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Pacific Tuna Tagging Programme

WCPFC15-2018-32
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Prepared by SPC-OFP and the Secretariat

1. The purpose of this paper is to introduce a joint research project, the Pacific Tuna Tagging Programme (PTTP), being implemented by the SPC. The goal of the PTTP is to improve stock assessment and management of skipjack, yellowfin and bigeye tuna in the Pacific Ocean. 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 utilization by tunas, and the impacts of FADs on behavior. Paragraphs 644 – 654 of the SC14 Summary Report can be referred for the details and the following two documents are attached to this paper:

- SC14-RP-PTTP-01 *Report of the Pacific Tuna Tagging Programme Steering Committee*
- SC14-RP-PTTP-02 *Project 42: Pacific Tuna Tagging Project Report and Workplan for 2018-2021*

2. SC14 produced the following recommendations:

1) SC14 agreed that continuing the tagging work is essential because of its importance in providing critical information for the assessments of tropical tuna stocks.
2) SC14 acknowledged the voluntary contributions from the Republic of Korea, European Union, Papua New Guinea, Australia, New Zealand and ISSF. SC14 encouraged other CCMs and observer organisations to consider contributing to this important work. Further SC14 acknowledged the support of national fisheries administrations, observer programmes and the tuna fishing industry in assisting with the project, in particular in the recovery of recaptured tags.
3) SC14 recommended that the Commission support the PTTP work plan and associated budget for 2019 and the work plan and associated indicative budget for 2020-2021, noting that it includes consideration of the recent voluntary contribution from the Republic of Korea.
4) SC14 noted the advice of the Scientific Services Provider and the PTTP Steering Committee (SC14-RP-PTTP-01) that the availability and cost of suitable tuna fishing vessels to undertake tagging charters is subject to considerable uncertainty. SC14 recommended that should available budget be insufficient or if a suitable pole-and-line vessel makes it impossible to conduct WP5 in 2019 as scheduled in the work plan, the Executive Director may authorize an amendment to the schedule such that CP14 be conducted in 2019 and WP5 be conducted in 2020.

5) SC14 also noted the advice of the Scientific Services Provider and the PTTP Steering Committee (SC14-RP-PTTP-01) that there is considerable uncertainty in the long-term sustainability of the tagging programme due to the escalating costs of vessel charter and limited availability of suitable vessels. SC14 therefore recommended that the Finance and Administration Committee and the Commission consider the proposed Project 83, in which it is proposed to assess the business case for the acquisition and operation of a dedicated research vessel for this purpose, with a view to realising cost-savings for the Commission over the long term. However one CCM did not consider that Project 83 was a scientific project and it should be possibly funded under another more appropriate budget line.

3. The proposed budget for 2019 and indicative budget for both Project 42 and Project 83 for 2020-2021 (USD) are reflected in the SC work programme and budget, which will be discussed at FAC12:

Project title	TORs	Essential	Priority rank	2019	2020	2021
Project 42. Pacific Tuna Tagging Program (PTTP) Other: Approx. $170,000 from Korea in 2019-2021, plus an additional $85,000 in each of 2019 and 2020 utilizing the 2018 contribution from Korea also of approx. $170,000	Annex A	Yes	High 1	645,000	645,000	730,000

Project title	TORs	Essential	Priority rank	2019	2020	2021
Project 83. Investigating the potential for a WCPFC tag vessel (Co-funded to be sought)	Annex B	No	High 2	95,000		

Annex A

PROJECT 42 (REVISED PROPOSAL)
Pacific Tuna Tagging Programme (PTTP)

Project title	TORs	Essential	Priority / Rank	2019	2020	2021
Project 42 Pacific Tuna Tagging Program (PTTP)	Annexed	Yes	High	730,000	730,000	730,000
Budget with $170,000 p.a. from Republic of Korea (2019-2023) and PTTP personal costs and some publication costs from SPC				730,000 170,000 285,000 1,185,000	730,000 170,000 285,000 1,185,000	730,000 170,000 285,000 1,185,000

It has been highlighted in SC12-SA-WP-04, SC12-MI-WP-05 and SC12-RP-PTTP-01 that regular tagging is required to support stock assessment and harvest strategy implementation for tropical tuna. SC12-RP-PTTP-01 proposed that skipjack and yellowfin focused tagging using pole-and-line fishing and bigeye tagging using handline fishing be conducted in alternate years. WCPFC 13 agreed to this approach and included a budget for 2017 and an indicative budget for out-years in its 2017 budget. SC13-RP-PTTP-01 and SC-13-RP-PTTP-02 highlighted implementation of that approach. SC14-RP-PTTP-01 and SC-14-RP-PTTP-02 highlight further implementation of this approach and this project will support continuation in the medium term. Under this plan, a SKJ+YFT (PL) research voyage will occur in 2019 and 2021, and a BET (HL) research voyage will occur in 2020 and 2022.

The following funding support[1] is required to implement this work on an ongoing basis, which would target the release of 25,000 skipjack tuna and 5,000 yellowfin tuna in each pole-and-line (PL) two-month voyage, and 2,000 bigeye tuna in each handline (HL) five-week voyage (with 100 archivally tagged). The two budget columns below refer to the alternating years targeting SKJ/YFT and BET:

Budget item	SKJ+YFT (PL)	BET (HL)
Vessel charter	965,000	360,000
Tags/equipment	40,000	150,000
Personnel at-sea	85,000	50,000
Personnel PTTP	275,000	275,000
Travel	35,000	35,000
Tag recovery rewards	55,000	15,000
Analysis/reporting/publications	15,000	15,000
TOTAL	**1,470,000**	**900,000**

These amounts averaged across two years give an annualised budget for the PTTP of $1,185,000. To date, SPC has met the PTTP personnel costs from a variety of sources, as well as a range of analysis, reporting and publications costs ($285,000 p.a.). Until at least 2021 this can continue, however in future that is dependent on the goodwill and priorities of SPC's donors. The Republic of Korea has been a long-term direct supporter of the PTTP and during SC14 announced it would continue this funding for another five years from 2019-2023 ($170,000 p.a.). With these two sources of external funding for the PTTP, the balance left to be met by WCPFC on an annualised budget basis is $730,000 per annum.
Note that it is assumed that a dedicated research vessel would reduce the costs in vessel charter for pole and line research in future (see Project 83), however the detailed study needs to be completed to confirm this.

[1] This budget has been updated based on costs in 2016, 2017 and 2018 to date.

Annex B

PROJECT 83	**Investigating the potential for a WCPFC tag research vessel**
Objectives	To explore the costs and benefits of the permanent use of an adaptable research vessel dedicated to the collection of the data used in tuna stock assessment in the WCPO.
Rationale	**A. Rationale for project** **1. General** More than 70% of the global tuna catch are fished in the Pacific Ocean for an estimated value of over US$6 billion. The harvesting level of tuna resources and the efficiency of the involved industrial fleet henceforth impose a very responsive management mode. The management measures need to be supported by strong evidence based on high quality data allowing stock assessment containing a minimum of uncertainty. The data obtained independently from the fishing fleets have become essential and the science based management bodies have the responsibility to support their analysis with the best scientific evidence available. This requires a continuous acquiring of mortality rates for the impacted species, a detailed knowledge of their biology, along with their behaviour in response to fishing gears and in response to the variations in their environment. Assessing the fishing impact on the whole ecosystem requires collecting data on all the species living in association with tuna and tuna-like species, data about their prey and the pelagic ecosystem. The collection of all this information requires the permanent use of an adaptable research vessel properly designed for the purpose. There are currently no suitable tuna research vessels available in the region (or beyond). Concurrently the fleet of vessels available to charter for research, especially in pole and line fisheries, are becoming increasingly difficult to procure or no longer meet standards necessary for the conduct of research (PTTP Steering Committee, 2018). Accordingly it is increasingly urgent to carefully explore the permanent use of an adaptable research vessel dedicated to the collection of the data used in tuna stock assessment. **2. SC 13 and SC 14** At SC13 the PTTP Steering Committee considered the issue of the availability of suitable tagging vessels, especially for pole and line based research, at its 11th meeting during SC13. The PTTP Steering Committee endorsed the proposal outlined in SC13-RP-P42-02 Appendix II and recommended that SC13 support an assessment of the cost-effectiveness of acquiring a dedicated tagging vessel (SC13-RP-P42-01). The 2018 report of the PTTP highlights the increased urgency of conducting this work (SPC-OFP 2018), especially given not only the increasing costs, but also the difficulty in securing a suitable vessel for charter in the region. At SC14 the PTTP Steering Committee recommended to SC14 that the priority of this work be increased to high. **B. Current availability of suitable research platforms** **1. For tagging experiments** Tagging studies are commonly used in fisheries research to improve estimation of animal population size, mortality, movement (spatial stock structure) and growth. Until now, large scale tuna tagging campaigns for skipjack tuna have chartered medium-size commercial fishing boats around 200 GT tonnage (199 GT for last PTTP, 237 GT for IOTP) for cost reasons, and also due to size restrictions on bait ground access and

restricted suitable anchorage in some areas. Releasing a large number of conventionally tagged tuna implies the use of a pole-and-line vessel, but suitable such tagging platforms are becoming increasingly scarce worldwide. In most countries, pole-and-line fleets have been replaced by purse-seine fleets.

Research cruises more orientated towards electronic tagging and targeting all size tuna and their associated species need a more polyvalent tagging platform that could deploy a large variety of fishing gears (e.g. horizontal and vertical longlines, troll lines, danglers, and rod and reel). Catching and handling large size fish requires a working deck with easy access to the sea and a boat with high manoeuvrability facilitated by steering commands located at the working deck level. For example, the design of a standard Japanese pole and line vessel is not suitable for the purpose.

In the Pacific, some longline type fishing boats have been used to target the tuna schools that are associated with floating objects, mainly the oceanographic buoys (TAOs) that are anchored along the equator and the drifting FADs used by the purse seine fleet. The distances involved between floating objects and from ports with appropriate facilities for deploying a research voyage require the use of long-range (> 6,000 nm) platforms which are not common in the region for the necessary size of fishing vessels for successful research.

2. For collecting ecosystem biological and physical data

This necessitates the use of gears that are usually not found on a commercial tuna fishing vessel, including : trawling nets to catch tuna prey and plankton size organisms, CTDs to collect sea water temp/depth profiles, and multi-beam echo-sounders that can manage continuous records of highly detailed bio-acoustic data.

Boats used in this type of research are typically from the oceanographic vessel category. They are usually linked to governmental scientific institutes. To operate the different types of gears used at an ocean wide scale, those vessels need to be large (>400 GT). To cover important operational and maintenance costs, their use is often shared between multidisciplinary research projects. Their availability is therefore limited, subjected to utilisation applications that need to be planned years in advance.

C. Arguments for the construction of a new multipurpose platform dedicated to tuna research:

1. Practicality:

- Tuna tagging data are likely to become increasingly important and need to be collected continuously rather than episodically. Other types of data need to be continuously collected to monitor the ecosystem changes.
- The pole and line vessels that can currently still be chartered are disappearing along with the associated fisher knowledge on operations and bait grounds. These platforms cannot cover all the different data collection needs.
- The global applicability of continuous data collection is likely to facilitate collaboration between the different tuna commissions (RFMOs). The cumulated needs at the Pacific scale could probably cover most parts of the yearly schedule of a single boat.
- A crew specifically recruited and trained to the specific research methods and strategies will be more capable than a commercial fishing boat crew that often need a long training period before they become fully efficient.

2. Cost:

- Continuous research would avoid the substantial establishment costs needed each time a new programme is started.

	• Some examples: ➢ Previous recent charter costs, including fuel, for a long range tuna tagging platform (about 200GRT) were situated between 150,000 and 200,000 USD/month. The WP4 charter cost jumped to over 420,000 USD/month. Recent enquiries to utilise vessels from the north Pacific suggest considerably higher costs. ➢ The total tagging platform charter costs spent during each of the last large tagging projects (PTTP and IOTP) is over the current estimated cost for building a new boat of around 35 metres/200GRT (*Between 5 and 8 USD millions, IOTP vessels were built at about 4 USD millions in 2000*). Last estimation for the currently running (2017) AOPT total charter cost is 9.1 million Euro (ICCAT, SCRS/2014/092). ➢ A pre-assessment of some of the operational costs of an appropriate platform that could be built to address all the tuna research needs for the Pacific Ocean has been provided to SPC by F&S, a consultancy office specialized in the fisheries sector. That work would be available to this project.
Scope	The project would assess the full range of operational costs, including options on governance, inter-RFMO vessel sharing, multiple research modes, and future vessel replacement. These costs should be compared with the costs and benefits of the current approach. However, the current approach is not sustainable so the cost benefit analysis will need to consider alternate benchmarks in combination with the current approach. The scope of work includes undertaking this assessment utilising suitable external experts. A report will be prepared and provided to SC15 for its consideration.
Timeframe	Start early 2019, completed by late 2019
Budget	2019 USD$95,000 *Note that this covers the cost of the external consultancy/consultancies (60 days) and reporting of the project outcomes to SC. It is also includes travel to the various locations that will be required to review some of the available vessels. The Scientific Services Providers input to the project will be provided as in-kind support.
References	PTTP Steering Committee. 2017. Report of the Pacific Tuna Tagging Programme Steering Committee. SC13-RP-PTTP-01. Thirteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Rarotonga, Cook Islands, 9-17 August 2017. PTTP Steering Committee. 2018. Report of the Pacific Tuna Tagging Programme Steering Committee. SC14-RP-PTTP-01. Fourteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Korea, 8-17 August 2018. SPC-OFP. 2017. Project 42: Pacific Tuna Tagging Project Report and Workplan for 2017-2020. SC13-RP-PTTP-02. Thirteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Rarotonga, Cook Islands, 9-17 August 2017. SPC-OFP. 2018. Project 42: Pacific Tuna Tagging Project Report and Workplan for 2018-2021. SC14-RP-PTTP-02. Fourteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Korea, 8-17 August 2018.

SCIENTIFIC COMMITTEE
FOURTEENTH REGULAR SESSION

Busan, Republic of South Korea

8-16 August 2018

Report of the Pacific Tuna Tagging Programme Steering Committee

WCPFC-SC14-2018/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 12th meeting of the PTTP Steering Committee was held at the 14th Regular Meeting of the WCPFC Scientific Committee, Busan, Republic of Korea on 09th August 2018. 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 (SC14-RP-PTTP-02)

Since the last PTTP Steering Committee meeting, one tagging voyage, WP4, in the tropical western Pacific has been conducted, and in addition, continued implementation and refinement of tag recovery processes, tag data curation, tag seeding, data preparation for use in WCPO stock assessments, and a range of tag related analyses and modelling conducted (SPC-OFP, 2018).

Research voyages

WP4 was a research voyage of 50 days duration conducted in Sep-Nov 2017 targeting skipjack tuna in Papua New Guinea (21 days) and Solomon Islands EEZs (29 days). WP4 was a large-scale tagging voyage designed to collect data collection on tuna movements, exploitation rates, biology and ecology.

The Noro-based pole and line fishing vessel *Soltai 105* was chartered for the voyage. A total of 27,779 tuna (25,424 skipjack, 2,335 yellowfin, and 20 bigeye) were tagged. Very limited numbers of good size yellowfin and bigeye were caught during this voyage and only seven archival tags were released in five yellowfin and two bigeye tunas. For skipjack, the size distribution of fish tagged in PNG was smaller than in the Solomon Islands, although with very small numbers of fish out to 65cm. In the Solomon Islands, two strong size modes were tagged and good numbers of larger fish tagged, around 60-65cm. For yellowfin, more small fish were tagged in PNG, although the distribution of sizes in PNG was very broad. In the Solomon Islands, there was a mode around 50cm and the range of sizes was smaller than in PNG.

The lack of bait and fish hampered the PNG leg of the WP4 voyage, resulting in in 50% lower success (in terms of tags per day) than expected from past experiences in those waters. In contrast, the skipjack tagging in Solomon Islands waters was exceptional in terms of the numbers and size of the fish tagged. The pole and line method of tag and release again allowed large-scale release of tagged skipjack tuna in a relatively short period. In summary, this was a successful research voyage.

Tag recovery

The total tag releases for the PTTP are 429,425 tuna including 1,733 that were tagged with archival tags. Over 78,259 tagged tuna had been recaptured and the data reported to SPC. Tag attrition follows the expected declining pattern with the rate of decline in skipjack tag returns indicating their shorter expected lifespan and higher natural mortality when compared to yellowfin and bigeye tuna. The pattern of recoveries from WP4 is already very similar to that reported from WP1-3, and across all voyages similar to that reported to the steering committee at SC13 in 2017. The yellowfin and bigeye remain very useful for stock assessment purposes, but it is clear that there remains a significant gap in the tagging of larger BET in the western central Pacific. The successful re-establishment of skipjack tagging with WP4 should be very useful for the next skipjack stock assessment.

Tag Recovery staff continued their work in Wewak, Madang, Honiara, Rabaul, General Santos, Noro and Tarawa. Across the region, the previously full-time Tag Recovery Officers (TROs) have now taken on other duties at their respective local fisheries agencies, however they generally continue to act as TROs. New fisheries officers in American Samoa, Tonga, Samoa, Taiwan and Tuvalu are now acting as TROs. As of mid-2017, negotiations with Kiribati MFMRD to re-establish a full time TRO position in Tarawa are still under progress. The establishment of these positions has provided greater opportunity for collection of tags during unloading, transhipments and processing in canneries with more complete and reliable capture information. The re-establishment of the position in Noro has provided greater opportunity for collection of tags during unloading, transhipments and processing arising from WP4 tags. Re-establishment of the position is Lae is needed (and is included in the 2018-19 work plan).

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 the trophic status of the western and central Pacific pelagic ecosystem. Since the beginning of the PTTP, 6,279 stomach samples have been collected, mainly from skipjack, yellowfin, bigeye and albacore tuna (including 290 additional stomachs from WP4, mostly skipjack and yellowfin). These research voyages have provided

the opportunity to measure the fat content of 4,167 specimens a specialist type of sampling that cannot be conducted by observers undertaking biological sampling on industrial fishing vessels. Additionally, the tagging research voyages have provided a large volume of biological samples for the WCPFC Tuna Tissue Bank with a total of 6,479 fish sampled to date (these tagging research voyage samples represent 25.5% of the total fish sampled for the tissue bank).

Tag database and data capture improvements

A new dedicated web application allowing access to TagDager for approved users has been developed. The purpose of the app includes improved identification of fake tag recovery and/or tag data validation (e.g. through immediate access to release information such as species and length). These improvements to the tag databases will improve tag quality and reduce the risk of potential tag reward fraud.

Tag data analyses

Reporting rate (RR) prior parameters were calculated for the alternative regional structure included in the 2018 bigeye re-assessment, using the approach outlined in Peatman et al. (2016). The RR prior parameters were insensitive to the shift of the northern boundary between regions 1 & 2 and 3 & 4 due to the low levels of purse seine effort between 10N and 20N west of 140E.

Scutt Phillips et al. (2018) have developed a tagging simulator for skipjack tuna in the WCPO known as IKAMOANA. It provides a framework to examine the potential movement of individual tuna schools under a variety of behavioural assumptions. The movement of both individual or cohesive schools of skipjack are simulated. An initial suite of simulations for skipjack tag releases in skipjack stock assessment region five has been undertaken to examine the degree of tag mixing that may have occurred during recent years. Simulation results were highly dependent on the environmental forcing of the ENSO phase being examined. Releases in the Solomon Sea show lower initial dispersal than other locations but good levels of mixing in skipjack stock assessment region five. Simulated releases in the Bismarck Sea area were, in general, consistently over-depleted compared to fish of the same cohort for all assessment regions into which tagged fish subsequently moved. Releases in logistically more challenging locations appear to drive greater within-region mixing of tagged fish compared with releases in core fishing areas where high fishing effort result in tag return data that are less representative of the stock. Further examination of these results and additional simulations would provide guidance on future design of PTTP skipjack research voyages (including WP5 planned for 2019).

2018-2021 Work Plan

Issues arising from 2017-18

The PTTP continues to be successful, recently with WP4 completed in November 2017 and with CP13 underway during SC14. The PTTP and the data it produces are set to continue as a strong part of WCPFCs science for the medium term, but there remain significant issues to resolve. The significant commitment from the Commission to ongoing funding is helping to finance annual tagging voyages; however, the increasing costs of vessel time and the staged

approach to funding increases (Appendix J, SC report, 2017) mean SPC still needs to obtain funds from external sources to complete the tagging work programme.

Beyond budget, the most significant issue is the availability of suitable research vessels. This is particularly an issue for pole and line vessels required for large-scale tagging of skipjack tuna. Those that remain in the south Pacific are either too small, or are rapidly ageing and through a combination of deterioration and limited spare parts availability no longer offer sufficiently reasonable conditions to be used for research. This creates considerable difficulty in procuring a vessel for this pole and line research, and places significant cost pressure on the research programme. Although several suitable longline vessels exist in the region for the various line fishing techniques used to target bigeye tuna, very few possess the range required for current research needs, and none are designed for research fishing. These issues build a strong case for identifying a long-term multi-purpose tagging platform in the WCPFC area. A comprehensive cost analysis of such an approach to fisheries and ecosystem research for WCPFC is urgently required to progress this concept.

Work plan

The proposed PTTP work plan for the period 2018-2021 was discussed by the PTTP SC and is set out in Table 1. There are five main work streams covering tagging, tag recovery, data management, data analyses and planning.

Tagging research voyages include:

- CP13 (underway at the time of SC14) a BET target and focused in the Western tropical Pacific;
- WP5 is planned for 2019, to have a skipjack focus within the warm pool;
- CP14 is planned to occur second half of 2020, to have a BET focus, and is likely to include a return to the central Pacific area; and
- WP6 is planned for 2021, to have a skipjack focus within the warm pool.

Note that for the tag research voyages SPC routinely invites participation from Pacific Island fisheries staff and this will continue across this workplan. Participation from other WCPFC CCMs is also welcomed if logistics allow.

As already reported to SC12 (PTTP Steering Committee, 2016) and SC13 (PTTP Steering Committee, 2017), and highlighted again to SC14 (SPC-OFP, 2018), the operational issues in getting a suitable vessel at a reasonable cost have reached limits that will constrain or even totally compromise future implementation of a pole and line tagging voyage. Based on the experience during WP4, it seems that unless a vessel can be procured from outside the region, WP5 may need to be delayed a year (and CP14 bought forward a year to ensure continuous tagging).

The additional work streams include:

- Continued tag recovery efforts across the region including ongoing tag recovery network development and enhancement;
- Ongoing verification of tag recapture information with VMS and logbook data, and consolidation of the web-based tag data framework;
- Further investigations of tag data including further analyses of tag seeding data and reporting rates, inclusion of tag data into MFCL and SEAPODYM analyses; and
- A review and analysis of the cost-effectiveness of a WCPFC tagging research vessel.

Table 1: Indicative PTTP workplan for the period 2018-2021.

ACTIVITIES		2018[1]	2019	2020	2021
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.		Plans to be refined after assessing viable available options		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.	A charter arrangement has been concluded with Hawaiian LL company to use FV GutsyLady4 to implement a 35 day research voyage	Dependent on outcome of obtaining suitable pole and line vessel, may be better 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.				
5.	Develop new tag recovery poster.				
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.				
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 analyses.		Optimal design for 2019 WP5 voyage		
PLANNING					
14.	Review and update research plan	Ongoing annual task for rolling plan.			
15.	Consultancy on cost-effectiveness of a research vessel.				

[1] This programme is all either complete or well underway (e.g. research voyage CP13).

Other Regional or Sub-regional Tagging Projects

PNG

PNG updated the PTTP on its involvement in the work of the PTTP, including:

- Supporting the implementation of a number of collaborative tagging operations with SPC since 2006, and recently WP4 in 2017, noting PNG has contributed financially and in-kind logistic support for the tagging operations, as well as, recruiting dedicated tag recovery officers in the main ports in PNG and paying tag rewards to fishers;
- As part of these tagging operations a large number of samples have been collected and sent to SPC for further analysis and the data collected during these tagging operations had become part of the WCPFC Tuna Tissue Bank stored at SPC, and contributes to the work of providing scientific services to PNG and the broader region in managing shared tuna stocks;
- NFA involvement in WP4 was from September to October 2017, with 19 sea-days spent in the PNG EEZ during the implementation of the tagging operations;
- Awareness work was undertaken with local communities regarding the collection of baitfish for use during tagging operations, and research visas for the SPC scientists and technicians were facilitated in line with PNG immigration and customs requirements; and
- Tag recovery rates post WP4 have been low with 188 tags from WP4 recovered by officers in PNG ports.

PNG highlighted that due to several factors at the national level they will not be able to continue the same level of support to the tagging program. The dialogue with SPC on how PNG can continue its collaboration with the PTTP is ongoing. PNG reiterated to the committee that it continues to see the value of a tagging program to inform the stock assessments for tunas in the WCPO and encouraged SC to provide adequate support to the science services provider in this regard.

Japan

Japan advised it had conducted limited tagging of skipjack in the high seas areas in late 2017, and that it hoped to conduct further tagging in late 2018. Collaboration with other organisations and countries will continue to be required to ensure that reporting of tag recoveries is high. The Steering Committee encouraged SPC and Japan to continue to explore the possibility of collaboration in tagging voyages in the coming years.

IATTC

The Steering Committee noted with interest that the IATTC is currently investigating beginning a new phase of large-scale tagging of tunas. This may identify suitable pole and line vessels for charter from outside the WCPO area. Further, it needs to be explored in the proposed investigation of cost effectiveness around obtaining a research vessel for the WCPO.

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.

WP4 in 2017 was only possible due to a significant input of funding from SPC-OFP (approximately one-third of the total costs). That source of funds has now been fully utilised and we do not anticipate that SPC-OFP will be able to supplement funding for tagging voyages to the same extent in the future. CP13 in 2018, underway during the meeting, is significantly supported by the European Union through the *WCPFC Mitigating bycatch of bigeye tuna and yellowfin tuna juveniles by purse seine fisheries* project.

During the PTTP Steering Committee, the Republic of Korea informed the meeting that it would be able to continue supporting the PTTP over the period 2019-2023 at a level of US$170,000-180,000 (dependent on the exchange rate in each year). The announcement by the Republic of Korea that it would continue its generous support of the PTTP from 2019-2023 was welcomed.

The indicative budget in 2020, with the contribution from the Republic of Korea, is close to levels that will allow the bigeye tuna programme to continue sustainably. However, the increase of the PTTP budget in out-years remains important for the skipjack tuna programme.

Discussion

The Steering Committee noted that the decision to normalise the tagging programme in 2016 was being implemented (WCPFC, 2017) with the CP12, WP4 and CP13 research voyages and associated activities. The work plan, and in particular funding and the access to suitable tagging vessels in future, were discussed in detail.

With the continued increases in the Commission's budget in 2018 and the indicative budget for out-years and the contribution from the Republic of Korea, the budget is getting closer to necessary levels. However, given the increasing costs of procuring suitable vessels for research, further funds are needed to support the programme. For example, the 2017 research voyage could only be completed due to approximately 33% of the work being funded from SPC sources. The budget needs to continue to increase to the levels indicated in current analyses (e.g. US$1,470,000 for a pole and line voyage, and US$900,000 for a dangler and troll voyage).

Access to a more cost effective research vessel would also make the tagging programme more sustainable. The most reliable and successful approach – globally – for large-scale tagging of skipjack tuna is to use the pole and line method of fishing. At the same time, this fleet has shrunk globally to the point where there now remain only a very small number of vessels in the Pacific region that can be utilised for this research. Those that remain are in high demand for industrial fishing as they produce a sought after product. This creates considerable difficulty in procuring a vessel for this research. Although several suitable longline vessels exist in the region for the various line fishing techniques used to target bigeye tuna, the reality is that none are designed for research fishing. In 2017, this led to the development of a proposal for a cost-effectiveness study in 2017 (PTTP Steering Committee, 2017; Appendix J, WCPFC-SC, 2017). That proposal received a medium priority, but even though SPC had identified a source for 50% of the funding, it was not funded by the Commission[2] (WCPFC 2018). As tagging provides key information on abundance and

[2] The proposal in 2017 included SPC funding 50% of the costs of the project. As that source of funding is no longer available (used instead to ensure WP4 could proceed), that approach is now not possible.

fishing mortality for skipjack tuna stock assessments, there is increasing urgency to address these issues. The Steering Committee agreed that this project should now receive a high priority. The project proposal includes an assessment of the full range of operational costs, including options on governance, inter-RFMO vessel sharing, multiple research modes, and future vessel replacement, with costs compared with the costs and benefits of the current approach. The Steering Committee agreed to develop the proposal further, especially the budget, for submission to the budget committee and recommendation to SC14.

With respect to securing a vessel for WP5 in 2019, the Steering Committee recommended exploring options to utilise a vessel from outside the WCPO. In the case that a suitable vessel could not be procured, the Steering Committee agreed that the scientific services provider should have the discretion to conduct CP14 in 2019 and defer WP5 to 2020 if necessary.

Recommendations for SC14

The Steering Committee therefore recommended to SC that it:

- note the successful 2017 research voyage, including participation from local science staff in PNG waters, and that the 2018 voyage is currently underway;
- request members to actively support the tag recovery network;
- support the 2019 tagging programme, and associated budget;
- support the 2020-2021 tagging programme, and associated indicative budget;
- support the PTTP workplan for 2019-2021, noting that should available budget and pole-and-line vessel availability dictate, that the research voyage schedule be modified to conduct CP14 in 2019 and defer WP5 to 2020 if necessary; and
- support the project to address the increasingly urgent issue of cost-effectiveness of vessel charter in relation to acquiring a dedicated tagging vessel by increasing its priority from medium to high.

The Steering Committee asked SC14 to consider the following as recommendations to WCPFC.

1. The Commission support the PTTP work plan and associated budget for 2019, and the work plan and associated indicative budget for 2020-2021;
2. Should available budget or pole-and-line vessel availability make it impossible to conduct WP5 in 2019 as scheduled in the work plan, the WCPFC Executive Director may authorise an amendment to the schedule such that CP14 be conducted in 2019 and WP5 be conducted in 2020; and
3. To address the increasingly urgent issue of cost-effectiveness of vessel charter for tagging and associated research, the Commission implement the proposed project to assess the business case for the acquisition and operation of a dedicated research vessel for this purpose.

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SCIENTIFIC COMMITTEE
14TH REGULAR SESSION

Busan, Republic of Korea

8-16 August 2018

Project 42: Pacific Tuna Tagging Project Report and Workplan for 2018-2021

WCPFC-SC14-2018/RP-PTTP-02

SPC-OFP

1 INTRODUCTION

This Pacific Tuna Tagging Programme (PTTP) report provides background on the PTTP to date, and covers the tagging activities undertaken in 2017-18 under the banner of the PTTP including research voyages, tag recoveries, tag recovery and tag seeding activities, and tagging related analyses. Issues arising in 2018 for PTTP Steering Committee consideration are highlighted. The PTTP work planned for 2018-2021 is outlined and an agenda for the 2018 meeting of the PTTP steering committee is provided.

1.1 Programme objectives

The PTTP is a joint research project being implemented by the Oceanic Fisheries Programme (OFP) of the Pacific Community (SPC). The goal of the Pacific Tuna Tagging Programme 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-SC6-2010/GN-IP-04 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.

1.2 Programme funding

Since its commencement in 2006, funding support for the PTTP has been provided by the PNG National Fisheries Authority, New Zealand Aid Agency, the Government of the Republic of Korea, Australian Centre for International Agricultural Research, European Community 8th European Development Fund, European Community 9th European Development Fund, European Community 10th European Development Fund, the French Pacific Fund, the Government of Taiwan, Heinz Australia, the Global Environment Facility, the International Seafood Sustainability Foundation, the European Union through voluntary contributions to WCPFC and the WCPFC itself. In 2011, SPC and the PNG National Fisheries Authority (NFA) began a three-year tag release programme in the PNG EEZ, funded by NFA. This project, referred to here as the PNG Tagging Project (PNGTP) is considered under the umbrella of the PTTP and where relevant is reported on in this annual Project 42 report.

In 2016 the PTTP steering committee recommended that SC normalise the tagging programme as part of the ongoing work of the SC (WCPFC-SC 2016). Ideally this would include research voyages every year alternating between skipjack via pole and line in one year and bigeye via handline and dangler fishing in the next, starting with skipjack in 2017 (noting that yellowfin would be adequately covered by these surveys). The SC took this recommendation forward to the Commission and at WCPFC13, the Commission agreed to the recommendation and allocated funds for 2017 and indicated funding for 2018-19 to implement this work (WCPFC, 2017). In 2017 SC endorsed the PTTP workplan for 2017-2020 and supported ongoing tagging programme as part of the ongoing work of the SC (WCPFC-SC, 2017). In 2017 at WCPFC14, the Commission agreed to the recommendation and allocated funds for 2018 and indicated funding for 2019-20 to continue this work (WCPFC, 2018).

1.3 Operational structure

The overall operational structure of the PTTP to date is given in Table 1, with the work completed since the last PTTP reported highlighted and the scheduled work for 2018 also shown. The spatial distribution of these research voyages in the Western and Central Pacific Ocean is shown given in Figure 1.

Table 1: Period, area and vessel used in PTTP tagging research voyages since the inception of the programme. Work completed since the last PTTP report to SC13 in 2017 highlighted and the scheduled work for 2018 shown in red.

	Time period	Operational area	Tagging vessel
Phase 1	Aug – Nov 2006	PNG	*Soltai 6*
	Feb – May 2007	PNG	*Soltai 6*
	Oct – Nov 2007	Solomon Islands	*Soltai 6*
	Feb – Mar 2008	Solomon Islands	*Soltai 6*
	Apr 2008	Solomon Islands	*Soltai 105*
Phase 2 (to date)	May – Jun 2008	Central Pacific (CP1)	*Double D*
	Jun – Nov 2008	Western Pacific (WP1)	*Soltai 105*
	Mar – Jun 2009	Western Pacific (WP2)	*Soltai 105*
	May – Jun 2009	Central Pacific (CP2)	*Double D*
	Jul – Oct 2009	Western Pacific (WP3)	*Soltai 105*
	Oct – Nov 2009	Central Pacific (CP3)	*Aoshibi Go*
	May – Jun 2010	Central Pacific (CP4)	*Aoshibi Go*
	Oct – Nov 2010	Central Pacific (CP5)	*Pacific Sunrise*
	Oct 2011	Central Pacific (CP6)	*Pacific Sunrise*
	Nov – Dec 2011	Central Pacific (CP7)	*Aoshibi Go*
	Sep – Oct 2012	Central Pacific (CP8)	*Pacific Sunrise*
	Nov – Dec 2013	Central Pacific (CP9)	*Pacific Sunrise*
	Aug 2014	Central Pacific (CP10)	*Pacific Sunrise*
	Sep - Nov 2015	Central Pacific (CP11)	*Gutsy Lady4*
	Sep-Oct 2016	Central Pacific (CP12)	*Gutsy Lady4*
	Sep-Oct 2017	Western Pacific (WP4)	*Soltai 105*
	Jul-Aug 2018	Central Pacific (CP13)	*Gutsy Lady4*
PNGTP	Apr – Jul 2011	PNG (PNGTP1)	*Soltai 105*
	Jan – Mar 2012	PNG (PNGTP2)	*Soltai 105*
	Aug 2012	PNG (TAO trial)	*FTV Pokajam*
	Apr – Jun 2013	PNG (PNGTP3)	*Soltai 101*
	July 2016	PNG (TAO trial)	*FTV Pokajam*

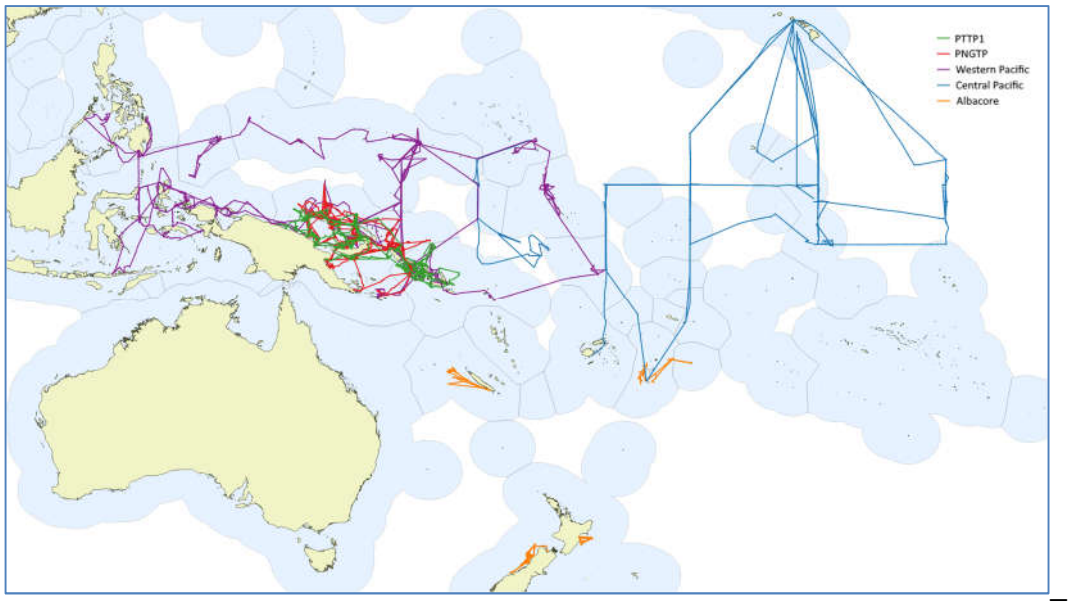

Figure 1: Tagging vessel tracks for all voyages for all PTTP research voyages to date. Legend relates to the operational areas described in Table 1.

2 SUMMARY OF PTTP ACTIVITIES IN 2017-2018

Since SC13 (SPC-OFP, 2017a), PTTP activities have included one large-scale pole and line voyage, WP4, in the waters of PNG and Solomon Islands, continued implementation and refinement of tag recovery processes and tag seeding, data preparation for use in the post-SC additional analyses conducted on the bigeye stock assessment, and data preparation for use in the albacore tuna stock assessment in 2018. Research voyage CP13 preparations began in late 2017 and the vessel departed Majuro, Marshall Islands, 16th July 2018.

2.1 WP4 pole and line tagging voyage

In the framework of the PTTP and following the recommendations of the 12th Scientific Committee, in 2017 the SPC implemented a new tagging experiment focussing on skipjack and yellowfin tuna (funded by WCPFC, Korea and SPC). To achieve this work, SPC chartered a Pole and Line vessel from the National Fisheries Developments (NFD)/Tri Marine (TMI) fishing fleet based in Noro/Western Province/Solomon Islands. The research voyage started from Noro on the 17th of September for a total duration of 50 days. The first 3 weeks of the charter were spent releasing tagged tuna in the waters of PNG, then the vessel moved west and south into the Solomon Island EEZ (see voyage tracks in Figure 2).

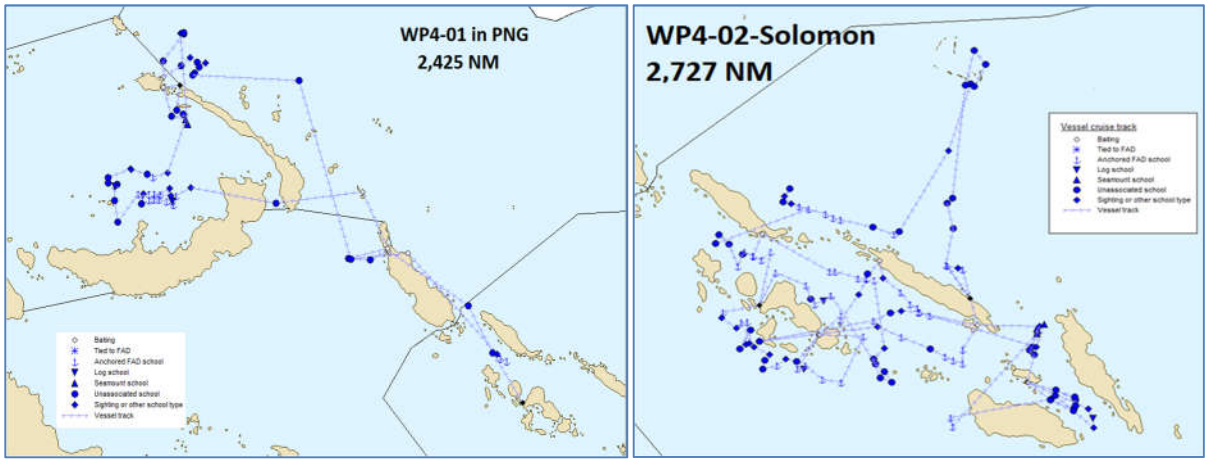

Figure 2: Voyage tracks during the Sep-Oct 2017 WP4 voyage in PNG (left) and Solomon (right) waters.

2.1.1 WP4 tag releases

In PNG: Over the 21 days of the voyage leg, 17 days were spent searching and fishing and four full or partial days in port. 6,641 fish were tagged and released during the voyage, at a relatively low (compared to previous tagging experiments in PNG waters) average of **390** fish per day. The species composition in total was 87% skipjack, 13% yellowfin with only 2 bigeye tuna tagged. No archival tags were released due to the lack of yellowfin or bigeye of suitable size.

In Solomon Islands: Over the 29 days of the voyage leg, 25 days were spent searching and fishing and four full or partial days in port. **21,139** fish were tagged and released during the voyage, at an average of **845** fish per day. The species composition in total was **93%** skipjack, **7%** yellowfin with only 18 individual bigeye tuna tagged. These percentages are quite different from previous tagging in the same area (**33%** of Y and B combined in 2007 and **61 %** in 2008). Very limited numbers of good size yellowfin and bigeye were caught during this voyage and only seven archival tags were released in five yellowfin and two bigeye tunas. Figure 3 shows the distribution of releases during the voyages.

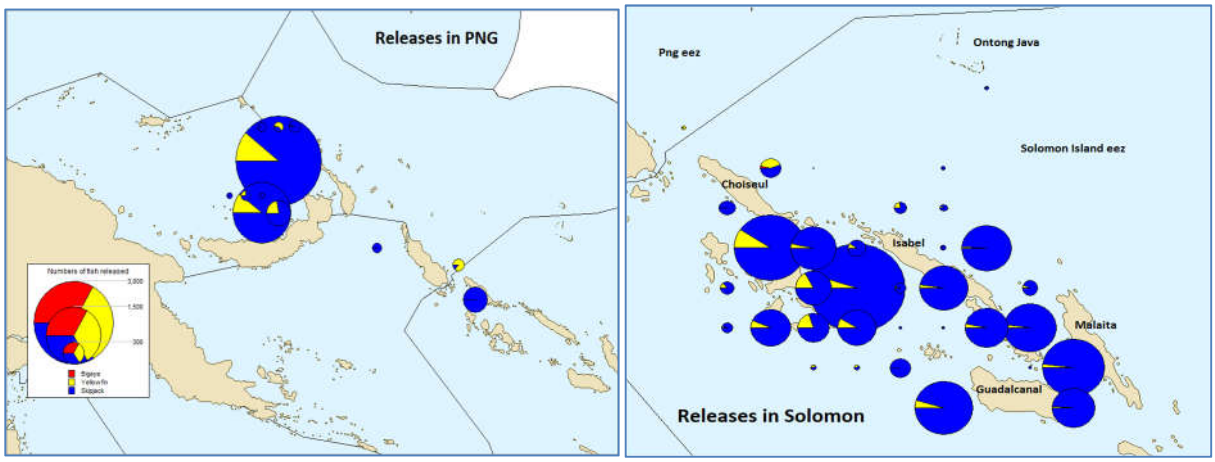

Figure 3. Distribution of tag releases per species in PNG (left) and Solomon (right) waters.

Releases by school association and by species for each voyage leg are given in Tables 2 and Table 3.

Table 2: Release per species and school association in PNG waters.

school association	BET	SKJ	YFT	Total	%
Seamount	0	2195	253	**2448**	**37**
Drifting Fad	1	32	58	**91**	**1**
Anchored Fad	0	2157	271	**2428**	**37**
Log	0	123	13	**136**	**2**
free school	1	1301	236	**1538**	**23**
Total	**2**	**5808**	**831**	**6641**	100

Table 3: Release per species and school association in Solomon waters.

School association	BET	SKJ	YFT	TOTAL	%
Seamount	-	853	20	**873**	**4**
Whale shark	-	436	25	**461**	**2**
Drifting FAD	2	810	38	**850**	**4**
Anchored FAD	4	12213	895	**13113**	**62**
Log	-	794	223	**1017**	**5**
Free school	12	4510	303	**4825**	**23**
Total	**18**	**19616**	**1504**	**21139**	100

Figures 4 and 5 display the length frequency for the fish tagged on each voyage leg.

2.1.2 Biological sampling

As part as its planned activities, the WP4 voyage provided a significant number of biological samples as identified in Table 4.

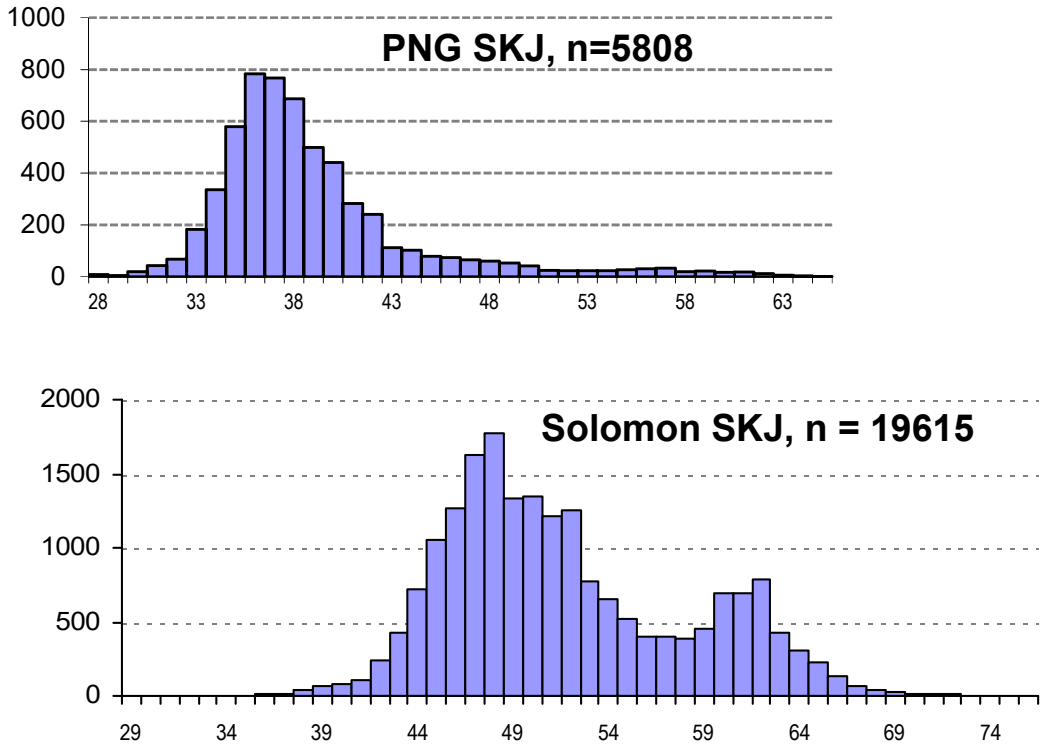

Figure 4: Length frequencies for tagged skipjack in PNG (top) and Solomon (bottom).

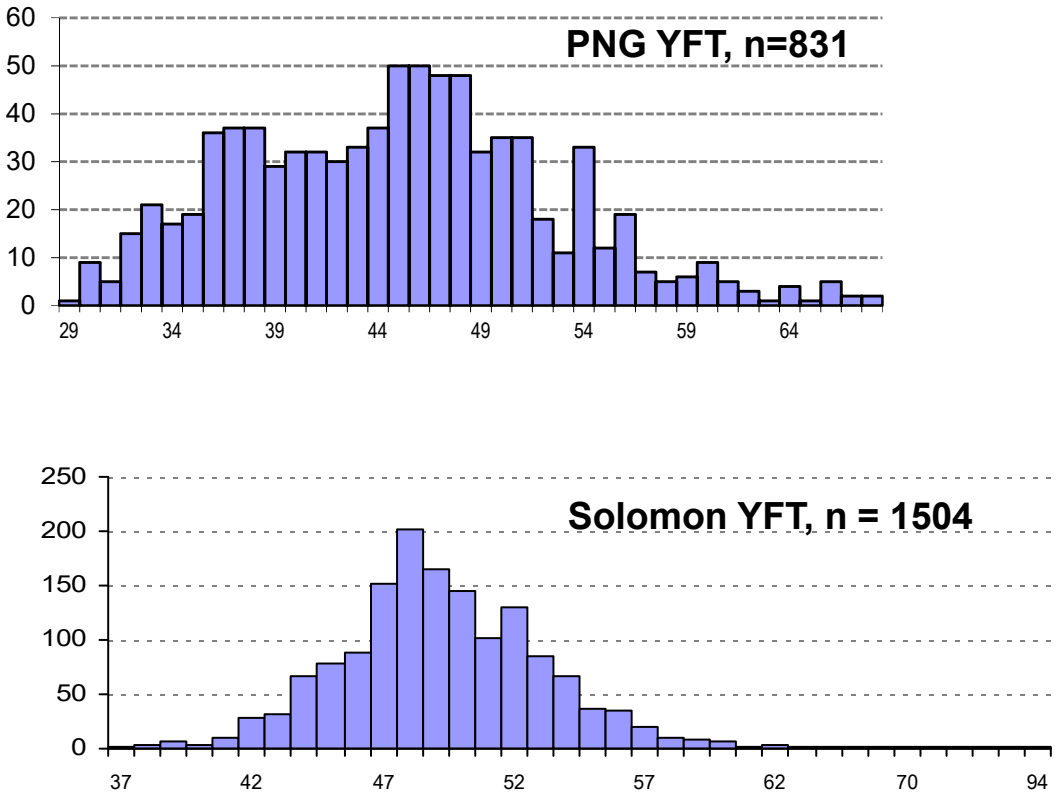

Figure 5: Length frequencies for tagged yellowfin in PNG (top) and Solomon (bottom).

Table 4: Number of samples per species and sample type

Species	Gonad	Liver	Muscle	Otolith	Spine	Stomach	Total
FRIGATE TUNA	4	4	4	3	4	4	23
MAHI MAHI / DOLPHINFISH	11	11	11	7	1	11	52
OCEAN TRIGGERFISH (SPOTTED)	1	1	1	1		1	5
RAINBOW RUNNER	13	13	13	9	1	13	62
SKIPJACK	183	182	182	178	173	183	1081
YELLOWFIN	79	79	79	78	69	78	462
Total	**291**	**290**	**290**	**276**	**248**	**290**	**1685**

2.1.3 WP4 result

The lack of bait and fish hampered the PNG leg of the WP4 voyage, resulting in in 50% lower success than expected from past experiences in those waters. In contrast, the skipjack tagging in Solomon Islands waters was exceptional in terms of the numbers and size of the fish tagged. The pole and line method of tag and release again allowed large-scale release of tagged skipjack tuna in a relatively short period. In summary, this was a very successful research voyage.

2.1.4 Papua New Guinea support

The PNG National Fisheries Authority (NFA) supported the PNG leg of the WP4 voyage by providing an additional tagger, a biological sampler and a security agent, and by helping vessel logistics in Buka port. Additionally, the NFA maintain the PNG Tag Recovery Officer network and have provided funding for tag rewards paid in PNG in 2017. An MoU between SPC and NFA has been renewed in 2018 to maintain ongoing collaboration for the PTTP.

2.1.5 WP4 key lessons

For any future WP pole and line campaigns to be successful, two challenges remain. In PNG waters better access to reliable bait grounds will need to be established. This will require support from NFA, especially with visits to all key bait ground areas to negotiate access in advance of the tagging research voyages. This is a time consuming and challenging task in remote areas, often with difficult access other than by sea.

The second challenge goes to the future of pole and line based research. As already reported to SC12 and SC13 (SPC-OFP 2016, SPC-OFP 2017a), the operational issues in getting a suitable research platform at a reasonable cost have reached limits that will constrain or even totally compromise future implementation of a similar tagging voyage. Currently there are only two options for pole and line vessel charter – NFD in Solomon Islands, as done for WP4, and Japan-based vessels. Based on the experience during WP4, the currently available vessels at NFD are becoming marginal because of cost, age and availability of spare parts. Japanese pole-and-line vessels, while they are larger and more flexible in their operational areas, are expensive, can only be chartered for a limited duration (due to the need to return to Japan to take on bait) and are not necessarily actually available for charter. It seems that unless we can share the costs of chartering a Japanese vessel with the Japan Far Seas Fisheries Research Laboratory, this option will remain out of reach. The most viable option for the region may well be to obtain its own (possibly shared with other RFMOs) suitable research platform. Following the discussions at SC13, SPC has made some progress in obtaining robust information to build the case for identifying a long-term multi-purpose tagging platform in the WCPFC area (see Section 4 for additional discussion of this issue).

3 PTTP RESULTS

The Pacific areas covered by the different tagging voyages implemented since 2006 are shown in Figure 1. Although there are noticeable gaps in coverage in the extreme east and west of the area, and in the southern latitudes, these are a direct result of the PTTP focus on the tropical tunas, and undertaking research voyages in areas and with methods with appropriate catch rates for research purposes.

The release numbers and recovery percentages to date of conventional and archival tags made during the 12 Central Pacific (CP) voyages, the PNGTP and Phase 1 and 2 of the PTTP are detailed in Table 5.

Table 5: CP, PNGTP and total PTTP tag release numbers, and % of recoveries to date (July 2018) of conventional and archival tags.

Project	Tag Type	Release Numbers				Recapture Percentages			
		SKJ	YFT	BET	Total	SKJ	YFT	BET	Total
CP	Archival	32	257	744	**1,033**	0.0	7.8	19.5	**16.0**
	Conventional	762	2,536	38,539	**41,837**	4.2	14.2	28.8	**27.4**
PNGTP	Archival	0	68	12	**80**	NA	27.9	58.3	**32.5**
	Conventional	80,444	27,065	2,915	**110,424**	20.2	18.6	21.2	**19.8**
Total PTTP	Archival	129	672	932	**1,733**	3.1	12.1	19.3	**15.3**
	Conventional	272,401	109,133	47,891	**429,425**	17.2	16.6	27.2	**18.2**

The number of tags released over time are substantial for the tropical tuna species, but small for albacore. The displacements as reported for the recaptures are shown in Figure 6 A-C. Note that these are only straight-line displacements for tagged tuna between their release and recovery positions. The results highlight a general lack of information for albacore, and that data in the most recent years relates largely to bigeye tuna in the central Pacific area.

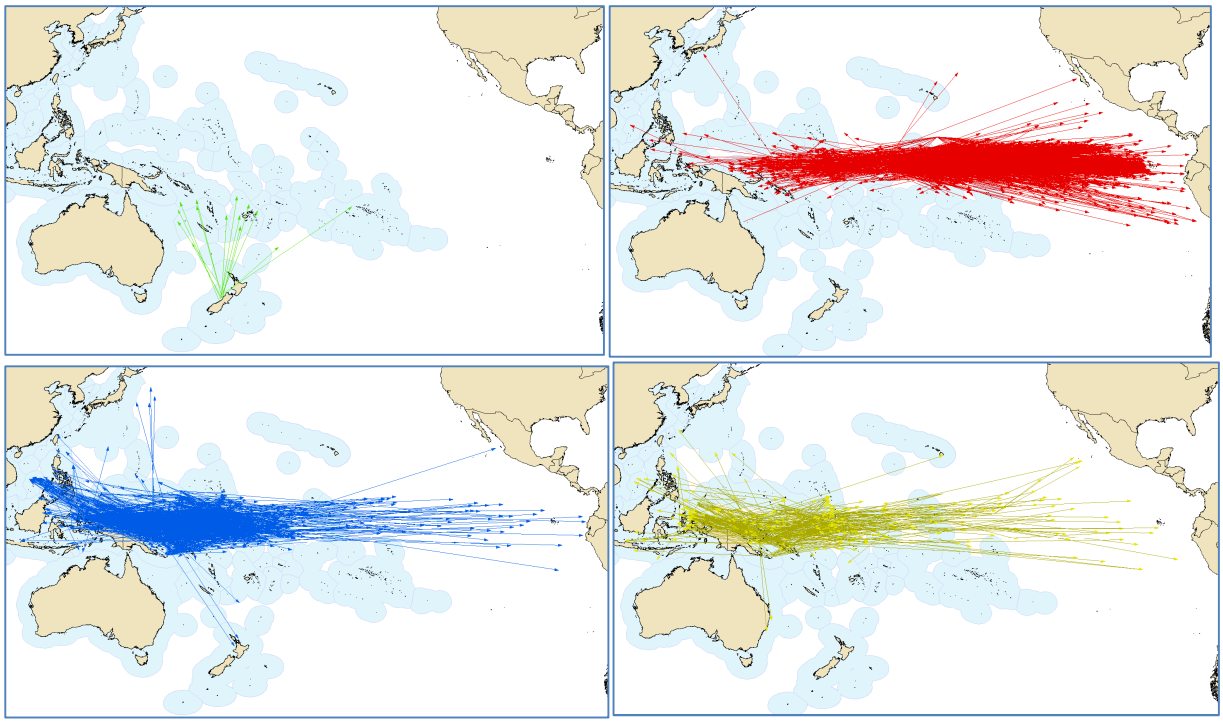

Figure 6A: Displacement of tagged tuna. Albacore (green) top left, bigeye (red) top right, skipjack (blue) bottom left and yellowfin (yellow) bottom right. All recoveries for all years with displacement >1000 nm.

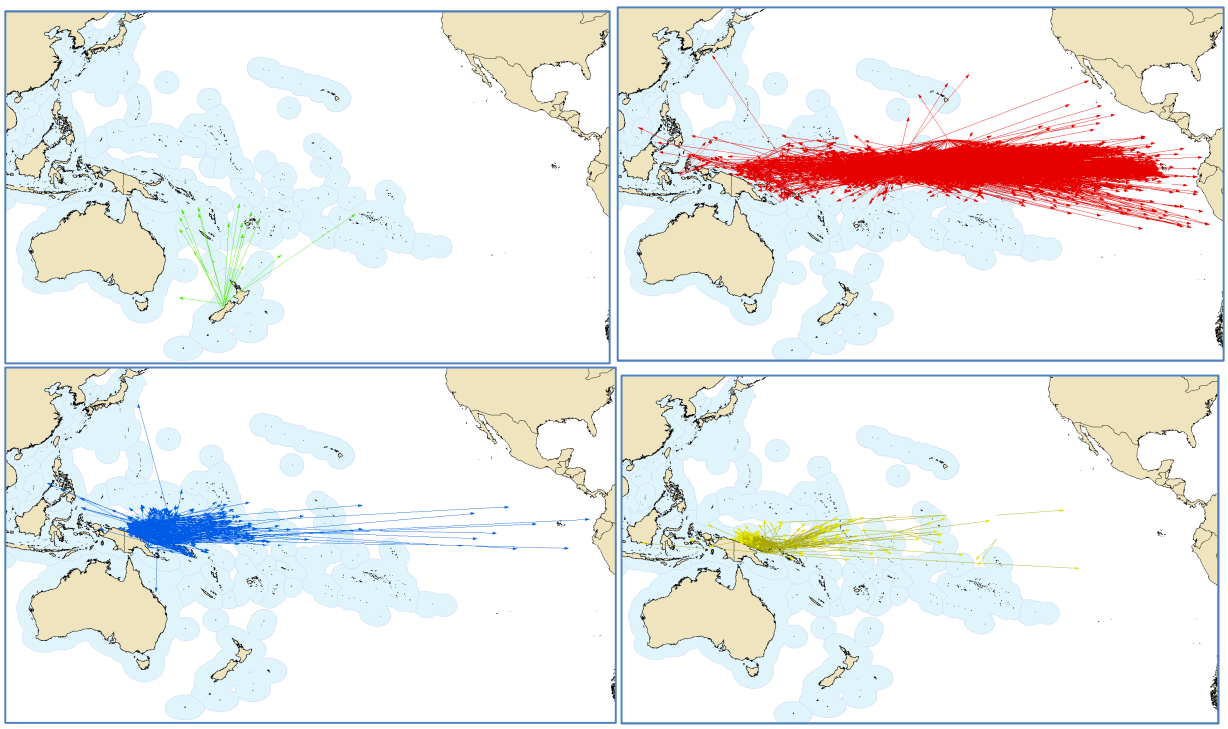

Figure 6B: Displacement of tagged tuna. Albacore in green (top left), bigeye in red (top right), skipjack in blue (bottom left) and yellowfin in yellow (bottom right). Showing all recoveries with displacements >500nm since 2007 for ALB and BET and since 2012 for SKJ and YFT.

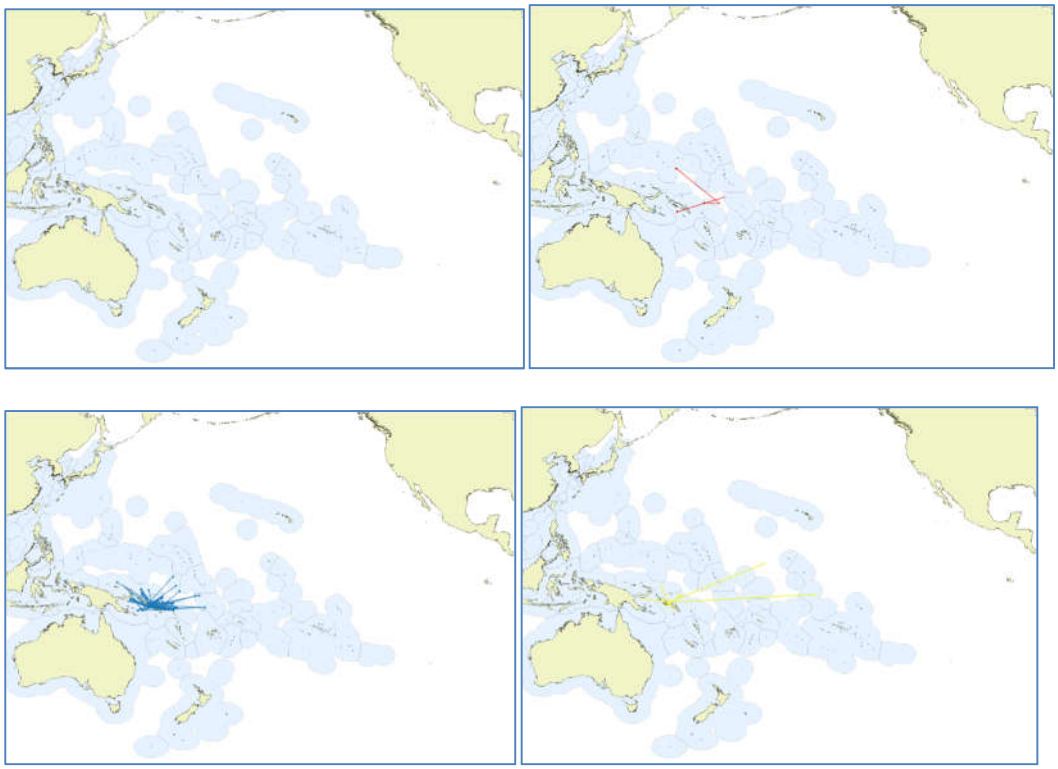

Figure 6C: Displacement of tagged tuna. Albacore in green (top left), bigeye in red (top right), skipjack in blue (bottom left) and yellowfin in yellow (bottom right). Showing all recoveries with displacements >300nm in the last year.

3.1 Biological sampling during tagging voyages

A total of 6279 stomach samples have been collected since the beginning of the PTTP, mainly from skipjack, yellowfin, bigeye and albacore tuna (Table 6).

Table 6: Total number of stomach samples collected and analysed to 30 June 2018.

PREDATOR SPECIES		COLLECTED	ANALYSED	% ANALYSED
ALB	ALBACORE	245	245	100%
YTL	AMBERJACK (LONGFIN YELLOWTAIL)	1	1	100%
BET	BIGEYE	477	367	77%
BUM	BLUE MARLIN	12	3	25%
FRI	FRIGATE TUNA	99	95	96%
NXI	GIANT TREVALLY	1	1	100%
KAW	KAWAKAWA	124	118	95%
MSD	MACKEREL SCAD / SABA	5	5	100%
DOL	MAHI MAHI / DOLPHINFISH / DORADO	87	45	52%
CNT	OCEAN TRIGGERFISH (SPOTTED)	1	0	0%
PLS	PELAGIC STING-RAY	1	1	100%
BRZ	POMFRETS AND OCEAN BREAMS	3	3	100%
CFW	POMPANO DOLPHINFISH	2	2	100%
RRU	RAINBOW RUNNER	145	112	77%
FAL	SILKY SHARK	4	4	100%
SKJ	SKIPJACK	2832	2474	87%
SWO	SWORDFISH	6	6	100%
WAH	WAHOO	16	6	38%
YFT	YELLOWFIN	2218	2017	91%
	TOTAL	6279	5505	88%

3.1.1 Tuna stomach contents

The examination of the stomachs is an ongoing process and is conducted in the laboratory at SPC, Noumea. A total of 5,505 stomachs, representing 88% of the samples collected, have been examined and the corresponding data entered into a dedicated database, BioDaSys (Table 6).

3.1.2 Tuna fat content

The tagging research voyages have provided the opportunity to measure the fat content of 4,167 specimens (Table 7). This fat content research is important in the context of ecosystem dynamics and due the specialist nature of the sampling, cannot be conducted by observers undertaking biological sampling on industrial fishing vessels. A recent analysis of the fat-meter measurements taken on skipjack, albacore and yellowfin highlighted:

- Juvenile albacore caught around New Zealand have an average fat content higher than adult albacore caught in subtropical areas (Tonga and New Caledonia). Juvenile albacore are in a fast growing phase and do have access to high quantities of high-energy content krill as food around New Zealand. Fat content increases with size for juvenile albacore between 45 and 80 cm, while it does not present a significant trend for adult tuna between 80 and 110 cm.

- Adult skipjack tuna caught in equatorial waters have higher fat content than juvenile skipjack caught in the same waters. It is hypothesized that adult fish have better access to prey. During the juvenile phase the fat content increases with the fish size between 25 and 50 cm. No difference in fat content has been recorded according to sex. No difference in fat content has been recorded between fish caught in free schools or under FADs. However, a FAD fish might have spent only a few hours under a FAD or a free school fish might have just left a FAD a few hours ago. The potential FAD effect is a complex topic to study, and it requires more sampling and analysis particularly to clarify how long the fish has spent under FADs and how many FADs it visited in the past weeks to properly identify and differentiate. Impact of ENSO on the fat content was explored but due to inadequate sample size, was inconclusive.
- Only juvenile yellowfin have been sampled and they show an increasing trend in fat content with size between 25 and 80 cm. No difference in fat content has been recorded according to sex. Fish caught under FADs have a significantly lower fat content than fish caught in free schools. However, a FAD fish might have spent only a few hours under a FAD or a free school fish might have just left a FAD a few hours ago. The potential FAD effect is a complex topic to study, and it requires more sampling and analysis particularly to clarify how long the fish has spent under FADs and how many FADs it visited in the past weeks to properly identify and differentiate. Impact of ENSO on the fat content was explored but due to inadequate sample size, was inconclusive.
-

Table 7: Total number of specimens where fat content has been analysed during tagging research voyages to 30 June 2018.

PREDATOR SPECIES		NB fish sampled
SKJ	SKIPJACK	2180
YFT	YELLOWFIN	1562
BET	BIGEYE	134
ALB	ALBACORE	287
FRI	FRIGATE TUNA	1
	TOTAL	4164

3.1.3 WCPFC Tuna Tissue Bank contribution

Additionally, the tagging research voyages provide a large volume of biological samples for the WCPFC Tuna Tissue Bank (total of 21,585 samples to date). In addition to the *fat-meter* analyses (see 3.2.1 above), a total of 6,479 fish have been sampled from which 7,063 samples have been analysed to date. For the WCPFC Tuna Tissue Bank as a whole, these tagging research voyage samples including fatmeter analysis represent 25.1% of the total fish sampled, 25.5 % of the total samples collected, and 32.1 % of the analyses processed from the tissue bank (Table 8). In general tagging research voyages continue to provide a key contribution to the WCPFC Tuna Tissue Bank and its utility (SPC-OFP, 2017b)

Table 8: Total number of samples collected from research tagging voyages and analysed to July 2018.

Predator species		Nb fish sampled	Total samples	Blood	Gonad	Liver	Muscle	Otolith	Spine	Stomach	Nb sample analysed	% analysed
FRI	FRIGATE TUNA	99	308		4	99	99	3	4	99	95	30.8%
ALB	ALBACORE	404	1514		269	276	277	259	188	245	786	51.9%
BET	BIGEYE	560	2065	30	191	475	510	281	101	477	632	30.6%
BRZ	POMFRETS AND OCEAN BREAMS	3	3							3	3	100.0%
BSH	BLUE SHARK	1	1				1				0	0.0%
BUM	BLUE MARLIN	13	55	5	8	12	13		5	12	3	5.4%
CFW	POMPANO DOLPHINFISH	2	4			1	1			2	2	50.0%
CNT	OCEAN TRIGGERFISH (SPOTTED)	1	5		1	1	1	1		1	0	0.0%
DOL	MAHI MAHI / DOLPHINFISH	88	273		31	73	74	7	1	87	45	16.5%
FAL	SILKY SHARK	4	12			4	4			4	4	33.3%
KAW	KAWAKAWA	124	316			96	96			124	118	37.3%
MSD	MACKEREL SCAD / SABA	5	15			5	5			5	5	33.3%
NXI	GIANT TREVALLY	1	1							1	1	100.0%
PLS	PELAGIC STING-RAY	1	3			1	1			1	1	33.3%
RRU	RAINBOW RUNNER	146	453		20	139	139	9	1	145	112	24.7%
SKJ	SKIPJACK	3654	9236		284	2773	2864	284	199	2832	2576	27.9%
SWO	SWORDFISH	6	15		1	4	4			6	10	66.6%
WAH	WAHOO	16	52		6	15	15			16	6	11.5%
YFT	YELLOWFIN	2739	7251	15	275	2133	2169	268	173	2218	2235	30.8%
YTL	AMBERJACK (LONGFIN YELLOWTAIL)	1	3			1	1			1	1	33.3%
	Total	**7868**	**21585**	**50**	**1090**	**6108**	**6274**	**1112**	**672**	**6279**	**6646**	**30.8%**

3.2 Conventional and archival tag recoveries for the PTTP

As at 21 June 2018, a total of 78,259 tagged tuna had been recaptured and the data reported to SPC. The numbers of conventional tag recoveries by species and by main tagging voyage are given in Table 9. Tag recoveries have occurred over the duration of the project, and are expected to continue. Tag attrition follows the expected declining pattern (Figure 7) with the rate of decline in skipjack tag returns indicating their shorter expected lifespan and higher natural mortality when compared to yellowfin and bigeye tuna. The recovery rates of yellowfin and bigeye tagged with archival tags and conventional tags vary depending on voyage (Table 10). Initial observations of this data suggest increased tag rejection/fish mortality with archival tagging on some voyages.

There is a notable reduction in bigeye conventional tag recovery rate from CP9 onwards (from ~30+% up to voyage CP8, down to 14% for CP9 and between 3 to 15% for CP10 to CP12, as shown in Table 8.

For CP10, CP11 and CP12 there are significant changes in the distribution of tag releases and subsequent fishing activity which appear to readily explain the differences in recapture rates. During these voyages, the release method changed with 45 to 95% of the releases being done on dFADs, as opposed to 100% at TAO buoys in previous voyages. This also changed the species composition of tagging with 20 to 30% less bigeye being tagged on dFADs compared to tagging on TAO buoys. Further, the dFADs were not fished in the following month as it was the FAD closure period (previously many fish were recaptured during this period, Figure 7). The assumption is that fish had more time to disperse before fishing recommenced, thus reducing the tag recapture rate. Also no large school aggregations were found around the TAO buoys during those two voyages with the maximum releases on one buoy being around 200 fish, whereas 1000-4000 fish had been released on at least one TAO buoy during the previous CP voyages.

The observed reduction in bigeye recovery rate for the CP9 voyage (14% c.f. 30 %+) is less readily explained. Possibly some of the fleets that increased their effort in the Phoenix and Line Islands EEZ after the CP9 voyage have not reported all their tag recoveries. This needs further investigation.

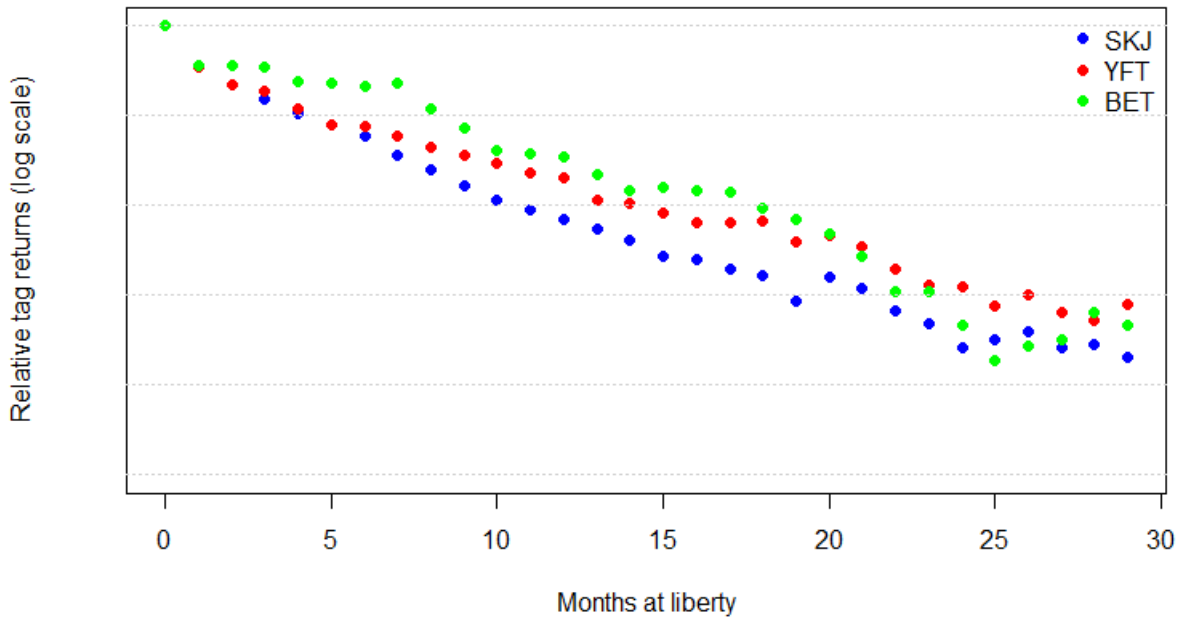

Figure 7: Tag recoveries by time at liberty for skipjack, yellowfin and bigeye tuna. Note that the values on the y-axis are uninformative and thus omitted. At the top-left the points (overlaid so as only BET shows) are the (species) specific maximum logarithm of recoveries, standardised so that the attrition curves all start at the same value. The gradient is a proxy for total mortality.

Table 9: Tag releases and recaptures for the PTTP to date (as at 21/06/2018).

Voyages	Releases				Number recovered (% recovered)			
	SKJ	YFT	BET	Total	SKJ	YFT	BET	Total
PG1 Aug-Nov 2006	13,948	7,806	562	**22,316**	2,645 (19%)	1,806 (23.1%)	229 (40.7%)	**4,680** **(21%)**
PG2 Feb-May 2007	26,493	12,845	129	**39,467**	2,508 (9.5%)	1,719 (13.4%)	8 (6.2%)	**4,235** **(10.7%)**
SB1 Oct-Nov 2007	7,479	3,565	139	**11,183**	1,976 (26.4%)	784 (22%)	18 (12.9%)	**2,778** **(24.8%)**
SB2 Feb-Apr 2008	15,327	14,405	414	**30,146**	1,765 (11.5%)	2,422 (16.8%)	62 (15%)	**4,249** **(14.1%)**
CP1 May-Jun 2008	57	116	1,736	**1,909**	4 (7%)	25 (21.6%)	575 (33.1%)	**604** **(31.6%)**
WP1 Jun-Nov 2008	37,691	17,647	1,467	**56,805**	6,378 (16.9%)	2,058 (11.7%)	362 (24.7%)	**8,798** **(15.5%)**
WP2 Mar-Jun 2009	34,207	13,919	3,145	**51,271**	4,608 (13.5%)	2,353 (16.9%)	489 (15.5%)	**7,450** **(14.5%)**
CP2 May-Jun 2009	169	205	2,309	**2,683**	5 (3%)	27 (13.2%)	573 (24.8%)	**605** **(22.5%)**
WP3 Jul-Oct 2009	30,722	7,340	735	**38,797**	6,699 (21.8%)	1,430 (19.5%)	197 (26.8%)	**8,326** **(21.5%)**
CP3 Oct-Nov 2009	66	237	4,802	**5,105**	2 (3%)	64 (27%)	1,770 (36.9%)	**1,836** **(36%)**
CP4 May-Jun 2010	7	120	2,284	**2,411**	1 (14.3%)	13 (10.8%)	513 (22.5%)	**527** **(21.9%)**
CP5 Nov-Dec 2010	40	228	6,090	**6,358**	7 (17.5%)	46 (20.2%)	1,962 (32.2%)	**2,015** **(31.7%)**
PNGTP1 Apr-Jul 2011	28,730	11,571	355	**40,656**	5,771 (20.1%)	2,479 (21.4%)	60 (16.9%)	**8,310** **(20.4%)**
CP6 Oct-Oct 2011	2	123	3,804	**3,929**	0 (0%)	29 (23.6%)	1,036 (27.2%)	**1,065** **(27.1%)**
CP7 Nov-Dec 2011	52	245	4,212	**4,509**	1 (1.9%)	21 (8.6%)	1,451 (34.4%)	**1,473** **(32.7%)**
PNGTP2 Jan-Mar 2012	28,312	9,607	2,008	**39,927**	7,232 (25.5%)	1,697 (17.7%)	521 (25.9%)	**9,450** **(23.7%)**
CP8 Sep-Oct 2012	20	140	6,014	**6,174**	2 (10%)	32 (22.9%)	2,304 (38.3%)	**2,338** **(37.9%)**
PNGTP3 Apr-Jun 2013	23,402	5,955	564	**29,921**	3,261 (13.9%)	870 (14.6%)	45 (8%)	**4,176** **(14%)**
CP9 Nov-Dec 2013	29	135	4,296	**4,460**	1 (3.4%)	11 (8.1%)	619 (14.4%)	**631** **(14.1%)**
CP10 Aug-Aug 2014	12	98	195	**305**	0 (0%)	6 (6.1%)	4 (2.1%)	**10** **(3.3%)**
CP11 Sep-Nov 2015	231	775	1,966	**2,972**	6 (2.6%)	25 (3.2%)	192 (9.8%)	**223** **(7.5%)**
PG6 Jul-Jul 2016	0	17	2	**19**	0 (NA%)	2 (11.8%)	0 (0%)	**2** **(10.5%)**
CP12 Sep-Oct 2016	109	371	1,575	**2,055**	3 (2.8%)	81 (21.8%)	235 (14.9%)	**319** **(15.5%)**
WP4 Sep-Nov 2017	25,425	2,335	20	**27,780**	3,950 (15.5%)	209 (9%)	0 (0%)	**4,159** **(15%)**
Total	**272,530**	**109,805**	**48,823**	**431,158**	**46,825** **(17.2%)**	**18,209** **(16.6%)**	**13,225** **(27.1%)**	**78,259** **(18.2%)**

Table 10: Comparison of archival and conventional tag recoveries by species and voyage for the PTTP, 2006-2017.

	Archival Recoveries (%) (Number tagged)				Conventional Recoveries (%) (Number tagged)			
Voyages	**SKJ**	**YFT**	**BET**	**Total**	**SKJ**	**YFT**	**BET**	**Total**
PG1 Aug-Nov 2006	100% (1)	37% (46)	44% (25)	**40.3% (72)**	19% (13,947)	23.1% (7,760)	40.6% (537)	**20.9% (22,244)**
PG2 Feb-May 2007	0% (1)	9.1% (187)	0% (23)	**8.1% (211)**	9.5% (26,492)	13.4% (12,658)	7.5% (106)	**10.7% (39,256)**
SB1 Oct-Nov 2007		0% (5)	0% (7)	**0% (12)**	26.4% (7,479)	22% (3,560)	13.6% (132)	**24.9% (11,171)**
SB2 Feb-Apr 2008		22.7% (22)	0% (1)	**21.7% (23)**	11.5% (15,327)	16.8% (14,383)	15% (413)	**14.1% (30,123)**
CP1 May-Jun 2008		40% (5)	24.4% (45)	**26% (50)**	7% (57)	20.7% (111)	33.4% (1,691)	**31.8% (1,859)**
WP1 Jun-Nov 2008		0% (13)	38.9% (36)	**28.6% (49)**	16.9% (37,691)	11.7% (17,634)	24.3% (1,431)	**15.5% (56,756)**
WP2 Mar-Jun 2009	0% (39)	3.6% (56)	3.7% (81)	**2.8% (176)**	13.5% (34,168)	17% (13,863)	15.9% (3,064)	**14.6% (51,095)**
CP2 May-Jun 2009		11.1% (9)	17.3% (81)	**16.7% (90)**	3% (169)	13.3% (196)	25.1% (2,228)	**22.8% (2,593)**
WP3 Jul-Oct 2009	5.4% (56)	7.7% (13)	0% (1)	**5.7% (70)**	21.8% (30,666)	19.5% (7,327)	26.8% (734)	**21.5% (38,727)**
CP3 Oct-Nov 2009		21.4% (28)	34.6% (107)	**31.9% (135)**	3% (66)	27.8% (209)	36.9% (4,695)	**36.1% (4,970)**
CP4 May-Jun 2010		10% (20)	12.8% (39)	**11.9% (59)**	14.3% (7)	11% (100)	22.6% (2,245)	**22.1% (2,352)**
CP5 Nov-Dec 2010			22.4% (58)	**22.4% (58)**	17.5% (40)	20.2% (228)	32.3% (6,032)	**31.8% (6,300)**
PNGTP1 Apr-Jul 2011		15.8% (19)	0% (3)	**13.6% (22)**	20.1% (28,730)	21.4% (11,552)	17% (352)	**20.4% (40,634)**
CP6 Oct-Oct 2011		50% (2)	15.7% (51)	**17% (53)**	0% (2)	23.1% (121)	27.4% (3,753)	**27.2% (3,876)**
CP7 Nov-Dec 2011	0% (30)	1.2% (85)	16.3% (92)	**7.7% (207)**	4.5% (22)	12.5% (160)	34.9% (4,120)	**33.9% (4,302)**
PNGTP2 Jan-Mar 2012		42.1% (19)	87.5% (8)	**55.6% (27)**	25.5% (28,312)	17.6% (9,588)	25.7% (2,000)	**23.6% (39,900)**
CP8 Sep-Oct 2012			44.4% (18)	**44.4% (18)**	10% (20)	22.9% (140)	38.3% (5,996)	**37.8% (6,156)**
PNGTP3 Apr-Jun 2013		26.7% (30)	0% (1)	**25.8% (31)**	13.9% (23,402)	14.5% (5,925)	8% (563)	**13.9% (29,890)**
CP9 Nov-Dec 2013		0% (1)	19.5% (41)	**19% (42)**	3.4% (29)	8.2% (134)	14.4% (4,255)	**14.1% (4,418)**
CP10 Aug-Aug 2014		12.5% (8)	4.2% (24)	**6.2% (32)**	0% (12)	5.6% (90)	1.8% (171)	**2.9% (273)**
CP11 Sep-Nov 2015		2.8% (71)	11.6% (95)	**7.8% (166)**	2.6% (231)	3.3% (704)	9.7% (1,871)	**7.5% (2,806)**
PG6 Jul-Jul 2016					NA% (0)	11.8% (17)	0% (2)	**10.5% (19)**
CP12 Sep-Oct 2016	0% (2)	14.3% (28)	15.1% (93)	**14.6% (123)**	2.8% (107)	22.4% (343)	14.9% (1,482)	**15.6% (1,932)**
WP4 Sep-Nov 2017		0% (5)	0% (2)	**0% (7)**	15.5% (25,425)	9% (2,330)	0% (18)	**15% (27,773)**
Total	**3.1% (129)**	**12.1% (672)**	**19.3% (932)**	**15.3% (1,733)**	**17.2% (272,401)**	**16.6% (109,133)**	**27.2% (47,891)**	**18.2% (429,425)**

The majority of recoveries have come from purse-seine vessels (92%), followed by pole and line and other gear types (4%), unknown (4%) and longline recoveries <0.5% (224 in total). Table 11 shows the number of recoveries by gear type for yellowfin and bigeye that have been at liberty for at least 1 year before recapture. After 1 year at liberty, the fish should be approximately 80cm-100cm in length and available to purse-seine and longline fleets. The same trend is observed if the analysis is restricted to just the spatial domain of the purse-seine fleet (10°N to 10°S). The accuracy of information returned from tags recovered on fishing vessels remains higher than that received from canneries or via transhipment (Figure 8). The information from transhipment on date and location of recovery is typically reported as unknown. To improve understanding of tag recovery patterns, the number of fish caught by purse seine needs to be compared with the numbers caught by longline to explore whether tag recoveries are really disproportionate or not between the fleets.

3.3 Tag Recovery staff

Across the region the previously full-time Tag Recovery Officers (TROs) have now taken on other duties at their respective local fisheries agencies, however they generally continue to act as TROs. New TROs have been appointed in Honiara and Noro, negotiations with Kiribati MFMRD to re-establish a full time TRO position in Tarawa are still in progress, and a new MOU with PNG has been established to maintain the PNG TRO network and initiate the recruitment of a TRO in Lae

Regular emails, visits in countries, as well as meetings held at SPC allow maintenance of constant contact with the existing network. Emails to raise awareness on the tagging program prior to research voyages and at the end of research voyages are now part of the ongoing awareness program. The PIRFO website is also use as a portal for awareness among observers.

Recovery information is received at SPC from TROs on a semester basis. The establishment of these TRO positions has provided greater opportunity for collection of tags during unloading, transhipments and processing in canneries with more complete and reliable capture information (Table 12). Major unloading and processing facilities as well as transhipping vessels in port have been visited by TROs over the last 12 months (excepted for Tarawa and LAE (PNG) where TRO positions have not as yet been re-established). An additional SPC staff is now entering tag recovery information into TagDager and undertaking validation process.

3.4 Tag Seeding

To date nearly 55% of seeded tags have been returned to SPC. In addition to allowing estimation of tag reporting rates, the tag seeding data also allow the error rate in tag return information to be determined (see Section 3.5; Peatman et al., 2016).

From February 2007 to July 2018, a total of 570 tag seeding kits (consisting of 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 (Table 13). Since 2011, kits have been modified to contain a mix of steel head and plastic barb tags to test the effect of tag type. When a kit is not completely deployed during a trip, the kit is either kept aside or used in another kit for deployment. Table 13 details the number of seeded tags deployed per EEZ to date.

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 570 kits distributed to observer coordinators, 417 have been given to observers for deployment, of which 352 tag seeding datasheets have been received for observer trips.

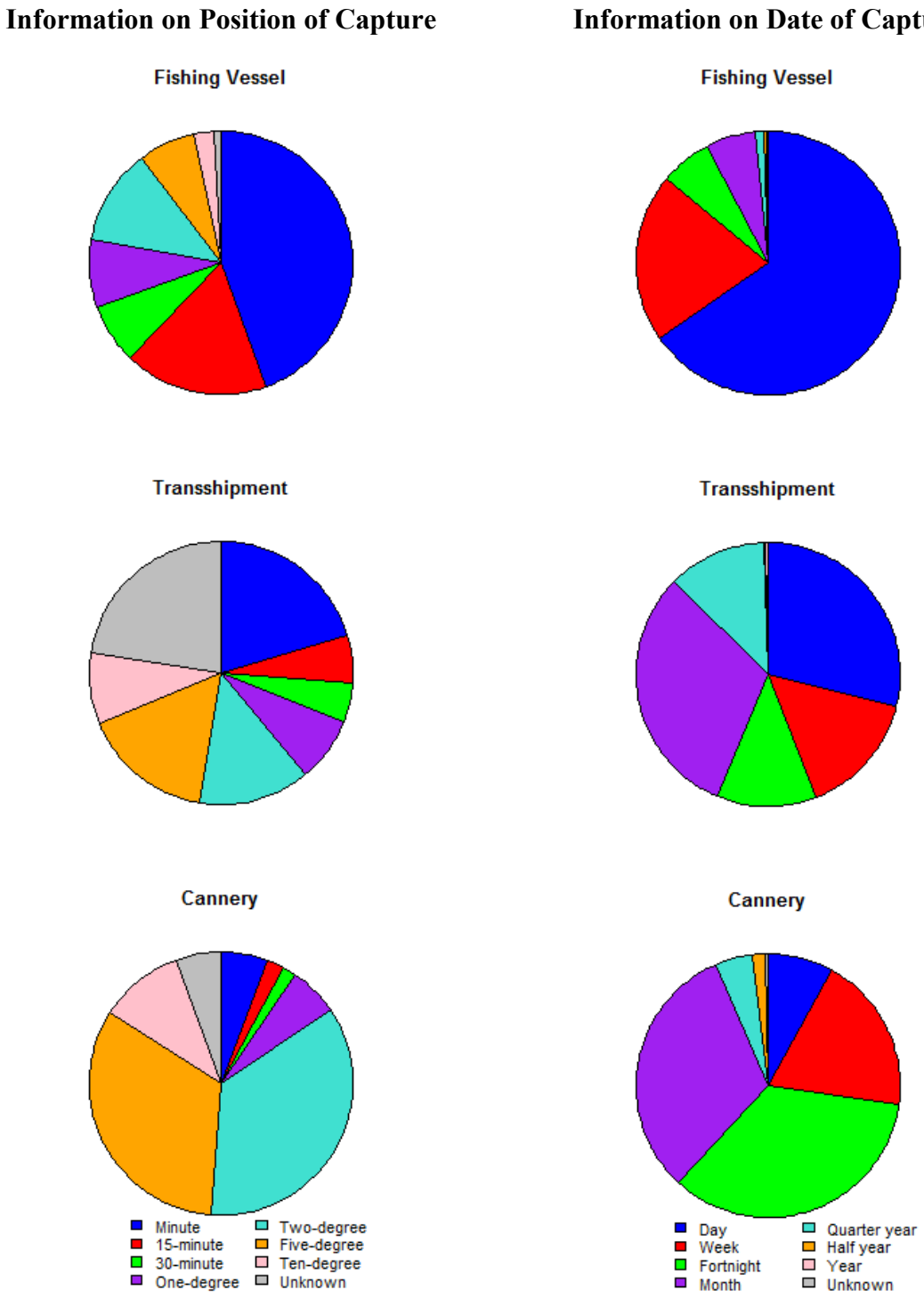

Figure 8: Location and date of tag recovery accuracy information for recoveries on fishing vessels, during transhipment and at canneries.

Since June 2017, 9 kits have been deployed, using a total of 237 tags. This is a lower rate of deployment in comparison to the previous year (11 kits for 294 tags). As at 1st July 2018, there have been 7,254 reported tags that have been seeded and 3,981 (54.8%) of these have been returned to SPC. Tables 14 and 15 detail the reporting of vessel name by location and cannery, respectively. 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 639 tags, was absent from the recovery information for 183 tags and was correct for 3159 tags.

3.5 Analysis of Tag Seeding data

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 were calculated for the revised regional structure included in the 2017 bigeye update assessment, using the approach outlined in Peatman et al. (2016). The RR prior parameters were insensitive to the shift of the northern boundary between regions 1 & 2 and 3 & 4 due to the low levels of purse seine effort between 10N and 20N west of 140E.

3.6 Analyses of Movement

Movement trends observed from both conventional and archival tags are consistent with expectations for highly migratory species with larger movements positively related to time at liberty (Figure 9).

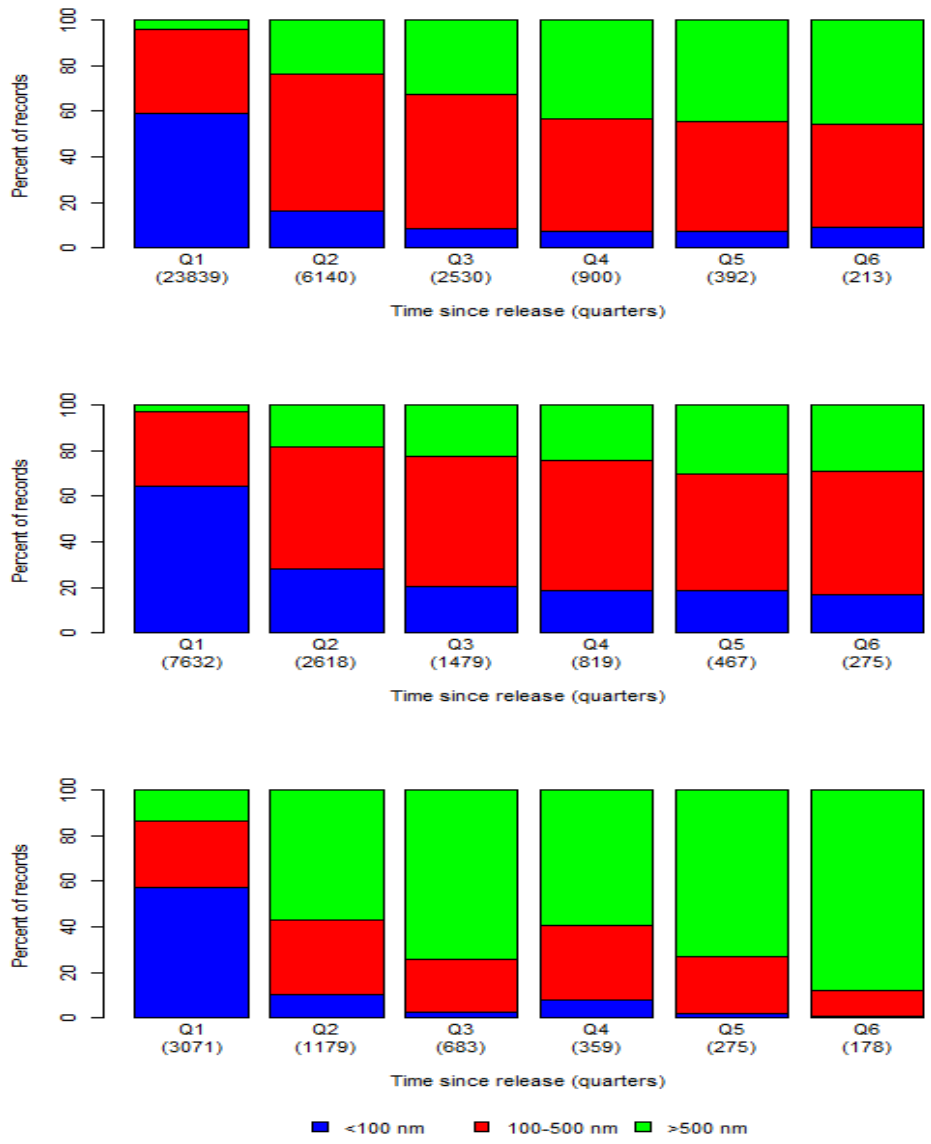

Figure 9: Reported recoveries within 100 nm, 100-500 nm and >500 nm in the first 6 quarters (18 months) since release for skipjack (upper graph), yellowfin (middle graph) and bigeye (lower graph). The sample size for each quarter is provided in the parentheses below the quarter label on the x-axis.

Table 11: Tag recoveries by gear type with ≥1 year at liberty.

Project	Recoveries		Purse Seine		Longline		Pole & Line		Other		Unclassified	
	YFT	BET	YFT	BET	YFT	BET	YFT	BET	YFT	BET	YFT	BET
PTTP Phase 1 - Papua New Guinea tagging project	408	9	364	6	13	1	1	0	18	0	12	2
PTTP Phase 1 - Solomon Islands tagging project	272	8	263	8	2	0	0	0	1	0	6	0
PTTP Phase 2 - Central Pacific #1	0	84	0	74	0	2	0	0	0	0	0	8
PTTP Phase 2 - Central Pacific #2	4	87	3	77	0	2	0	0	0	2	1	6
PTTP Phase 2 - Central Pacific #3	3	197	2	176	0	8	0	0	0	1	1	12
PTTP Phase 2 - Central Pacific #4	1	58	1	54	0	3	0	0	0	0	0	1
PTTP Phase 2 - Central Pacific #5	7	351	7	342	0	5	0	0	0	0	0	4
PTTP Phase 2 - Central Pacific #6	5	97	4	90	0	4	0	0	1	0	0	3
PTTP Phase 2 - Central Pacific #7	2	194	2	181	0	12	0	1	0	0	0	0
PTTP Phase 2 - Central Pacific #8	0	52	0	44	0	7	0	0	0	0	0	1
PTTP Phase 2 - Central Pacific #9	0	72	0	66	0	5	0	0	0	0	0	1
PTTP Phase 2 - Central Pacific #10	1	2	1	2	0	0	0	0	0	0	0	0
PTTP Phase 2 - Central Pacific #11	6	21	6	21	0	0	0	0	0	0	0	0
PTTP Phase 2 - Central Pacific #12	0	6	0	6	0	0	0	0	0	0	0	0
PTTP Phase 2 - Western Pacific #1	152	12	130	12	1	0	2	0	14	0	5	0
PTTP Phase 2 - Western Pacific #2	262	44	240	23	9	14	0	0	3	4	10	3
PTTP Phase 2 - Western Pacific #3	160	23	147	20	1	3	0	0	7	0	5	0
PNGTP - Papua New Guinea #1	254	2	241	2	5	0	0	0	0	0	8	0
PNGTP - Papua New Guinea #2	240	40	236	39	2	1	0	0	1	0	1	0
PNGTP - Papua New Guinea #3	43	6	41	4	0	2	0	0	2	0	0	0
PNGTP TAO trial Voyage #2	1	0	1	0	0	0	0	0	0	0	0	0
Total	**1,821**	**1,365**	**1,689**	**1,247**	**33**	**69**	**3**	**1**	**47**	**7**	**49**	**41**

Table 12: Tag recoveries by source and validation.

Source	Recov.	% Valid.	% VMS	% Logsheet	% Archival	% Buffer	% Other	% None	% No vessel name	% Vessel but no date	% Vessel but no position	% No length
American Samoa	2,183	96.34	93.20	0.19	0.48	0.00	0.33	5.80	3.11	1.65	28.03	23.77
China	35	42.86	20.00	0.00	0.00	0.00	0.00	80.00	80.00	0.00	2.86	77.14
Fishing vessel	557	92.82	80.46	1.74	0.00	0.00	15.09	2.71	1.80	0.72	3.59	4.85
FSM	697	89.10	96.78	0.81	0.16	0.00	0.00	2.25	2.15	1.00	9.76	25.25
FSM (SPC)	189	61.90	68.38	15.38	0.85	0.00	11.97	3.42	1.06	0.00	5.29	3.17
IATTC	9,625	25.11	47.12	3.97	1.45	0.00	14.40	33.06	23.78	10.58	14.48	70.90
Indonesia	5,984	81.23	0.12	0.00	0.00	95.19	3.25	1.44	2.07	0.00	5.01	5.60
IOTC	10	30.00	0.00	0.00	0.00	0.00	0.00	100.00	70.00	0.00	30.00	20.00
Japan	3,030	74.62	91.91	3.80	0.09	0.00	0.71	3.49	3.73	4.79	20.07	4.85
Kiribati (Kiritimati)	343	80.17	92.00	0.00	2.55	0.00	0.00	5.45	5.25	21.28	20.41	24.20
Kiribati (Tarawa)	1,038	84.39	72.03	0.11	0.68	0.00	0.46	26.71	21.58	3.37	17.53	9.54
Korea	610	68.69	16.23	1.19	0.24	0.00	0.48	81.86	82.30	0.00	4.10	9.84
Marshall Islands	1,014	90.14	88.40	8.86	0.44	0.00	0.44	1.86	1.38	2.56	12.13	26.23
Nauru	2	100.00	0.00	0.00	0.00	0.00	0.00	100.00	50.00	0.00	50.00	50.00
Philippines (direct)	8,444	56.68	67.09	4.35	0.06	0.00	7.71	20.79	16.65	4.73	26.40	65.67
Philippines (Frabelle)	352	51.99	97.27	0.55	1.64	0.00	0.55	0.00	7.39	3.12	0.85	27.56
Philippines (NFRDI)	175	49.71	59.77	4.60	0.00	0.00	4.60	31.03	10.29	0.00	10.29	13.71
PNG (China Fisheries Association)	7	14.29	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85.71	85.71
PNG (Dologen ltd)	1	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PNG (Fairwell Fishery)	28	53.57	60.00	20.00	0.00	0.00	0.00	20.00	3.57	10.71	39.29	32.14
PNG (Fong Seong Fishery)	7	100.00	85.71	14.29	0.00	0.00	0.00	0.00	0.00	28.57	28.57	0.00
PNG (Frabelle)	6,774	82.03	88.45	10.02	0.05	0.02	0.04	1.42	1.74	1.31	3.51	8.06
PNG (Japanese Far Sea Tuna Association)	2	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00
PNG (Korean Overseas Association)	3	66.67	100.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	33.33	33.33
PNG (Luminar Fishing)	12	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	8.33	16.67	0.00
PNG (NFA)	515	85.63	70.07	5.22	0.45	0.00	2.27	22.00	17.28	1.55	11.84	22.91
PNG (other)	1,076	79.65	71.30	0.82	0.12	0.00	0.12	27.65	6.13	2.23	14.78	12.45

Source	Recov.	% Valid.	% VMS	% Logsheet	% Archival	% Buffer	% Other	% None	% No vessel name	% Vessel but no date	% Vessel but no position	% No length
PNG (Pacific Blue Sea Fishing)	274	70.44	95.34	4.66	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00
PNG (RBL Fishing)	962	72.14	99.71	0.14	0.00	0.00	0.00	0.14	0.52	2.18	7.59	6.76
PNG (RD)	9,517	93.59	80.07	17.95	0.06	0.00	0.03	1.89	1.77	0.53	2.30	3.94
PNG (RR Fishing)	30	83.33	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PNG (Sepik Coastal Agencie)	10	100.00	90.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00	10.00	10.00
PNG (SST)	1,438	43.53	62.94	13.58	0.00	0.00	11.98	11.50	36.16	1.39	29.62	34.49
PNG (Taiwan Deep Sea Association)	19	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	5.26	15.79	5.26
PNG (TPJ Fishing)	1,860	69.09	89.18	4.36	0.08	0.00	0.39	5.99	4.25	2.31	4.35	6.34
PNG (TSP Marine)	457	83.81	99.48	0.00	0.00	0.00	0.00	0.52	0.00	1.09	7.22	2.41
Solomon Islands (Global Investment)	1,083	97.88	78.87	12.55	0.00	0.00	0.00	8.58	8.59	1.02	1.94	55.96
Solomon Islands (Korean Deep Sea Association)	355	59.15	100.00	0.00	0.00	0.00	0.00	0.00	0.28	10.14	14.08	7.32
Solomon Islands (MFMR)	508	46.26	75.32	3.83	2.55	0.00	0.00	18.30	8.27	0.59	13.39	22.24
Solomon Islands (NFD)	7,838	92.12	81.20	18.46	0.01	0.00	0.00	0.32	0.15	2.04	9.31	13.91
Solomon Islands (other)	200	78.50	85.35	2.55	0.00	0.00	0.00	12.10	17.00	3.00	10.50	33.00
Solomon Islands (Soltai)	3,070	92.74	79.87	10.89	0.00	0.00	0.56	8.68	7.13	0.16	1.53	2.70
Solomon Islands (Taiwan Deep Sea Association)	559	95.35	100.00	0.00	0.00	0.00	0.00	0.00	0.00	1.79	1.97	1.07
Solomon Islands (Western Solomon ventures limited)	11	63.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00	27.27	27.27	9.09
Tagging vessel	240	56.25	2.22	0.00	0.74	0.00	95.56	1.48	0.42	0.00	9.17	2.08
Taiwan	69	91.30	95.24	0.00	0.00	0.00	0.00	4.76	0.00	0.00	23.19	0.00
Thailand	10,748	63.32	93.45	3.64	0.16	0.00	0.04	2.70	1.44	0.06	95.37	1.65
Vanuatu	30	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	293	65.53	56.77	1.56	10.94	0.00	6.77	23.96	14.68	0.00	10.58	33.11

Table 13: Number of seeded tags deployed per EEZ since the beginning of the project.

EEZ	Releases
Not known yet	1,801
American Samoa	3
Cook Islands	62
Federated states of Micronesia	328
Fiji	7
Gilbert Islands	635
Howland & Baker	4
Indonesia	7
International waters H4	88
International waters H5	73
International waters I2	114
International waters I4	25
International waters I5	15
International waters I6	59
International waters I9	5
Jarvis	5
Marshall Islands	91
Nauru	224
Northern Line Islands	20
Other international waters	4
Papua New Guinea	2,047
Phoenix Islands	390
Samoa	20
Solomon Islands	624
Tokelau	184
Tuvalu	419
Total	**7,254**

Table 14: Vessel reported per locations of seeded tag recovery.

Recovery location	All tag recoveries	Tag seeding recoveries (TSR)	Wrong vessel reported (TSR)	No vessel reported (TSR)	Correct vessel reported (TSR)	% correct vessel
GENERAL SANTOS, Philippines	8,553	231	71	23	137	59.3
HONIARA, Solomon Islands	1,558	473	79	2	392	82.9
LAE, PNG	5,457	192	41	5	146	76.0
LONDON, Kiribati	162	2	0	0	2	100.0
MADANG, PNG	2,880	300	59	0	241	80.3
MAJURO, Marshalls	1,201	280	29	0	251	89.6
MANTA, Ecuador	1,473	48	13	0	35	72.9
NORO, Solomon Islands	10,772	52	20	1	31	59.6
PAGO PAGO, A. Samoa	2,169	523	45	22	456	87.2
POHNPEI, FSM	982	134	39	0	95	70.9
PORT MORESBY, PNG	524	80	14	0	66	82.5
RABAUL, PNG	396	133	34	0	99	74.4
SAMUTSAKOM, Thailand	10,705	611	242	6	363	59.4
SAN DIEGO, USA	8,274	193	35	78	80	41.5

Recovery location	All tag recoveries	Tag seeding recoveries (TSR)	Wrong vessel reported (TSR)	No vessel reported (TSR)	Correct vessel reported (TSR)	% correct vessel
SHIMIZU, Japan	3,001	7	2	1	4	57.1
TARAWA, Kiribati	1,033	176	6	4	166	94.3
VIDAR, PNG	7,149	192	13	1	178	92.7
WEWAK, PNG	6,984	253	88	1	164	64.8

Table 15: Vessel reported per cannery (Thailand).

Cannery Name	Tag seeding recoveries	Wrong vessel reported	No vessel reported	Correct vessel reported	% correct vessel reported
Asian Alliance International	21	0	1	20	95.2
CHOTIWAT	15	15	0	0	0.0
EKSAKHON COLD STORAGE CO., LTD	30	6	0	24	80.0
ISA VALUE	8	4	0	4	50.0
PATAYA FOOD INDUSTRIES LTD.	131	94	0	37	28.2
PREMIER CANNING INDUSTRY	1	1	0	0	0.0
R.S. Cannery Co., Ltd.	36	9	0	27	75.0
Songkla Canning PLC.	62	44	0	18	29.0
SOUTHEAST ASIAN PACKAGING	50	8	0	42	84.0
Thai Union Manufacturing Co.	57	10	0	47	82.5
TROPICAL CANNING	15	2	0	13	86.7
Unicord	1	1	0	0	0.0
Unicord Public Co., Ltd.	111	23	2	86	77.5

3.7 Tagging simulator

The Ikamoana individual-based model, which has been developed specifically for examining movement hypotheses for pelagic species, is now available to be applied to the design and analysis of the PTTP or other monitoring programmes (Scutt Phillips et al., 2018). Movement parameterisations for a skipjack-specific model have been incorporated from a recent SEAPODYM solution (Senina et al. 2016), allowing the movement of both individual or cohesive schools of skipjack to be simulated in the Pacific Ocean. Historical or future fishing effort can be exerted upon modelled cohorts, and the levels of depletion (or any other spatiotemporally varying data) tracked and compared between individuals. An initial suite of simulations for skipjack tag releases in assessment regions 2 and 5 have been undertaken to examine the degree of tag mixing that may have occurred during recent years of differing ENSO phase. Model runs consisted of simulating an entire cohort of skipjack tuna in the Pacific Ocean, and comparing the relative catch per assessment region over time with that experienced by fish released only at typical tag release event locations in a separate simulation.

Preliminary results suggest similar conclusions to previous work on mixing (e.g. Kolody & Hoyle 2015). Under the current movement assumptions, it appears that within-region mixing rarely occurs within a time-frame consistent with current stock assessment assumptions. However, simulation results are highly dependent on the environmental forcing of the ENSO phase being examined, and some examples of relatively more complete mixing appear possible under certain temporal and release location scenarios. In particular, releases in the

Solomon Sea show lower initial dispersal than other locations but good levels of mixing in region 5, particularly during a 2010 La Niña simulation scenario. Conversely, more oceanic releases in the EEZ of the Federated States of Micronesia exhibited better mixing in region 2 during the non-La Niña time periods simulated. Simulated releases in the Bismarck Sea area were, in general, consistently over-depleted compared to fish of the same cohort for all assessment regions into which tagged fish subsequently moved.

It is clear that a balance must be obtained between releases in logistically more challenging locations, which appear to drive greater within-region mixing of tagged fish, and releases in core fishing areas where high fishing effort and lower effort result in tag return data that are less representative of the entire, untagged cohort in that region. Further examination of these results and additional simulations would provide guidance on future design of PTTP skipjack research voyages. Additionally such work may reveal scenarios under which historic tag returns previously not used in MF-CL assessment due to the presently assumed mixing period of one quarter, could now be included for more data-rich assessments.

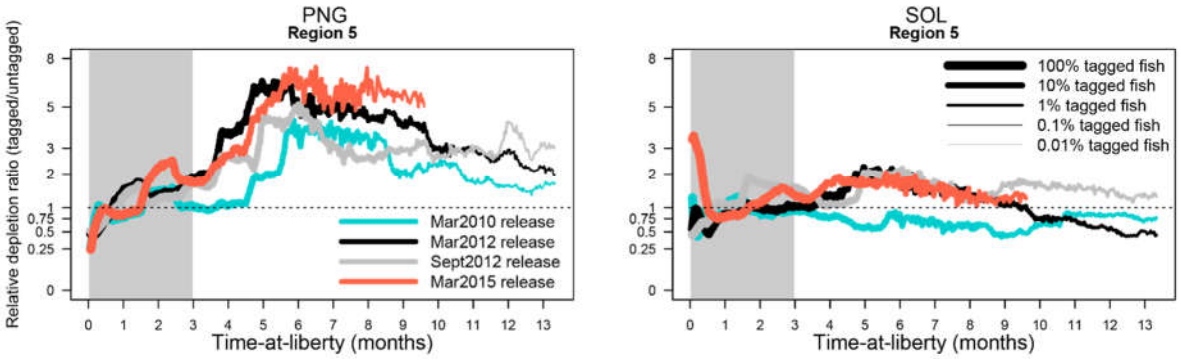

Figure 10: Example comparison of relative depletion ratios between simulated tagged schools and the untagged cohort in assessment regions 5, during the first 14 months at liberty for skipjack released at 40cm FL. Results are shown for releases from a Bismarck Sea location (left, 'PNG') and Solomon Sea location (right, 'SOL'). Line colours denote different temporal release scenarios, with line widths showing the percentage tag fish in region. Note non-linear scales for the y-axes and line-width.

3.8 Albacore tagging

A description of albacore tagging activities was outlined previously in WCPFC-SC5-2009/GN IP-16 and WCPFC-SC6-2010/GN IP-06. Since SC13, no new tag recapture has been reported with the total of 31 recoveries (1%) for the project. Movements of recaptured fish for which we received accurate recovery position are displayed in Figure 11.

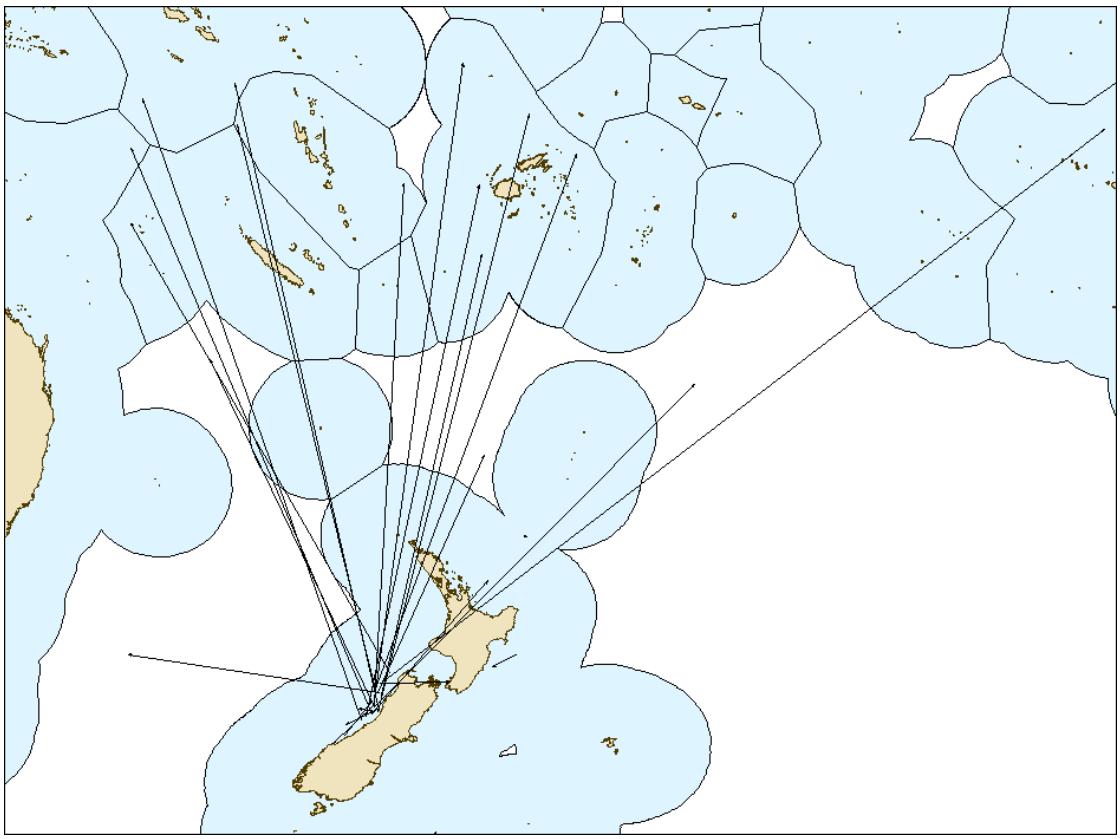

Figure 11: Release-recovery arrow map for albacore tags reported to SPC.

3.9 Database 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 authorised users. The purpose of the web tagging data system is to:

- identify fake recovery: e.g. tags lost/tag used for training or publicising the tagging project/tag already recovered;
- access the release information (vessel, date of release, latitude and longitude of release, species, length);
- help to validate “date found” (the “date found” cannot be a date before the “date release”).
- estimate “date caught” when date found is only provided
- search release information relative to tags seeded; and
- provide full access to the TagDager DB from any authorised users connected to the web.

These improvements to the tag databases will improve tag quality and significantly reduce the risk of attempted tag reward fraud.

4 ISSUES ARISING

By just about any measure, the PTTP has been very successful to date and with the significant commitment from the Commission to ongoing funding in late 2016, and again in 2017, the successful WP4 and the CP12 voyage now underway, this programme looks set to continue as a strong part of WCPFCs science for the medium term. However, there remain significant issues facing the success of any tuna tagging research in the region.

First is the issue of increasing costs of vessel time. This has two major effects, one is that to stay within existing budgets we have to constrain the amount of at-sea time and thus the amount and spatial distribution of tagging which can be undertaken. The other is that to complete research targets we need to seek additional funding. The increased funding from WCPFC in 2017 and 2018 and in the indicative budget for out years will help this.

Second is the availability of suitable research vessels. The most reliable and successful approach – globally, and in the WCPO – for large-scale tagging of skipjack tuna is to use the pole and line method of fishing. At the same time, this fleet has shrunk globally to the point where there now remain only a very small number of vessels in the Pacific region that can be utilised for this research. Those that remain are in high demand for industrial fishing as they produce a sought after product, especially those in the north Pacific. Those that remain in the south Pacific are either too small, or are rapidly ageing and through a combination of deterioration and limited spare parts availability no longer offer sufficiently reasonable conditions to be used for research (see Section 2.1.5). This creates considerable difficulty in procuring a vessel for this pole and line research, and means that we become a price-taker as the market is non-existent. This is a very significant cost pressure on the research programme. WP4 in 2017 was only possible due to a significant input of funding from SPC-OFP (approximately one-third of the total costs of around USD 675,000). That source of funds has now been fully utilised and we do not anticipate that SPC will be able to supplement funding for tagging cruises to the same extent in the future.

Although several suitable longline vessels exist in the region for the various line fishing techniques used to target bigeye tuna (although very few possess the range required for our current research needs), the reality is that none are designed for research fishing. By way of example, a constraint often encountered is the number of science staff that can be placed on the vessel, especially to allow fishing throughout the day and night. This in turn limits the amount of tagging that can be completed, with the consequence that either more time at-sea is required, or less research is conducted. The space for science staff is even more substantive an issue in pole and line based tagging.

These issues build a strong case for identifying a long-term multi-purpose tagging platform in the WCPFC area. 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. Obviously, such a proposal would need to be carefully investigated before moving to deciding to obtain such a platform. Accordingly, SPC has let a small consultancy to undertake a pre-assessment of some of the operational costs of a dedicated tuna research vessel for the Pacific Ocean. The preliminary results of that work are available to inform PTTP steering committee discussions. A more comprehensive cost analysis of such an approach to fisheries and ecosystem research for WCPFC is urgently required to progress this concept. SPC have prepared a draft terms of reference for such an analysis (see Appendix II). It is intended that the PTTP Steering Committee discuss this matter further at its 2018 meeting (Appendix I) with a view to progressing such a consultancy as soon as practical.

5 PTTP 2018-2021 workplan

The PTTP Steering Committee will meet during SC14. A draft agenda for the meeting is attached at Appendix 1. The workplan identified in 2017 (SPC-OFP, 2017a) has been completed. The proposed workplan for the PTTP for 2018-2021 is highlighted in Table 16 below. The workplan recognises the decisions of SC in 2016 to normalise the tagging programme (WCPFC SC, 2017) and the decisions of SC in 2017 where this rolling medium-term research workplan was endorsed (WCPFC-SC 2017).

6 RECOMENDATIONS

SC14 is invited to note the report of ongoing progress in implementation of the PTTP. In particular we recommend that SC:

- Note the successful 2017 research voyage, including participation from local science staff in PNG waters;
- Support the 2019 tagging programme, and associated budget;
- Support the 2020-2021 tagging programme, and associated indicative budget;
- Consider and support the PTTP workplan for 2018-2021; and
- Support a project to address the increasingly urgent issue of cost-effectiveness of vessel charter in relation to acquiring a dedicated tagging vessel.

Table 16: Proposed PTTP workplan for the period 2018-2021.

ACTIVITIES		2018	2019	2020	2021
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.		Plans to be refined after assessing viable available options		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.	A charter arrangement has been concluded with an Hawaiian LL company to use their FV GutsyLady4 to implement a 35 day research voyage from mid-July	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.				
5.	Develop new tag recovery poster.				
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.				
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 analyses.		Optimal design for 2019 research voyage		
PLANNING					
14.	Review and update research plan	Ongoing annual task for rolling plan.			
15.	Consultancy on cost-effectiveness of a research vessel.				

7 ACKNOWLEDGEMENTS

Material for this report was provided by T. Peatman[1], S. Caillot[1], B. Leroy[1], F. Roupsard[1], J. Muir[2], J. Scutt Phillips[1, 4], C. Sanchez[1], T. Usu[3], B. Sabub[3], J. Hampton[1], and N. Smith[1].

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APPENDIX I

Proposed agenda for the 2018 PTTP Steering Committee meeting

PROVISIONAL AGENDA
PACIFIC TUNA TAGGING PROGRAMME STEERING COMMITTEE
17:30-19:00, Thursday 9 August 2017 (tbc)
(Venue TBC)

1			**PRELIMINARIES**
	1.1		Review and adoption of agenda
2			**PTTP PROGRESS REPORT**
	2.1		PTTP Activities (RP-PTTP-02)
		2.1.1	*At-sea*
		2.1.2	*Tag recovery*
		2.1.3	*Tag data analyses*
3			**WORK PLAN 2018-2021**
	3.1		2018 Bigeye research voyage (RP-PTTP-02)
	3.2		Tag recovery network (RP-PTTP-02)
	3.3		2019 Skipjack research voyage (RP-PTTP-02)
	3.4		Research voyages beyond 2019 (RP-PTTP-02)
	3.5		Related work in 2019 and beyond (RP-PTTP-02)
	3.6		Cost-effectiveness of a dedicated vessel (RP-PTTP-02)
4			**OTHER REGIONAL OR SUB-REGIONAL TAGGING**
5			**ADMINISTRATIVE MATTERS**
6			**ADOPTION OF REPORT**

APPENDIX II

Proposal for a study to assess the operational costs of a dedicated tuna research vessel for the Pacific Ocean

(DRAFT Terms of Reference)

Investigating the potential for a WCPFC tag research vessel	
Project	**Investigating the potential for a WCPFC tag research vessel**
Objectives	To explore the costs and benefits of the permanent use of an adaptable research vessel dedicated to the collection of the data used in tuna stock assessment in the WCPO.
Rationale	**A. Rationale for project** **1. General** More than 70% of the global tuna catch are fished in the Pacific Ocean for an estimated value of over US$6 billion. The harvesting level of tuna resources and the efficiency of the involved industrial fleet henceforth impose a very responsive management mode. The management measures need to be supported by strong evidence based on high quality data allowing stock assessment containing a minimum of uncertainty. The data obtained independently from the fishing fleets have become essential and the science based management bodies have the responsibility to support their analysis with the best scientific evidence available. This requires a continuous acquiring of mortality rates for the impacted species, a detailed knowledge of their biology, along with their behaviour in response to fishing gears and in response to the variations in their environment. Assessing the fishing impact on the whole ecosystem requires collecting data on all the species living in association with tuna and tuna-like species, data about their prey and the pelagic ecosystem. The collection of all this information requires the permanent use of an adaptable research vessel properly designed for the purpose. There are currently no suitable tuna research vessels available in the region (or beyond). Concurrently the fleet of vessels available to charter for research, especially in pole and line fisheries, are becoming increasingly difficult to procure or no longer meet standards necessary for the conduct of research. Accordingly it is appropriate timing to carefully explore the permanent use of an adaptable research vessel dedicated to the collection of the data used in tuna stock assessment. **2. SC 13 and SC 14** At SC13 the PTTP Steering Committee considered the issue of the availability of suitable tagging vessels, especially for pole and line based research, at its 11th meeting during SC13. The PTTP Steering Committee endorsed the proposal outlined in SC13-RP-P42-02 Appendix II and recommended that SC13 support an assessment of the cost-effectiveness of acquiring a dedicated tagging vessel (SC13-RP-P42-01).

The 2018 report of the PTTP highlights the increased urgency of conducting this work (SPC-OFP 2018). At SC14…to be completed at meeting.

B. Current availability of suitable research platforms

1. For tagging experiments

Tagging studies are commonly used in fisheries research to improve estimation of animal population size, mortality, movement (spatial stock structure) and growth. Until now, large scale tuna tagging campaigns for skipjack tuna have chartered medium-size commercial fishing boats around 200 GT tonnage (199 GT for last PTTP, 237 GT for IOTP) for cost reasons, and also due to size restrictions on bait ground access and restricted suitable anchorage in some areas. Releasing a large number of conventionally tagged tuna implies the use of a pole-and-line vessel, but suitable such tagging platforms are becoming increasingly scarce worldwide. In most countries, pole-and-line fleets have been replaced by purse-seine fleets.

Research cruises more orientated towards electronic tagging and targeting all size tuna and their associated species need a more polyvalent tagging platform that could deploy a large variety of fishing gears (horizontal and vertical longlines, troll lines, danglers, rod and reel etc…). Catching and handling large size fish requires a working deck with easy access to the sea and a boat with high manoeuvrability facilitated by steering commands located at the working deck level. For example, the design of a standard Japanese pole and line vessel is not suitable for the purpose.

In the Pacific, some longline type fishing boats have been used to target the tuna schools that are associated with floating objects, mainly the oceanographic buoys (TAOs) that are anchored along the equator and the drifting FADs used by the purse seine fleet. The distances involved between floating objects and from ports with appropriate facilities for deploying a research voyage require the use of long-range (> 6,000 nm) platforms which are not common in the region for the necessary size of fishing vessels for successful research.

2. For collecting ecosystem biological and physical data

This necessitates the use of gears that are usually not found on a commercial tuna fishing vessel, including : trawling nets to catch tuna prey and plankton size organisms, CTDs to collect sea water temp/depth profiles, and multi-beam echo-sounders that can manage continuous records of highly detailed bio-acoustic data.

Boats used in this type of research are typically from the oceanographic vessel category. They are usually linked to governmental scientific institutes. To operate the different types of gears used at an ocean wide scale, those vessels need to be large (>400 GT). To cover important operational and maintenance costs, their use is often shared between multidisciplinary research projects. Their availability is therefore limited, subjected to utilisation applications that need to be planned years in advance.

C. Arguments for the construction of a new multipurpose platform dedicated to tuna research:

	1. Practicality: • Tuna tagging data are likely to become increasingly important and need to be collected continuously rather than episodically. Other types of data need to be continuously collected to monitor the ecosystem changes. • The pole and line vessels that can currently still be chartered are disappearing along with the associated fisher knowledge on operations and bait grounds. These platforms cannot cover all the different data collection needs. • The global applicability of continuous data collection is likely to facilitate collaboration between the different tuna commissions (RFMOs). The cumulated needs at the Pacific scale could probably cover most parts of the yearly schedule of a single boat. • A crew specifically recruited and trained to the specific research methods and strategies will be more capable than a commercial fishing boat crew that often need a long training period before they become fully efficient. **2. Cost:** • Continuous research would avoid the substantial establishment costs needed each time a new programme is started. • Some examples: ➢ Previous recent charter costs, including fuel, for a long range tuna tagging platform (about 200GRT) were situated between 150,000 and 200,000 USD/month. The WP4 charter cost jumped to 420,000 USD/month. Recent enquiries to utilise vessels from the north Pacific suggest considerably higher costs. ➢ The total tagging platform charter costs spent during each of the last large tagging projects (PTTP and IOTP) is over the current estimated cost for building a new boat of around 35 metres/200GRT (*Between 5 and 8 USD millions, IOTP vessels were built at about 4 USD millions in 2000*). Last estimation for the currently running (2017) AOPT total charter cost is 9.1 million Euro (ICCAT, SCRS/2014/092). ➢ A pre-assessment of some of the operational costs of an appropriate platform that could be built to address all the tuna research needs for the Pacific Ocean has been provided to SPC by F&S, a consultancy office specialized in the fisheries sector. That work would be available to this project.
Scope	The project would assess the full range of operational costs, including options on governance, inter-RFMO vessel sharing, multiple research modes, and future vessel replacement. These costs should be compared with the costs and benefits of the current approach. However, the current approach is not sustainable so the cost

	benefit analysis will need to consider alternate benchmarks in combination with the current approach. The scope of work includes undertaking this assessment utilising suitable external experts. A report will be prepared and provided to SC15 for its consideration.
Timeframe	Start early 2019, completed by late 2019
Budget	2019 USD$125,000 *Note that this covers the Scientific Services Providers input to the project, the cost of the external consultancy and reporting of the project outcomes to SC.
References	PTTP Steering Committee. 2017. Report of the Pacific Tuna Tagging Programme Steering Committee. SC13-RP-PTTP-01. Thirteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Rarotonga, Cook Islands, 9-17 August 2017. PTTP Steering Committee. 2018. Report of the Pacific Tuna Tagging Programme Steering Committee. SC14-RP-PTTP-01. Fourteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Korea, 8-17 August 2018. SPC-OFP. 2017. Project 42: Pacific Tuna Tagging Project Report and Workplan for 2017-2020. SC13-RP-PTTP-02. Thirteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Rarotonga, Cook Islands, 9-17 August 2017. SPC-OFP. 2018. Project 42: Pacific Tuna Tagging Project Report and Workplan for 2018-2021. SC14-RP-PTTP-02. Fourteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Korea, 8-17 August 2018.