SCIENTIFIC COMMITTEE
FIFTEENTH REGULAR SESSION

Pohnpei, Federated States of Micronesia

12-20 August 2019

Project 35b: WCPFC Tuna Tissue Bank

WCPFC-SC15-2019/RP-P35b-01
Rev.1* (27 July 2019)

SPC-OFP

***Rev. 1** Table 4A (annual additions to collection) and 4B (total collection) had identical data, the annual additions to the collection data. Accordingly, Table 4b has been revised to include the actual total collection data.

EXECUTIVE SUMMARY

1. The WCPFC Tuna Tissue Bank (TTB) has been established over several years. The current project runs to 31 December 2019 with funding for 2020 and 2021 subject to the decisions of WCPFC 16 and WCPFC 17. The tissue bank is increasingly used externally and in the science of WCPFC (e.g. yellowfin age and growth).
2. Regular age and growth analyses of specimens for all tuna and tuna-like stocks for future stock assessments should be budgeted for and aligned with the stock assessment schedule. The priority species for the next phase of work remains albacore.
3. In addition to ensuring a flow of key samples into the TTB on an ongoing basis, other areas of current focus are to enhance the TTB through improvements to processes and systems, development of appropriate cost recovery models for sample access, improving researcher access to information about the samples and analyses available, expanding available storage and ensuring sample longevity through accessing long-term super-cold storage. The storage in Noumea has been expanded again this year by an additional 10% to cope with demand.
4. Training in biological sampling for observers and refresher courses continue. Observer sampling instructions have been updated and now include instructions to sample striped marlin. Materials for PIRFO Debriefers in biological sampling is now fully developed and used by debriefers and is currently awaiting the next PIRFO standards meeting to be accepted into the PIRFO training standards.
5. The deposits to the TTB over the period 01 July 2018 through 30 June 2019 include an additional 600 specimens with over 93% of these from five core species (albacore, bigeye, skipjack, yellowfin, and mahi mahi). The sampling effort per year (mean sampling rate per observer trip) was similar to the sampling effort in 2015; however with less than half the number of observer trips with biological sampling in 2018 compared to 2015, the number samples collected was the lowest since 2012.
6. The 2018 dedicated special print t-shirt recognising efforts in 2017 was discontinued this year due to the reduced number of samples collected in 2018 by the observers. Alternative approaches to incentivise sampling effort continue to be investigated, and revitalised member support is needed.
7. The online and database components of the TTB continue to be enhanced and are increasingly used: www.spc.int/ofp/PacificSpecimenBank.
8. One new external request was received in 2018-19. Sample extraction for Project 82 has been completed along with other internal sample requests as required. All researchers with current projects provided annual progress reports to the WCPFC Secretariat.
9. An ongoing programme of work to maintain and enhance the WCPFC Tuna Tissue Bank is identified and it is recommended that the WCPFC SC continue to endorse this work as essential.
10. The annual cost of supporting the WCPFC Tuna Tissue Bank now that it is established is USD97, 200 baselined in 2018, with an annual inflation adjustment agreed by the Commission in 2018 for out-years. The SC15 needs to decide if it wishes to place an indicative annual budget of USD101,180 continuing in 2021 and USD103,200 in 2022 (USD99,195 is already in the indicative budget for 2020). This comprises 60% for tuna tissue bank coordination, information management and training for samplers, 23% for sampling fees and freight, and 17% for the additional storage facility in Brisbane.

1. INTRODUCTION

The WCPFC Tuna Tissue Bank (TTB) has been established over several years (SPC-OFP, 2017) and its ongoing operation is now funded by WCPFC through Project 35b. The objective of the project is to maintain the WCPFC TTB with particular emphasis on WCPO bigeye, yellowfin, albacore and skipjack tunas, and swordfish, and, to facilitate transmission of samples to specified researchers with due cognizance of the WCPFC TTB Access Protocols (Anon., 2016). SPC as the Scientific Services Provider is tasked to maintain and develop the WCPFC TTB and through the biological sampling programme expand the inventory of samples held. This project currently runs to 31 December 2019 with funding for 2020 and 2021 subject to the decisions of WCPFC 16 and WCPFC 17.

This annual report briefly outlines:

- the history of the TTB and its current focus
- sample collection techniques and systems, including updates on samples collected this year
- changes to sample storage facilities
- the TTB database and developments of BioDaSys
- recent use of the TTB from within and external to the WCPFC
- work to maintain and enhance the TTB
- matters arising and future work is outlined for TTB steering committee consideration, and
- recommendations for the TTB steering committee and SC to consider.

An agenda for the 2019 inaugural meeting of the TTB steering committee is provided in Appendix I.

1.1 TUNA TISSUE BANK ORIGINS

The Western and Central Pacific Fisheries Commission (WCPFC) identified that information gaps in key biological parameters reduced the reliability of stock assessments and management measures for several large pelagic fish stocks in the Western and Central Pacific Ocean (WCPO).

The TTB began as part of Project 35 which was implemented over eight years (Nicol et al., 2011, 2014, 2015; Smith et al., 2016; SPC-OFP, 2017). It was originally designed to address the scientific committee's requirements for improved knowledge on albacore and bigeye tuna age, growth and reproductive biology. In 2011, WCPFC provided funding to collect 2500 otoliths and 300 gonads across the WCPO to estimate spatial variation in growth and reproductive biology. The European Union provided further funding in 2014 to extend this collection to other tuna and billfish species for the purposes of establishing a WCPFC tissue bank that would allow the WCPFC to have immediate access to biological material to answer stock biology and provenance questions. The project successfully met the sampling targets set through 2015 (Nicol et al., 2015).

In 2016, WCPFC funded two projects, Project 35 – Bigeye biology, and Project 35b – Tuna Tissue Bank to distinguish the two work streams. In 2017, the work specified under Project 35 was completed (SPC-OFP, 2017; Farley et al., 2017). In completing Project 35, SC13 endorsed the need to adopt a longer-term plan of work to ensure age and maturity data to generate growth curves and maturity ogives, with focus on characterizing spatial and temporal variation in growth, are available for the key tuna stocks, not just for bigeye tuna, following the agreed schedule for tuna stock assessment. Additional work on bigeye tuna was proposed, with the next phase of work to focus on yellowfin tuna(Anon., 2017a). Subsequently the additional bigeye tuna work has been completed (Farley et al., 2018a) and the yellowfin tuna work commenced (Farley et al., 2018b). In 2018, the priority species for the next phase of work was identified as albacore (SPC-OFP, 2018).

1.2 THE TUNA TISSUE BANK

WCPFC established its TTB so that national and international fisheries research institutes can access the collections to undertake the necessary research to enhance understanding of the dynamics of tuna and related species in the WCPFC region (including analyses to estimate spatial and temporal explicit age, growth and reproductive parameters, and genetics for stock structure for use in stock assessments).

In a broader ecosystem context, the collections are also used for trophic and system studies including diet analyses, stable isotopes, mercury and other biochemical elements for trophic structure and movements and taxonomic studies. Previous projects have seen a system of observer training, training of trainers, sample kit distribution, observer sampling at-sea and port-sampler sampling in port, sample transfer and sample curation established so that researchers can access an online database (Biological Database System – BioDaSys) of the WCPFC TTB. Procedures for granting access to the WCPFC TTB by third parties have been established and implemented (Anon., 2016).

1.3 CURRENT FOCUS

Recent analyses have demonstrated important spatial and temporal differences in the age, growth and reproductive biology's of tunas which exert considerable influence on the estimation of stock status in relation to fisheries reference points (e.g., bigeye tuna age and growth studies McKechnie et al., 2017, Farley et al., 2017). To reduce these uncertainties SC has prioritised its work programme to undertake and refine stock-wide studies on the age, growth and reproductive biology of tunas and billfishes (e.g. Projects 35 on bigeye tuna, Project 81 on refined bigeye tuna age and growth, Project 82 on yellowfin tuna age and growth and Project 94 - Workshop on yellowfin and bigeye age and growth) (Anon., 2017a; Anon., 2019a). Field work is underway through the tagging programme to lay the foundation for future work on skipjack and albacore, e.g. strontium chloride marking of skipjack tuna otoliths during WP5, and changes in tag rewards for albacore tuna in the longline fisheries (SPC-OFP, 2019a).

The range of analyses conducted through the tissue bank is rapidly expanding beyond age and growth, with external researchers utilising the resource to explore issues such as tropic positioning (Houssard et al., 2017) and to confirm species identification (Williams et al., 2018). There are several projects underway utilising TTB specimens to explore tuna stock structure and provenance with modern genetic approaches (e.g. CSIRO, Australia; Thünen Institute of Fisheries Ecology, Germany; and, University of the South Pacific, Fiji), some now beginning to present results, such as those on yellowfin tuna (Anderson et al., 2019). Many of these projects have the additional benefit of better informing ecosystem considerations, especially allowing better specification of Project 62's Spatial Ecosystem and Population Dynamics Model (SEAPODYM) (Senina et al., 2018).

In addition, to ensure a targeted flow of key samples into the TTB on an ongoing basis, the other areas of current focus are to:

- consistently enhance the WCPFC TTB through improvements to the TTB processes and systems
- develop appropriate cost recovery models for access to samples
- improve researcher access to information about the samples and analyses available, and
- ensure sample longevity through accessing a permanent long-term super-cold storage facility.

2. SAMPLE COLLECTION AND TTB PROGRESS IN 2018-19

This section addresses sample collection and the associated observer standards and training, samples collected in 2018-2019, the current range of storage facilities, and the status, development and use of the TTB database BioDaSys.

2.1 SAMPLE COLLECTION

To simplify the sampling numbering system as much as possible the WCPFC ROP Observers are issued with biological sampling kits that include sample tags that are already numbered (see Figure 1). The BioDaSys database tracks the distribution of kits and sample tags allowing the coordinators of the repository to ascertain the status of sampling supplies allocated to each ROP Observer and to ensure that regional observer offices have sufficient stock to replenish observer supplies.

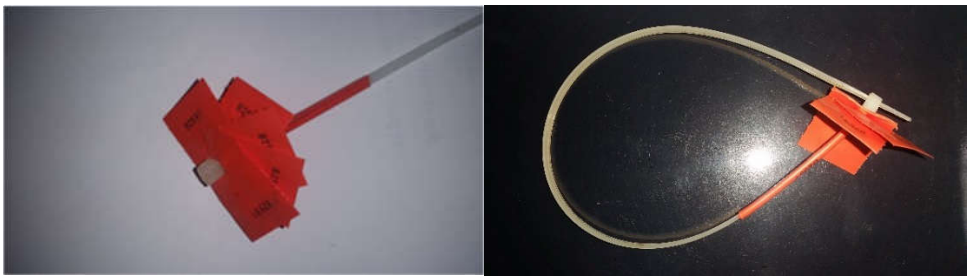

Figure 1. Photos of the cable tie tag that is issued to observers with unique numbers on them.

Biological sampling kits contain data sheets, pencils, knives, saws, cutters, cable tags, sample jars and bags, and instructions have been updated (see Figure 2 and Smith et al., 2016 *Appendix I* for Sampling Instruction Sheets). Gonad sampling and fixation instructions have also been developed for port sampling (see Smith et al., 2016 *Appendix II*). From 2018, instructions now also include mahi mahi and wahoo otolith and internal organ sampling, swordfish head and anal ray sampling, blood sampling, and otolith extraction, sample preservation quality codes, as well as more precise instructions for coordination at port.

Figure 2. Examples of the equipment and supplied provided to observers in the biological sampling kits.

2.1.1 Observer Training Standards

PIRFO standards of observers in biological sampling continue to be maintained at each upgraded training in biological sampling. Theoretical modules in understanding scientific sampling requirements and data collection continue to be updated, giving further skills to the observers in interpreting information from multiple sampling strategies. A video on striped marlin sample collection has been created, but needs further development to be provided at all biological sampling upgrade trainings. Gonad histological preparation is now demonstrated at all biological sampling upgrade trainings. The observer manual created and updated to the current sampling requirement (see Smith et al., 2016 *Appendix IV* for Biological sampling manual for observers and port samplers) is now used for all observer biological sampling upgrade trainings and is available in each members' country to brief observers before placement. A training manual has also been prepared (see Smith et al., 2016 *Appendix*

V for Observer training modules for biological sampling), and is still under revision to include new training procedures. Training for debriefers in biological sampling has been developed and is awaiting the next PIRFO standards meeting to be accepted into the PIRFO training standards.

2.1.2 Training Observers and Observer Trainers

Senior observers that remain active in the WCPFC ROP and within National Programmes continue to be identified and provided with training and refresher training in biological sampling, including fish hard part extraction, tissue sampling, gonad sampling and data recording. Training has also included sample handling and transportation procedures. An additional 12 observers were trained in 2018-19, and several refreshers were undertaken as described in Table 1. The number of observers trained to date is 492. In 2017-18, to increase sampling quality, new debriefing forms were developed requiring specific training. Materials and standards for training of debriefers in biological sampling have again been updated, and two debriefers were trained in 2018-19. Table 1 provides a summary of samplers trained during observer training, port sampling training and refresher training by nationality. Table 2 provides a summary of the number of observer trainers who can deliver biological sampling training by nationality. Table 3 provides a summary of the number of debriefers who can debrief observers in biological sampling in their respective ports.

Table 1. Summary of observers, port samplers, canneries and fisheries officers trained in biological sampling by nationality.

Country	No. of samplers	Country	No. of samplers
Cook Islands	4	Papua New Guinea	79
Fiji	47	Palau	12
Federated States of Micronesia	74	Solomon Islands	64
Kiribati	48	Chinese Taipei	33
Marshall Islands	40	Tonga	19
Nauru	9	Tuvalu	10
New Caledonia	2	Vanuatu	25
French Polynesia	5	Samoa	23

Table 2. Summary of observer trainers trained to deliver biological sampling training by nationality.

Country	No. of trainers
Federated States of Micronesia	2
Kiribati	1
Marshall Islands	2
Nauru	1
Papua New Guinea	3
Solomon Islands	2

Table 3. Summary of debriefers trained in debriefing biological sampling.

Country	No. of debriefers
Federated States of Micronesia	4
Marshall Islands	5
Tonga	1
Samoa	1
Cook Island	1
PNG	2

2.2 TTB SAMPLE COLLECTIONS IN 2018-19

Samples continue to be collected by national at-sea and in-port observers across the WCPO. Observers and port samplers collect to a strategy that optimizes the number of samples per set and maximizes sampling across sets and trips to create the greatest temporal spatial coverage possible. Opportunistic sampling on scientific cruises has also been undertaken and continues on the WP5 skipjack cruise which is now underway (SPC-OFP, 2019a).

In 2018-19, an additional 2,688 samples were collected from 600 fish and deposited in the TTB (see Table 4a). Samples were taken from 253 yellowfin, 79 skipjack, 104 bigeye, 88 albacore, 6 wahoo, 35 mahi mahi, 8 striped marlin, 17 rainbow runner, and 10 other species of fish. The provisional total SPC Marine Specimen Bank incorporating the WCPFC TTB sample holdings to 30 June 2019 include 73,880 available samples from 26,206 individual specimens (see Table 4b). The tables below summarise the tissue samples per species. Note the numbers of samples is greater than the number of fish as multiple samples are often available for the same fish. These data do not include samples awaiting cataloguing. The quantity and details of such samples have not as yet been verified due to the extended length of some observer trips, or the requirement to complete consecutive trips and the biological sampling information having not yet been submitted by the observer programme.

In 2018, an additional 347 fish were collected by the observers at-sea which represents 58% of all the fish sampled. The number of trips on which sampling occurred, the numbers of samples collected, and the sampling effort per year (mean sampling rate per trip) are given by year for 2012-2018 in Figure 3. In 2018, the number of observer trips on which sampling occurred dramatically decreased and the collection of samples was consequently reduced by 46% on the previous year (Figure 3). The rate of sampling of various species in key areas is monitored, and to the extent possible, observer and port sampler tasking is directed to ensure spatial, species and temporal spread across the WCPO.

To recognise the effort involved in biological sampling and those who put in the effort, sampling appreciation certificates were distributed in late 2015 to encourage and acknowledge the work of the samplers across the WCPO (see Smith et al., 2016). To continue this recognition, we selected observers from each country that contributed most to the sampling collection during the year 2017 and a dedicated special printed shirt was distributed to each selected observer (see SPC-OFP, 2018). This initiative was well received by the sampling network, but was discontinued this year due to the lack of samples collected in 2018 by the observers. Alternative approaches to incentivise sampling effort are needed and will be investigated and pursued for 2019-2020 (see Section 3.4.3). Opportunities arising from Project 90 sampling will also be utilised where possible (SPC-OFP, 2019b).

To incentivise collection of biological samples from archival tagged fish and fish with chemically marked otoliths (white tagged fish) caught by longline and purse seine vessels, a new reward is now in place and new posters have been created and are currently under translation (see Appendix II). Onboard purse seine vessels, observers are rewarded USD50 to coordinate the collection of biological samples and associated data for each fish. Onboard longline vessels, in addition to the current reward rate, the approach for tagged fish is to purchase them whole at a rate of USD10/kg.

Table 4a. Summary of 2018-19 additions to the WCPFC Tuna Tissue Bank (01 Jul 2018 – 30 Jun 2019).

Species		Hard parts		Reproduction	Multi-purpose				Diet
	Curated	Otoliths	Spine	Gonads	Blood	Muscle	Liver	Fin	Stomach
Bigeye	104	84	82	79	33	101	78	0	17
Yellowfin	253	192	189	246	26	230	154	0	79
Skipjack	79	76	75	78	0	79	78	0	78
Albacore	88	87	62	86	0	88	42	0	42
Swordfish	0	0	0	0	0	0	0	0	0
Wahoo	6	5	0	0	0	6	5	0	5
Mahi Mahi	35	18	0	0	0	35	14	0	13
Striped Marlin	8	6	8	8	0	7	8	2	8
Rainbow Runner	17	0	0	1	0	16	16	0	17
Other#	10	1	0	6	0	9	8	0	5

Table 4b. Total holdings in SPC Marine Specimen Bank incorporating the WCPFC TTB (at 30 Jun 2019).

Species		Hard parts		Reproduction	Multi-purpose				Diet
	Curated	Otoliths	Spine	Gonads	Blood	Muscle	Liver	Fin	Stomach
Bigeye	4,156	2,793	668	2,712	116	2,966	1,649	0	664
Yellowfin	7,726	4,358	1,678	4,292	223	6,145	4,657	0	1,946
Skipjack	4,704	1,824	1,258	1,686	114	4,395	4,423	0	1,742
Albacore	3,667	2,805	1,189	2,707	24	1,629	1,403	0	586
Swordfish	104	18	10	33	9	64	93	23	40
Wahoo	273	50	9	20	0	226	234	0	26
Mahi Mahi	294	40	1	34	13	275	219	0	57
Striped Marlin	97	6	9	33	23	89	75	2	15
Rainbow Runner	256	9	1	21	0	248	251	0	50
Other#	4,929	3,763	15	3,232	38	862	2,880	78	34

#includes lancetfishes, kawakawa, blue marlin, frigate and bullet tuna, moonfish, black marlin, escolar, spearfish, barracudas, mackerel scad, triggerfishes, blue shark, pelagic stingray, manta ray, silky shark, sailfish, Spanish mackerel, oilfish, short-finned and long-finned mako sharks, snake mackerel, pomfrets, trevallies, blue chub, oceanic white-tip shark, filefishes, batfishes, fangtooth, devil ray, sandbar shark, sergeant major, tiger shark, alfonsinos, amberjack, anchovies, bigeye thresher shark, bronze whaler shark, bull shark, unicornfish, crocodile shark, flying gurnards, gemfish, hammerhead sharks, reef sharks and squids.

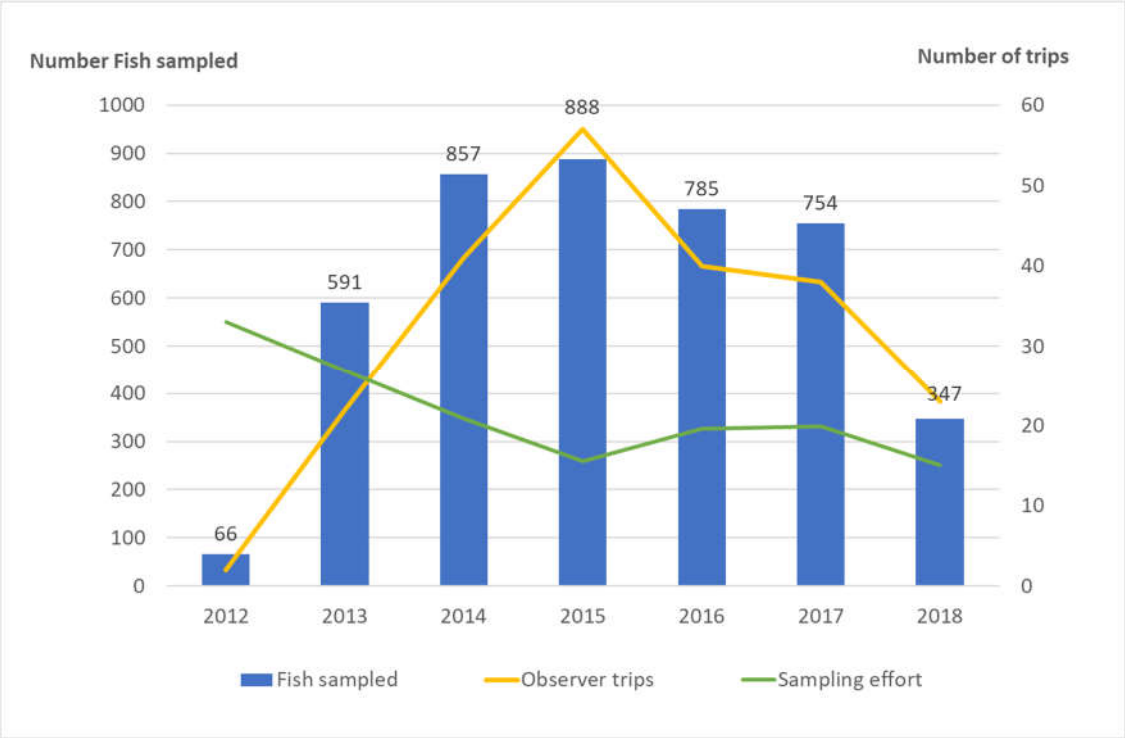

Figure 3. Number of fish sampled by observers, and number of trips at sea where biological samples were collected 2012-2019 (at 10 July 2019).

2.3 SAMPLE STORAGE INFRASTRUCTURE

The TTB has long-term storage facilities at SPC Headquarters in Noumea, New Caledonia and at CSIRO, Brisbane, Australia. The specific work completed by CSIRO includes sorting specimens on arrival and reconciling with quarantine data, entering data describing specimens received into BioDaSys, storing specimens systematically so that they can be retrieved when requested and providing laboratory and storage materials to complete curation.

In 2018, the Australian Department of Agriculture and Water Resources performed an Audit of the CSIRO storage facility. CSIRO needed to strengthen their inventory storage system to keep the Australian Quarantine Accreditation. Storage in Brisbane has been upgraded with smaller single plastic containers that can accommodate samples from a single sampling event rather than multiple sampling events, with an inscribed identification number to avoid label loss or deterioration. Samples have been inventoried and reorganised with the new storage system, allowing future fast sample retrievals.

The storage in Noumea has been expanded again this year by an additional 10% to cope with demand. Most of these facilities are currently being provided in kind to the project by both organisations. The project does contribute to costs for several of the short-term/staging storage facilities' infrastructure. A disused 19m^3 walk-in -20°C freezer previously used for storage of perishable supplies located at the SPC headquarters in Noumea, has been identified as available for renovation and long-term use. This renovation will double the current -20°C freezer storage capacity, and will be in use by the end of 2019. This is part of the Pacific Marine Specimen Bank extensions which will benefit the TTB. This expansion has been funded by New Zealand.

Numerous short-term/staging storage facilities in the key ports of the WCPO have been established, with no changes in 2018-19 identified (see Table 5) except for an additional freezer purchase in Noumea. Note that strategic investment in a super-cold storage facility is required to ensure the longevity and relevance of the WCPFC TTB (see Smith et al., 2017 for further discussion on this). Samples extracted in mid-2018 from the early years of the SPC Marine Specimen Bank (early 2000s) highlight the quality loss for samples used in genetic analyses (H. Kusche, Thünen Institute of Fisheries Ecology, pers. comm.), reinforcing the need for long-term super-cold storage becoming increasingly urgent for the WCPFC TTB (now nine years old).

Table 5. Locations and storage capacity for the WCPFC Tuna Tissue Bank.

Port	Country	Freezer Capacity	Comment
Noro	Solomon Islands	15 m^3 Blast freezer (-30°C)	Soltuna Cannery
Honiara	Solomon Islands	0.7 m^3 (-18°C)	Min. Fisheries and Marine Resources
Port Moresby	Papua New Guinea	0.36 m^3 (-18°C)	National Fisheries Authority
Kavieng	Papua New Guinea	0.7 m^3 (-18°C)	National Fisheries College
Rabaul	Papua New Guinea	0.7 m^3 (-18°C)	National Fisheries Authority
Lae	Papua New Guinea	0.36 m^3 (-18°C)	National Fisheries Authority
Madang	Papua New Guinea	0.7 m^3 (-18°C)	National Fisheries Authority
Wewak	Papua New Guinea	0.7 m^3 (-18°C)	National Fisheries Authority
Koror	Palau	0.1 m^3 (-18°C)	Natural Resources, Environment, Tourism
Yaizu	Japan	15 m^3 (-18°C)	National Research Institute of Far Seas Fisheries, Shimizu
Pohnpei	FSM	0.7 m^3 (-18°C)	National Oceanic Resources Management Authority
Majuro	Marshall Islands	0.7 m^3 (-18°C) 15 m^3 Blast Freezer (-30°C) 15 m^3 Blast Freezer (-30°C)	Marshall Islands Marine Resources Authority Marshall Islands Fishing Venture Pan Pacific Foods cold storage
Honolulu	USA	10 m^3 (-18°C)	NOAA
Aiwo	Nauru	0.15 m^3 (-18°C)	Fisheries and Marine Resources Authority
Tarawa	Kiribati	15 m^3 Blast Freezer (-30°C)	Kiribati Fish Limited
Papeete	French Polynesia	0.7 m^3 (-18°C)	Resources marine et minieres
Pago Pago	American Samoa	0.5 m^3 (-18°C)	Min. Marine and Wildlife Resources
Apia	Samoa	0.5 m^3 (-18°C)	Min. Agriculture and Fisheries
Suva	Fiji	0.7 m^3 (-18°C)	Min. Fisheries and Forests
Port Villa	Vanuatu	0.2 m^3 (-18°C)	Min. Agriculture, Livestock, Forestry, Fisheries Biosecurity
Noumea	New Caledonia	8.9 ~~8.1~~ m^3 (-18°C)	SPC
Brisbane	Australia	20 m^3 Blast Freezer (-30°C)	CSIRO

2.4 THE TUNA TISSUE BANK DATABASE - BIODASYS

A central feature of the TTB repository is a relational database that catalogues the samples, the Biological Data System (BioDaSys). A standalone web portal for the TTB was released in February 2017 (www.spc.int/ofp/PacificSpecimenBank). Specific information includes: sample number; all tissues that were collected from that individual fish; the condition of these samples; species and its measurements; all information on where each sample comes from and how and when it was collected; who collected the sample; the location(s) where it is currently stored; and, how it was transported and who transported it to its current location. The status of, and developments in BioDaSys during 2018-19 are identified below.

2.4.1 Key Features

Four new data processes have been added to BioDaSys to keep track of:

- Sample returned after analyses – samples withdrawn from the tissue bank can be returned and placed as available for other studies. Automatic features have been developed to ease the importation in BioDaSys.
- Single otolith status – considering the increasing use of otoliths in different analyses and recent interest for shape analysis purposes, the left otolith is differentiated from the right otolith and this status is reflected in BioDaSys.
- Debriefing – a table dedicated to observer debriefing quality and status has been developed allowing better debriefing quality control.
- Contract – inclusion of detailed information (parties involved, date of signature, number and type of samples withdrawn, freight associated, analyses received).
- Publications – inclusion of detailed information (title, author, date of issue, publisher, Direct Object Identifier, website URL).

These additional features make BioDaSys more complete with comprehensive information related to biological sampling and samples being systematically recorded into BioDaSys.

Efforts have also been made in tracking pending analyses to give better and quicker feedback to affected staff and thus promote a higher chance of retrieving missing information (see Figure 4 for an example).

Additional data fields per sample/shipment, including financial expenses per transport are monitored and included in the freight section to improve future budgeting for the project. Sampling targets per member country, as agreed in implementing arrangements, are still included in BioDaSys and monitored.

An important aspect of the database is that it catalogues the analysis of the samples. This includes a description of the laboratory analyses, WCPFC project number and the primary information derived from these analyses (e.g. sample weights, analyses performed and resulting estimates – e.g. age, reproductive status, chemical composition, etc. – who undertook the analyses and their contact details. These analyses are now linked to the associated contract and the publications resulting from the analyses. Subject to the approval of the data dissemination protocols by the Scientific Committee of the WCPFC it is expected all data will be available to institutions or organizations responsible for providing scientific advice in fisheries through the web-accessible component of the database.

2.4.2 ER for Biological data collection – linking in OnShore

A section for recording biological sampling collection is now included in the Electronic Reporting application *OnShore*, used by port samplers to collect size and catch composition at landing (see Figure 5). This section of the application links the data for the samples collected with the vessel's details, including the logsheet. The data is directly uploaded to TUFMAN2. To transfer the data from TUFMAN2 to BioDaSys, an intermediate loading Excel file is currently under development. This is a temporary process until the data can be transferred between TUFMAN2 and BioDaSys automatically. The biological sampling section of the application is still under testing and is presently only being used in New Caledonia for improvement before being tested in other locations where samples are collected

at port. Inclusion of this section in the application *OLLO* (Offline Longline Observer) for effort and catch data by at-sea observers is under development, and will be tested with observers embarking in New Caledonia who undertake biological sampling at-sea.

Report: Trip(s) associated with a freight 27-Jul-17

Freight: From [redacted] to 'SPC - Noumea'. Sent the 19/05/2017 and received the 21/05/2017 **Observer program:**

Trip	Staff	Instructions	BS form	Packaging	Nb fish	Nb samples	Available	Lost	Discarded	Pending	Analyzed	Inventory date
[redacted]		G	A	B	2	2	0	2	0	0	0	
empty boxes in the sex column, 2 mistakes in the Y/N columns (2 gonads recorded as collected but didn't find them during inventory), put dorsal spine in gonads bag, skin the muscle, take smaller piece of liver (not the whole thing)												
[redacted]		G	A	B	11	53	53	0	0	0	0	07-Jun-17
empty boxes in the sex column, 2 mistakes in the Y/N columns (2 gonads recorded as collected but didn't find them during inventory), put dorsal spine in gonads bag, skin the muscle, take smaller piece of liver (not the whole thing)												
[redacted]		G	A	B	7	32	32	0	0	0	0	07-Jun-17
empty Y/N boxes, mixed min/max latitudes, 2 mistakes in the Y/N columns (2 livers recorded as collected but didn't find them during inventory), put dorsal spine in gonads bag, skin the muscle, take smaller piece of liver (not the whole thing)												
[redacted]		G	A	B	7	33	33	0	0	0	0	07-Jun-17
fill the sex column, "I" if you didn't manage to identify the sex, "U" if you manage to check the gonads (for any reason), 1 mistakes in the Y/N columns (1 spine recorded as collected but didn't find it during inventory), put dorsal spine in gonads bag, skin the muscle, take smaller piece of liver (not the whole thing)												
[redacted]		B	G	B	31	181	181	0	0	0	0	07-Jun-17
[redacted] *More than 5 fish sampled per species per size range, more than 1 fish sampled during the same set and for the same size range, don't put all samples in the gonads bag (1 sample = 1 bag then roll all bags)*												
[redacted]		B	G	B	40	218	218	0	0	0	0	07-Jun-17
[redacted] *More than 5 fish sampled per species per size range (6 for 1 size range),more than 1 fish sampled during the same set and for the same size range, forgot to record the return date, don't put all samples in the gonads bag (1 sample = 1 bag then roll all bags)*												

Figure 4: Example of report generated from BioDaSys on inventory of samples and related fields for debriefing and curating the samples.

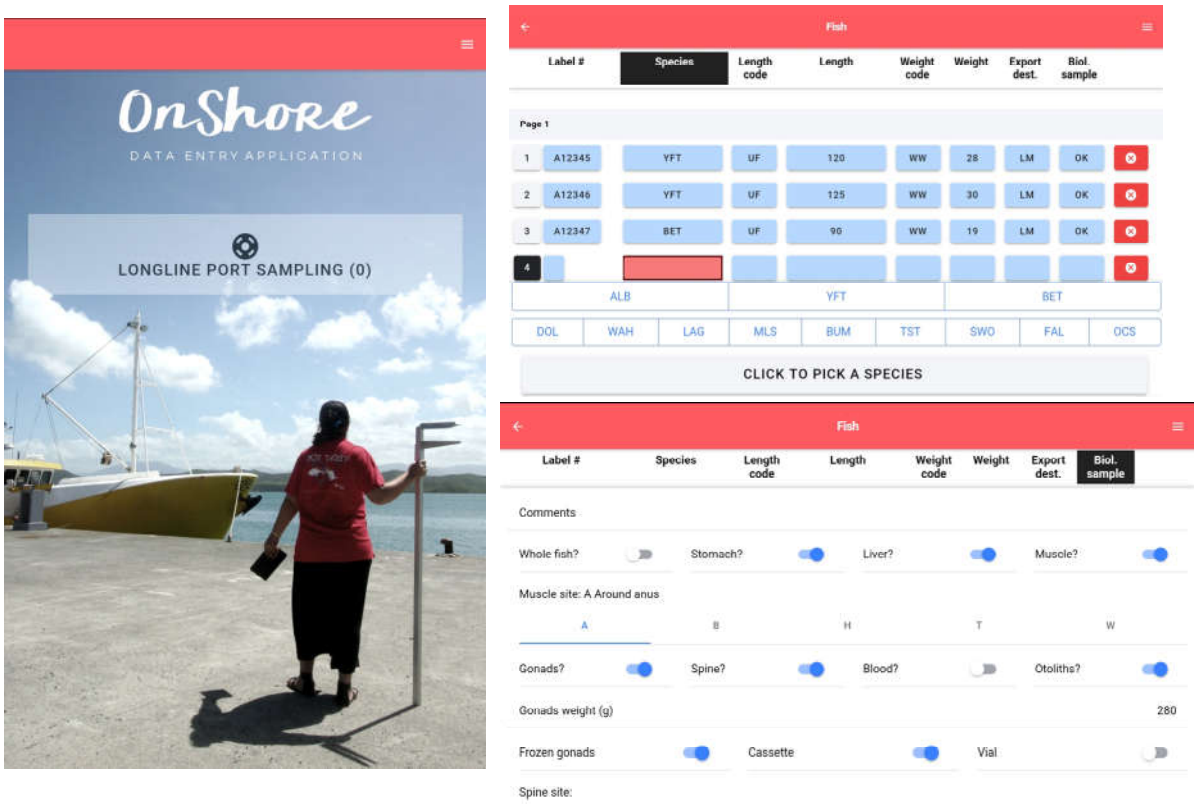

Figure 5: Examples of the biological sampling component of the *OnShore* application.

2.4.3 Tracking of Samples

BioDaSys tracks sampling trips undertaken by observers, port sampling events, quality of the sampling, as well as payment of samplers allowing the sampling coordinators to follow vessels on which sampling is undertaken (Figure 4) and now consider the quality of the debriefing (Section 2.4.1). This allows enhanced coordination of the reception of the samples, as well as the debriefing of the observer upon arrival. These changes have improved the ability to monitor the quality of the sampling undertaken, to coordinate payment for samples and provide feedback to the debriefers. In particular, the database allows validation of the sample collection position using VMS and logsheet tracks which increase the data quality control of the repository (Figure 6). Debriefing documents have been updated providing further control on the quality of the samples. The database also captures biological sampling training provided by SPC since 2009, with a link to the trainees' results and the quality of the samples and the data provided per sampler. Feedback on the quality of the sampling over time can be provided to the samplers, the debriefers and the coordinators and quality control reports per member country are generated after the inventory of the samples.

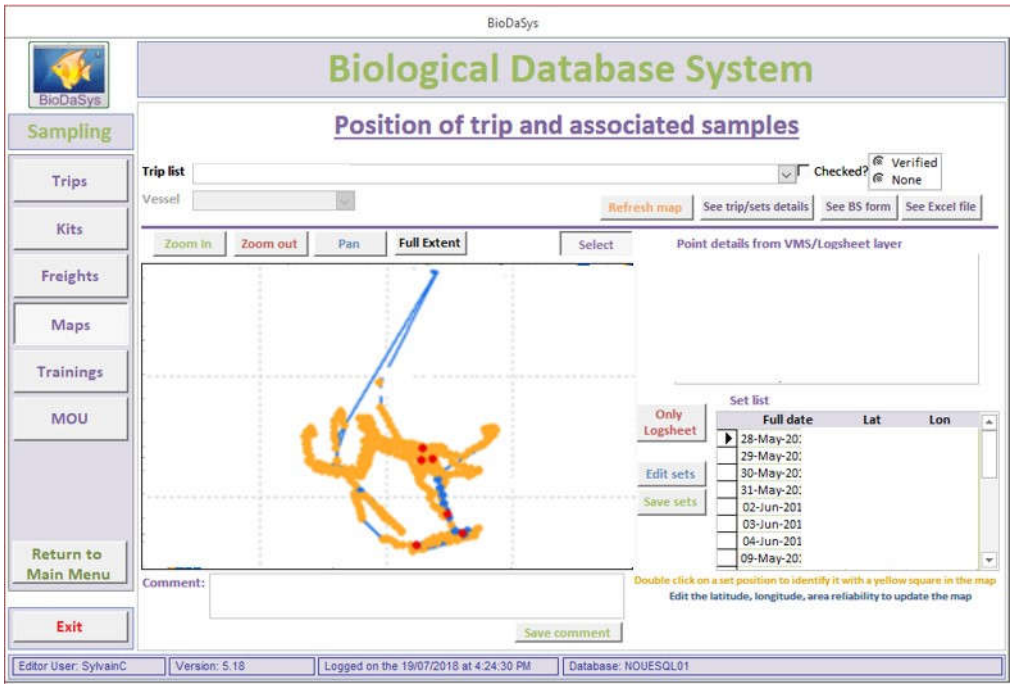

Figure 6: Example of trip information in BioDaSys as used by sampling coordinators to monitor and improve sample collection and data quality.

2.4.4 Web Accessibility

The dedicated web-based portal allows WCPFC members to track the collection of samples (via BioDaSys). It includes interactive maps where the user can obtain information on the number, type, species and length classes of samples collected from a particular EEZ and high seas areas (see Figure 7). The on-line query system is also included to allow more detailed information on each sample to be viewed (e.g. date and location of sample and types of samples taken from the individual, sample quality; see Figure 7).

The web portal is currently available at: www.spc.int/ofp/PacificSpecimenBank. To appropriately manage BioDaSys with respect to the WCPFC data access rules several features of BioDaSys remain accessible only to approved SPC-OFP staff. These authenticated users can have access to additional sections (sampling objectives, staff, freight, and sampling material stock). Using a tiered and layered approach to security, the Scientific Services Provider is able to provide bona fide researchers a greater level of access via username/password access. Researchers wishing to access more detailed information are able to apply for a login directly from the Scientific Services Provider (using a web-based registration process with authentication). Only those data fields necessary to design research are

accessible to authenticated users. Any specific request for samples still requires approval via the access protocol (see Section 3.1).This has eliminated the need for SPC to prepare many data extracts to potential researchers.

Initially a system to manage biological sampling in the Pacific Ocean (trips, sampled fish, samples and associated analysis), BioDaSys is now a full-featured infrastructure to allow, for example, to verify and validate data provided by samplers, to manage trainings or payments, track freights, sample movements and pending analyses. Developments continue, including establishing clear protocols on the way specimens are stored and related information in the database, the physical size of a specimen on arrival (e.g. volume or mass for a muscle sample), and changes to the sample size as a result of any use through approved access to the TTB.

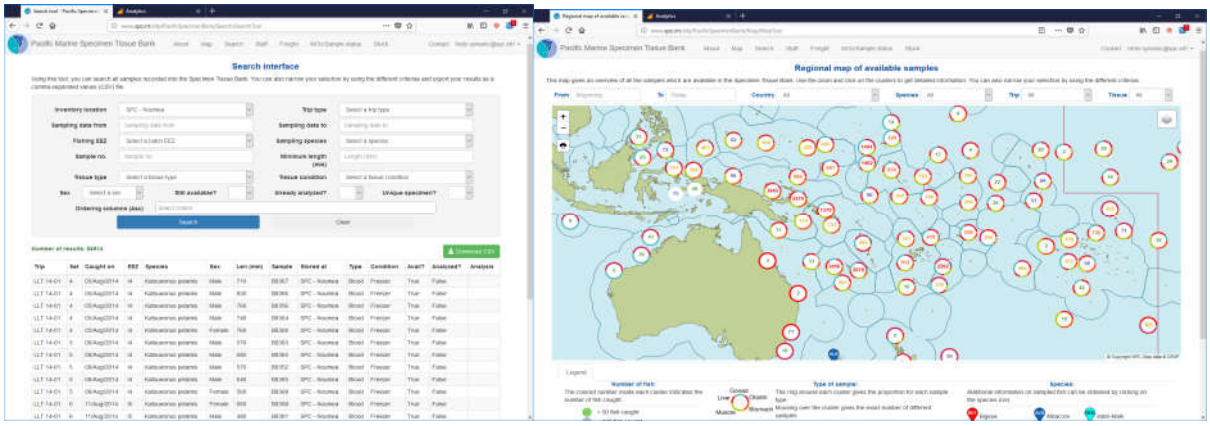

Figure 7: Search interfaces for WCPFC Tuna Tissue Bank web portal – tabular (left), map view (right).

3. TUNA TISSUE BANK ACCESS

This section addresses access to the TTB, the recent increasing use of the TTB within and external to WCPFC, ongoing work to maintain and enhance the TTB, and a proposed workplan for 2018-19.

3.1 ACCESS PROTOCOLS

Making samples available to third party organisations for analyses may be an option that the Scientific Committee pursues to fast track certain analyses. A protocol for accessing the TTB for subsequent laboratory and data analyses by third party organisations was adopted by the WCPFC-SC in 2015 (Anon., 2015a). Procedures for granting access to the WCPFC TTB by third parties were refined based on Smith et al. (2016) at SC12 (Anon., 2016) and were subsequently endorsed by the Commission (Anon., 2017b). These procedures are also available for researchers and interested parties online on BioDaSys at: www.spc.int/ofp/PacificSpecimenBank/Home/About. In 2017 at SC13, an approach to streamline the application process was adopted by the Research Sub-Committee (Anon., 2017a). Experience since that time has been that this revised procedure is working effectively.

3.2 ACCESS IN 2018-19

Apart from pre-approved WCPFC projects (e.g. CSIRO work on yellowfin tuna under Project 82, ongoing work by the Scientific Services Provider), there has been one new request to withdraw samples from the TTB in 2018-19. The request was sent to the WCPFC Research Sub-Committee for approval,

but remains pending consideration of WCPFCs strategic research approach to tuna population structure (see Macdonald et al., 2019). Sample extraction for two previously approved projects and Project 82 were completed. Table 6 outlines the projects that have previously and/or are currently accessing the TTB for WCPFC work.

3.3 REPORTS BASED ON THE TUNA TISSUE BANK PUBLISHED IN 2018-2019

All researchers with current projects withdrawing specimens from the TTB (five) have provided annual progress reports to the WCPFC Secretariat. A further paper has been submitted to the scientific committee of the WCPFC to report the results on the age and growth of yellowfin tuna in the WCPO (Farley et al., 2019). Two projects have resulted in primary literature publications (Anderson et al., 2019; Houssard et al., 2019). Several of the other projects have papers in review for publication.

3.4 WORK TO MAINTAIN AND ENHANCE THE TUNA TISSUE BANK

This report as a whole identifies the maintenance of the WCPFC Tuna Tissue Bank in 2018-19, and identifies a range of enhancements (e.g. observer training, storage and data curation in Section 2).

3.4.1 Additional Enhancements in 2018-19

In 2017-18 additional work has been completed to enhance the otolith storage system. All otoliths are now cleaned on entry to the TTB and then stored in a cross-referenced filing rack. The sample location is recorded in BioDaSys. With a simple alpha-numeric reference, samples can be rapidly recovered.

With funding from other sources, SPC-OFP has recommenced full enumeration of stomach contents from a range of tuna samples. A total of 185 stomachs from yellowfin and 162 stomachs from bigeye tuna caught between 2010 and 2018 were analysed. These analyses, along with previous samples, allowed an MSC student to undertake a preliminary evaluation of whether climate change is impacting apex predators' diet in the WCPO pelagic ecosystem. As more stomach data become available, this work will be expanded.

In the second half of 2019 a range of refinements to the laboratory are occurring – wet lab data-entry and online access to identification materials, new microscopes and cameras, and a fish x-ray machine – which will all improve curation of specimens and data quality.

3.4.2 Cost Recovery in 2017-19

In 2017, SC noted that cost recovery for TTB samples should begin to be explored, especially for third-party applications. To date, many applications have met most of the direct freight costs (e.g. freight from storage location to their lab). In 2018, one of the third-party applications was identified as being a case for partial cost-recovery on samples. A cost per sample was estimated and the third party signed an agreement with respect to the costs. Although this was a significant step forward for the TTB, it also highlighted many issues with engaging in cost recovery. Some of the ongoing enhancements in BioDaSys are designed to support more precise costing. One of the key issues identified was that for tissue samples, where only part of the sample is used and the rest is retained in the tissue bank, that size of the extract needs to be considered in cost estimation. Other key issues identified were the diversity of samples held (e.g. tissue vs. blood), whether the analysis is destructive or not (e.g. otoliths), and the age of samples (both with respect to quality and value). An analysis of data collected to date is planned for 2018-19. The planned review of material for genetic studies (Macdonald et al., 2019) will contribute in the context of a closer examination of age and quality issues.

Table 6. Projects that have previously or currently access the WCPFC Tuna Bank.

Project Description	Samples Used	Technique	Organisation	WCPFC-SC Project No
Age and Growth				
Bigeye Growth Curves	Otolith	Ageing	SPC CSIRO Sun Yat-Sen University	35
Bigeye Growth Curves	**Otolith**	**Ageing**	**CSIRO/SPC**	**81**
Yellowfin Growth Curves	**Otolith**	**Ageing**	**CSIRO/SPC**	**82**
Albacore Growth Curves	Otolith	Ageing	SPC CSIRO	39
Swordfish Growth Curves	Otolith/Spines	Ageing	CSIRO	71
Reproductive Biology				
Bigeye Maturity Ogives	Gonads	Histology	SPC CSIRO	35
Albacore Maturity Ogives	Gonads	Histology	SPC CSIRO	39
Albacore Reproductive Biology	Gonads	Histology	SPC CSIRO	39
Trophic dynamics				
Ecosystem Effects of Fishing	Stomach Muscle Survey	Diet Analyses DNA metabarcoding Taxonomy Fatty Acid	SPC University Canberra Curtin University CSIRO	37, 46
FAD impacts on trophic dynamics	Muscle Liver	Isotope	SPC University Southampton	37
PNG Long-term Climate Monitoring	Stomach e-DNA	Diet Analyses DNA metabarcoding	SPC University Canberra Curtin University	TBP
SEAPODYM	Stomach e-DNA	Diet Analyses DNA metabarcoding	SPC University Canberra Curtin University	62
Global scale analysis of tropical food web dynamics to understand climate impact on top predators (swordfish, four main tunas)	Muscle	Stable isotope analyses, fatty acid analyses	IRD SPC CSIRO	62
Movement				
South Pacific Albacore	Otolith	Trace Element	SPC	38
Spatial Variations in concentrations of metal contaminants in food webs of SPO	Muscle Blood	Isotopes & Mercury	IRD/SPC	TBP
Stock Structure				
Indonesia-west Pacific tropical tuna stock structure	Fin	DNA - Microsatellite	CSIRO	TBP
Global tropical tuna stock structure	Fin	DNA – NGS	University Bologna	TBP
Albacore	Muscle	DNA - mitochondrial	AZTI	TBP
Black marlin	Muscle, liver	DNA - SNP	University of Queensland	TBP
WCPO tuna stock structure and movement (albacore, skipjack, yellowfin and bigeye)	Muscle	DNA - SNP	University of the South Pacific	TBP
WCPO tuna stock structure	Muscle	DNA – SNP	CSIRO	TBP
Bigeye and wahoo ocean basin attribution	Muscle	DNA-SNP	Thünen Institute of Fisheries Ecology	TBP
Food Safety				
Spatial Variations in concentrations of metal contaminants in food webs of the South Pacific Ocean	Muscle Blood	Mercury Accumulation	IRD/SPC	TBP
MERTOX: Unravelling the origin of methylmercury toxin in marine ecosystems	Muscle	Mercury Accumulation, carbon and nitrogen stable isotopes and for a sub-sample selenium and other metal/mineral/nutrient concentrations	IRD	TBP

*TBP = To Be Provided

3.4.3 Future Maintenance and Enhancements

This project is intended to be ongoing. The efforts of people of the region contributing to the TTB are core to maintaining the TTB. Given the success of the TTB to date, consideration should be given to incorporating the budget into the 2020 budget and 2021-22 indicative budgets, especially as Scientific Committee endorsed this as a high priority ongoing project in 2018 (Anon., 2019a). The following additional work arises from this report on the TTB in 2018-19. Note that this work should be completed within the existing proposed budget.

In addition to maintaining and operating the TTB, in 2018-19 proposed enhancement work includes:

a. Further investment in training standards and in observer and observer-trainer training to enhance biological sampling as an ROP observer core duty, ensuring that the repository continues to develop – note that this requires support from Project 42, and may also integrate with Project 90 sample collection where possible;
b. Investigate incentives to increase the number of samples collected by observers. Additional rewards could be provided to the observers when reaching a certain amount of fish sampled and/or after a certain number of trips involving collection of biological samples;
c. Developing Electronic Reporting tools for biological sample collection to facilitate data collection and improve data quality;
d. Developing approaches to better ensuring marlin are correctly identified at time of sample collection, including better species identification guides and ensuring those working at sea and in port have species identification guides available;
e. Ongoing development of protocols for standard TTB extraction approaches and having such protocols stored on BioDaSys (e.g. for otoliths for sectioning);
f. Ongoing BioDaSys tracking developments including the physical size of a specimen on arrival (e.g. volume or mass for a muscle sample), and changes to the sample size as a result of any use through approved access to the TTB;
g. Ongoing development of protocols for managing the longevity of specimens in the bank;
h. With the WCPFC Secretariat and input from the Research Sub-Committee, ongoing refinement of the procedures for granting access to the WCPFC Tuna Tissue Bank by third parties for consideration at SC;
i. With the WCPFC Secretariat, continue to consider and develop cost recovery approaches for third party applications;
j. Implement the 2018 decision to move the management of the TTB within the annual SC meeting to a format more similar to the Pacific Tuna Tagging Programme, with an annual open meeting of a Steering Committee and a report from that committee to the SC;
k. Continue work with the WCPFC Secretariat to inform the development of protocols and procedures to ensure that the WCPFC TTB remains aligned with the key elements of the Nagoya Protocol;
l. Doubling the capacity of standard cold storage capacity in Noumea, and the associated reorganisation of sample storage; and
m. Continuing work on designing and seeking funding for strategic investment in a super-cold storage facility, required to ensure the longevity and relevance of the WCPFC TTB, noting the cost of initial design work has been met by New Zealand.

4. THE TUNA TISSUE BANK STEERING COMMITTEE

The TTB Steering Committee will meet for the first time during SC15. A draft agenda for the meeting is attached at Appendix 1. The work-plan identified in 2018 (SPC-OFP, 2018) has been largely completed. The proposed work-plan for the TTB for 2019-2020 is highlighted in Section 3.4.3 above. It is proposed that a brief report of the TTB SC be presented to the SC Plenary by its chair in the same manner as the PTTP SC operates, so as to expedite the work of the Scientific Committee whilst giving adequate time to discuss details of the TTB during the steering committee meeting.

5. RECOMMENDATIONS

The following recommendations arise from this report on the TTB in 2018-19. Note that most should be able to be completed within the existing proposed budget, or in co-operation with other existing WCPFC projects. Where additional resources would be required, they are identified:

- Regular age and growth analyses of specimens for all tuna and tuna-like stocks for future stock assessments should be budgeted for and aligned with the stock assessment schedule (additional resources required).With yellowfin tuna underway, the next priority species is South Pacific albacore tuna;
- Support initiatives to increase rates of observer biological sampling, noting that this contribution is essential to the ongoing success of WCPFCs work;
- As the WCPFC Tuna Tissue bank is intended to be ongoing, is considered essential, and given its success and measured quality to date, incorporate the identified budget into the 2020 budget and the 2021-22 indicative budgets;
- SC participants should visit www.spc.int/ofp/PacificSpecimenBank and provide feedback inter-sessionally to SPC-OFP;
- To ensure longevity of TTB samples, support initiatives to obtain super-cold storage capacity; and
- In addition to maintaining and operating the WCPFC Tuna Tissue Bank in 2019-20, the work plan in Section 3.4.3 a.-m. should be pursued by the Scientific Services Provider.

6. ACKNOWLEDGEMENTS

For 2018-19, the TTB has been funded by WCPFC through Project 35b. Previously the development of the TTB has been generously supported by WCPFC through Project 35, the European Union through the European Maritime and Fisheries Fund, and Australia, IRD and SPC with in kind and direct funding. We are grateful for the provision of storage and sample distribution by the range of agencies identified in Table 5.

A special thanks to the observers, observer trainers and observer managers across the region that make the TTB possible. Also, special thanks to the staff of the agencies co-ordinating biological sampling across the region including: Marshall Islands Marine Resources Authority, Marshall Islands; Ministry of Fisheries and Forests, Fiji Islands; National Oceanic Resources Management Authority, Federated States of Micronesia; National Fisheries Authority, Papua New Guinea; Ministry of Fisheries and Marine Resources, Solomon Islands; Ministry of Fisheries and Agriculture, Samoa; Direction des Resources Marines et Minières, French Polynesia; Direction des Affaires Maritimes, New Caledonia; and Ministry of Natural Resources, Environment and Tourism, Palau. This project continues to be a Pacific Island Country and Territory collaboration from inception to completion. We are also very grateful to the support received from Luen Thai in Majuro and Palau, Kiribati Fish Limited (KFL) in Tarawa, Soltuna in Noro, Solander in Suva, The National Oceanic and Atmospheric Administration in American Samoa and National Research Institute of Far Seas Fisheries (NRIFSF) in Japan for access to fish and providing support to observer biological sampling.

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7. REFERENCES

Anderson, G., Lal, M., Hampton, J., Smith, N., and Rico, C. 2019. Close kin proximity in yellowfin tuna (*Thunnus albacares*) as a driver of population genetic structure in the tropical Western and Central Pacific Ocean. *Frontiers in Marine Science*, 6: 341. doi: 10.3389/fmars.2019.00341

Anonymous. 2015a. Report of the Eleventh Regular Session of the Scientific Committee of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. 5-13 August 2015, Pohnpei, FSM. WCPFC, Pohnpei, Federated States of Micronesia.

Anonymous. 2015b. Report of the Twelfth Regular Session of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. 3–8 December 2015, Bali, Indonesia. WCPFC, Pohnpei, Federated States of Micronesia.

Anonymous. 2016. Report of the Twelfth Regular Session of the Scientific Committee of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. 3-11 August 2017, Bali, Indonesia. WCPFC, Pohnpei, Federated States of Micronesia.

Anonymous. 2017a. Report of the Thirteenth Regular Session of the Scientific Committee of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. 9-17 August 2017, Rarotonga, Cook Islands. WCPFC, Pohnpei, Federated States of Micronesia.

Anonymous. 2017b. Report of the Thirteenth Regular Session of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. 5–9 December 2016, Denarau Island, Fiji. WCPFC, Pohnpei, Federated States of Micronesia.

Anonymous. 2019a. Report of the Fourteenth Regular Session of the Scientific Committee of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. 8-16 August 2018, Busan, Republic of Korea. WCPFC, Pohnpei, Federated States of Micronesia.

Anonymous. 2019b. Report of the Fifteenth Regular Session of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. 9–14 December 2018, Honolulu, Hawaii, USA. WCPFC, Pohnpei, Federated States of Micronesia.

Evans, K., P. Grewe, R. Gunaskera and M. Lansdell. Connectivity of tuna and billfish species targeted by the Australian Eastern Tuna and Billfish Fishery with the broader Western Pacific Ocean.SA-IP-03. WCPFC-SC13-2017/SA-WP-01. Thirteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Rarotonga, Cook Islands, 9-17 August 2017.

Farley, J., Eveson, P., Krusic-Golub, Sanchez, C., Roupsard, F., McKechnie, S., Nicol, S., Leroy, B., Smith, N., and Chang, S-K. 2017. Project 35: Age, growth and maturity of bigeye tuna in the Western and Central Pacific Ocean. WCPFC-SC13-2017/SA-WP-01. Thirteenth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Rarotonga, Cook Islands, 9-17 August 2017.

Farley, J., Eveson, P., Krusic-Golub, Clear, N., Sanchez, C., Roupsard, F., Satoh, K., Smith, N., and Hampton, J. 2018a. Update on age and growth of bigeye tuna in the WCPO WCPFC Project 81 Rev 1 (33 July 2018). WCPFC-SC14-2018/SA-WP-01. Fourteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Republic of Korea, 8-17 August 2018.

Farley, J., Krusic-Golub, Clear, N., Eveson, P., and Smith, N. 2018b. Progress on yellowfin tuna age and growth in the WCPO WCPFC Project 82. WCPFC-SC14-2018/SA-WP-13. Fourteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Republic of Korea, 8-17 August 2018.

Farley, J., et al. 2019. Analysis of age and growth of yellowfin tuna in the Pacific: Project 82. WCPFC-SC15-2019/SA-WP-03. Fifteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Pohnpei, federated States of Micronesia, 12-20 August 2019.

Houssard, P., Point, D., Tremblay-Boyer, L., Allain, V., Pethybridge, H., Masbou, J., Ferriss, B.E., Baya, P.A., Lagane, C., Menkes, C.E., Letourneur, Y., Lorrain, A., 2019. A Model of Mercury Distribution in Tuna from the Western and Central Pacific Ocean: Influence of Physiology, Ecology and Environmental Factors. Environ. Sci. Technol. 53, 1422–1431. https://doi.org/10.1021/acs.est.8b06058

Macdonald, J., Moore, B., and Smith, N. 2019. Stock structure considerations for Pacific Ocean tunas. WCPFC-SC15-2019/SA-IP-03. Fifteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Pohnpei, federated States of Micronesia, 12-20 August 2019.

McKechnie, S., Tremblay-Boyer, L., and G. Pilling. 2017. Background analyses for the 2017 stock assessments of bigeye and yellowfin tuna in the western and central Pacific Ocean. WCPFC-SC13-2017/SA-IP-06. Thirteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Rarotonga, Cook Islands, 9-17 August 2017.

Nicol, S., S. Hoyle, J. Farley, B. Muller, S. Retalmai, K. Sisior, and A. Williams. 2011. Bigeye tuna age, growth and reproductive biology (Project 35) - Rev.1. WCPFC-SC7-2011/SA-WP-01. Seventh Regular Session of the Scientific Committee of the WCPFC. Pohnpei, Federated States of Micronesia. 9–17 August 2015.

Nicol S., Muller B., Tavaga N., Golu C., Afeleti M., Phillips B., Usu T., Sisior K., Sanchez C., Roupsard F., Hosken M. 2014. Project 35: Bigeye tuna age and reproductive biology progress report. WCPFC-SC10-2014/SA-IP-15. Tenth Regular Session of the Scientific Committee of the WCPFC. Majuro, Republic of the Marshall Islands. 6-14 August 2014.

Nicol, S., J. Farley, B. Muller, C.Sanchez, F. Roupsard, N. Tavaga, B. Phillips, T. Usu, and K. Sisior. 2015. Project 35: Bigeye Biology & WCPFC Tuna Tissue Bank. WCPFC-SC11-2015/SA-WP-01. Eleventh Regular Session of the Scientific Committee of the WCPFC. Pohnpei, Federated States of Micronesia. 5–13 August 2015.

Senina, I., Lehodey, P., Calmettes, B., Dessert, M., Hampton, J., Smith, N., Gorgues, T., Aumont, O., Lengaigne, M., Menkes, C., Nicol, S., and Gehlen, M. 2018. Impact of climate change on tropical Pacific tuna and their fisheries in Pacific Islands waters and high seas areas. WCPFC-SC14-2018/EB-WP-01. Fourteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Republic of Korea, 8-17 August 2018.

Smith, N., Sanchez, C., Roupsard, F., Calliot, S., Allain, V., Brogan, D., Farley, J., Fukufoka, S., Hosken, M., Leroy, B., Nicol, S., Park, T., Peatman, T., and E. Vourey. 2016. Project 35: Bigeye biology, and Project 35b: WCPFC Tuna Tissue Bank. WCPFC-SC12-2016/RP-P35-01. Twelfth regular session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Bali, Indonesia, 3-11 August 2016.

Smith, N., Donato-Hunt, C., Allain, V., McKechnie, S., Moore, B., and Bertram, I. 2017. Developing a Pacific Community Marine Specimen Bank. SPC Fisheries Newsletter, 152: 43-47.

The Pacific Community – Oceanic Fisheries Programme (SPC-OFP). 2017. Project 35: Bigeye biology, and Project 35b: WCPFC Tuna Tissue Bank. WCPFC-SC13-2017/RP-P35-01. Thirteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Rarotonga, Cook Islands, 9-17 August 2017.

The Pacific Community – Oceanic Fisheries Programme (SPC-OFP). 2018. Project 35b: WCPFC Tuna Tissue Bank. WCPFC-SC14-2018/RP-35b-01. Fourteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Busan, Republic of Korea, 8-17 August 2018.

The Pacific Community – Oceanic Fisheries Programme (SPC-OFP). 2019a. Project 42: Pacific Tuna Tagging Project Report and Workplan for 2019-2022. WCPFC-SC15-2019/RP-PTTP-02. Fifteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Pohnpei, federated States of Micronesia, 12-20 August 2019.

The Pacific Community – Oceanic Fisheries Programme (SPC-OFP). 2019. Project 90 Update: Better data on fish weights and lengths for scientific analyses. WCPFC-SC15-2019/ST-WP-03. Fifteenth Regular Session of the Scientific Committee of the Western and Central Pacific Fisheries Commission. Pohnpei, federated States of Micronesia, 12-20 August 2019.

Williams, S. M., Pepperell, J. G., Bennett, M. B. & Ovenden, J. R. (Accepted). Misidentification of istiophorid billfishes by fisheries observers raises uncertainty over stock status. Journal of Fish Biology, DOI: 10.1111/jfb.13738.

APPENDIX I

PROVISIONAL AGENDA
TUNA TISSUE BANK STEERING COMMITTEE
17:30-18:30, Thursday 15 August 2019
(Venue: COM/FSM China Friendship Sport Center, Palikir, Pohnpei State, Federated States of Micronesia)

1			**PRELIMINARIES**
	1.1		Review and adoption of agenda
2			**TTB PROGRESS REPORT**
	2.1		TTB Activities (RP-35B-01)
3			**WORK PLAN 2019-2020**
	3.1		General workplan (RP-35b-01, SECTION 3.4.3)
	3.2		Increasing biological sampling rates
	3.3		Tuna stock structure strategic research (SA-IP-03)
4			**FUTURE OPERATION OF THE TTB STEERING COMMITTEE**
5			**ADMINISTRATIVE MATTERS**
6			**ADOPTION OF REPORT**

APPENDIX II

A. New tagging posters with biological sampling information (for longline vessels)

B. New tagging posters with biological sampling information (for purse seine vessels)