellowfin tuna schools found in the designated area off Central America and Northern South America, between the coast and about 95^{o}W, during the tagging cruise. Concerns about finding schools of skipjack and other tunas in the designated area for tagging were discussed internally at IATTC three months in advance of the tagging cruise, as well as during the IATTC tagging workshop in January 2019, because of the intensive fishing effort by tuna purse-seine vessels in that region focused on unassociated schools of skipjack and tuna aggregations associated with fish aggregating devices. Permits were thus requested for access to undertake fishing and tagging activities within the closed waters of the Galapagos Islands National Park, Ecuador, Malpelo Island National Park, Colombia, and the Revillagigedo Islands National Park, Mexico so as to increase the probability of finding concentrations of unassociated skipjack schools, but unfortunately those permits were not obtained before the cruise.

During the tagging cruise only a total of 1,455 tunas were tagged: total SKJ 220 (43 with archival tags (ATs)), total BET 189 (46 with ATs), and total YFT 1,046 (242 with ATs).

The IATTC is currently planning to conduct two more tuna tagging cruises focused on SKJ during February through April of 2020 and 2021, with financial support from the European Union. The IATTC administration is currently working towards obtaining permits for conducting fishing/tagging activities within waters of the same national parks mentioned for those two tagging cruises.

Administrative Matters

The support of all current and past donors is gratefully acknowledged, as are the efforts of all contributors and project collaborators. The donors have recently included Papua New Guinea, the Republic of Korea, Australia, the European Union, New Zealand, the Pacific Community (SPC), the WCPFC and ISSF.

Discussion

The Steering Committee noted the work of WP5 undertaking strontium chloride marking, with plans to do so in future cruises. It was noted that this work relied on the receipt of accurate lengths and otoliths on the recapture of these fish. The Steering Committee noted that this activity would be across all species, including skipjack, although the potential issues with otolith-based ageing of this species were recognised.

Planning for CP14 in 2020 is yet to begin. The plan is to continue to focus the cruise within FAD closure months and access drifting FAD positions through e.g. TriMarine assistance, but other structures (such as Tau buoys or their replacement) would also be exploited as needed.

There was a repeated request for support in tag recovery activities.

Recommendations for SC15

The Steering Committee therefore recommended to SC15 that it:

- Note the successful 2018 CP13 tagging voyage
- Note the importance of effective tag seeding to estimating reporting rates, and support increased deployment and fleet coverage of tag seeding experiments;
- Note the need for continued member participation and support in tag reporting;
- Support the 2020 tagging programme, and associated budget;
- Support the 2021-2022 tagging programme, and associated indicative budget; and
- Consider and support the PTTP work-plan for 2019-2022.

References

Peatman, T., Caillot, S., Leroy, B., McKechnie, S., Roupsard, F., Sanchez, C., Nicol, S., and N. Smith. 2016. Analysis of tag seeding data and reporting rates. WCPFC-SC12-2016/SA-IP-13, Bali, Indonesia, 3–11 August 2016.

PTTP Steering Committee. 2016. Report of the Pacific Tuna Tagging Programme Steering Committee. WCPFC-SC12-2016/RP-PTTP-01, Bali, Indonesia, 3–11 August 2016.

Scutt Phillips, J., Sen Gupta, A., Senina, I., van Sebille, E. Van, Lange, M., Lehodey, P., Hampton, J., Nicol, S., 2018. Progress in Oceanography An individual-based model of skipjack tuna (*Katsuwonus pelamis*) movement in the tropical Pacific Ocean. *Prog. Oceanogr*. 164, 63–74. https://doi.org/10.1016/j.pocean.2018.04.007

Scutt Phillips, J., Leroy, B., Peatman, T., Escalle, L., Smith, N., 2019. Electronic tagging for the mitigation of bigeye and yellowfin tuna juveniles by purse seine fisheries. WCPFC-SC15-2019/EB-WP-08, Scientific Committee Fifteenth Regular Session. Pohnpei, Federated States of Micronesia, 12-20 Aug.

Senina, I., Lehodey, P., Calmettesa, B., Nicol, S., Caillot, S., Hampton, J., & Williams, P. (2016). Predicting skipjack tuna dynamics and effects of climate change using SEAPODYM with fishing and tagging data. Scientific Committee Twelfth Regular Session. Bali, Indonesia, 3-11.

SPC-OFP. 2017. Project 35: Bigeye biology, and Project 35b: WCPFC Tuna Tissue Bank. WCPFC-SC12-2016/ RP-P35-01, Rarotonga, Cook Islands, 9–17 August 2017.

WCPFC-SC. 2017. Summary Report. Thirteenth Regular Session of the Scientific Committee, Rarotonga, Cook Islands, 9-17 August 2017. The Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean.

WCPFC-SC. 2018. Summary Report. Fourteenth Regular Session of the Scientific Committee, Busan, South Korea, 8-16 August 2018. The Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean.