COMMISSION
FIFTEENTH REGULAR SESSION
Honolulu, Hawaii, USA
10 – 14 December 2018

Project 35b: WCPFC Tuna Tissue Bank

WCPFC15-2018-33
28 November 2018

Prepared by SPC-OFP and the Secretariat

1. The purpose of this paper is to introduce the work of the WCPFC Tuna Tissue Bank (TTB) during 2017-2019 as outlined in detail in the attached document SC14-RP-P35b-01. Several CCMs supported the work and highlighted its importance in improving stock assessments. Paragraphs 658 – 663 of the SC14 Summary Report can be referred for the details.

2. The Scientific Committee reconfirmed that maintaining and enhancing the WCPFC Tuna Tissue Bank (Project 35b) is an essential project and recommended the Commission support the work plan and associated budget for 2019, and the work plan and associated indicative budget for 2020-2021.

- The Scientific Committee agreed to run the process of WCPFC Tuna Tissue Bank (P35b) reporting in a similar manner to the PTTP (P42) at SC15.
- The Scientific Committee agreed that that the Secretariat and the Scientific Services Provider should work together to investigate any issues arising from the Nagoya Protocol for the Tuna Tissue Bank and provide advice on this matter to the Commission as appropriate.

3. The proposed budget for 2019 and indicative budget 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 35b. Maintenance and enhancement of the WCPFC Tissue Bank	Annex A	Yes	High 1	97,200	99,195	101,180

Annex A

PROJECT 35B
WCPFC Tuna Tissue Bank

The scope of work will include, but not limited to, the following:

- Maintain and develop:
    - the public SPC webpage informing interested parties of the tissue bank, including the rules of procedure to access samples from the tissue bank.
    - a web-accessed database holding non-public data
    - a relational database that catalogues the samples to include fishery/sampling metadata
    - the Brisbane (CSIRO) storage site, including 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 the laboratory and storage materials needed to complete curation. Australia has provided access to their quarantine and sample storage infrastructure through CSIRO. CSIRO has committed to the in-kind contribution of maintaining space and transfer of specimens on an ongoing basis with the sorting and curation funded through Project 35b. The specific work funded under Project 35b is to:
        - Sort specimens on arrival and reconcile with quarantine data
        - Enter data describing specimens received into BioDaSys
        - Store specimens systematically so that they can be retrieved when requested
        - Laboratory and storage materials to complete curation
- Tissue sample utilisation and a record of outcomes/outputs will also be detailed in the relational database.
- Subject to approval by the WCPFC Executive Director:
    - metadata will be made available to institutions or organizations responsible for providing scientific advice in fisheries through the web-accessible component of the database, and subsequently,
    - SPC-OFP will facilitate the transmission of requested samples to specified researchers/organisations, and the return of unused and/or processed samples to the relevant storage facility.
- Specifically in 2019 to work with the WCPFC Secretariat to investigate and propose options to address the implications of the Nagoya protocol in the ongoing work of the tissue bank.

SCIENTIFIC COMMITTEE
FOURTEENTH REGULAR SESSION

Busan, Republic of Korea
8-16 August 2018

Project 35b: WCPFC Tuna Tissue Bank

WCPFC-SC14-2018/RP-P35b-01

SPC-OFP

EXECUTIVE SUMMARY

1. The WCPFC Tuna Tissue Bank (TTB) has been established over several years. The current project runs to 31 December 2018 with funding for 2019 and 2020 subject to the decisions of WCPFC 15 and WCPFC 16. The tissue bank is increasingly used externally (third party applications) and in the science of WCPFC (e.g. bigeye age and growth, 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 is likely 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, and ensuring sample longevity through accessing long-term super-cold storage.
4. Training in biological sampling for observers and refresher courses continue. Observers sampling instructions have been updated and now include instructions on how to sample mahi mahi and wahoo. To improve data quality further, training and associated materials for PIRFO Debriefers in biological sampling has been developed 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 2017 through 30 June 2018 include an additional 1,112 specimens of which over 93% are from the five core species (albacore, bigeye, skipjack, yellowfin, and swordfish). The storage in Noumea has been expanded again this year by an additional 11% to cope with demand. The sampling effort per year (mean sampling rate per observer trip) was similar in 2017 to the sampling effort in 2016, with both years improvements on 2015 although below 2013-2014 levels. A dedicated special print t-shirt was distributed to observers winning national Best Biological Sampler of the Year awards to continue to incentivise sampling effort.
6. The online and database components of the TTB continue to be enhanced and are increasingly used: www.spc.int/ofp/PacificSpecimenBank.
7. Three new requests were received in 2017-18. Sample extraction for the approved projects and for Projects 81 and 82 have been completed. All researchers with current projects (five) provided annual progress reports to the WCPFC Secretariat. One of the five current projects submitted its final report in 2018 with the results reported in Williams et al. (2017).
8. An ongoing programme of work to maintain and enhance the WCPFC Tuna Tissue Bank is identified and it is recommended that the WCPFC SC endorse this work. Some of the work requires input from the WCPFC Secretariat and the Research Sub-Committee. Some of the tasks may have cost implications.
9. The annual cost of supporting the WCPFC Tuna Tissue Bank now that it is established is USD97, 250. The SC14 needs to decide if it wishes to place an indicative annual budget of USD97, 250 continuing in 2020 and 2021 (2019 is already in the indicative budget). This comprises USD55, 000 for tuna tissue bank coordination, information management and training for samplers, USD25, 000 for sampling fees and freight, and USD17, 250 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 2018 with funding for 2019 and 2020 subject to the decisions of WCPFC 15 and WCPFC 16.

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,
- future TTB work, and
- recommendations for the SC to consider.

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. The priority species for the next phase of work was identified as yellowfin tuna (Anon., 2017a).

1.2 THE TUNA TIISUE 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 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 refine bigeye tuna age and growth, and Project 82 on yellowfin tuna age and growth) (Anon., 2017a).

The range of analyses conducted through the tissue bank is rapidly expanding, with external researchers utilising the resource to explore issues such as tropic positioning (Houssard et al., 2017). 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), and to confirm species identification (Williams et al., 2018). Many of these projects have the additional benefit of better informing ecosystem considerations, especially allowing better specification of Project 62 on 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 2017-18

This section addresses sample collection and the associated observer standards and training, samples collected in 2017-2018, 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.

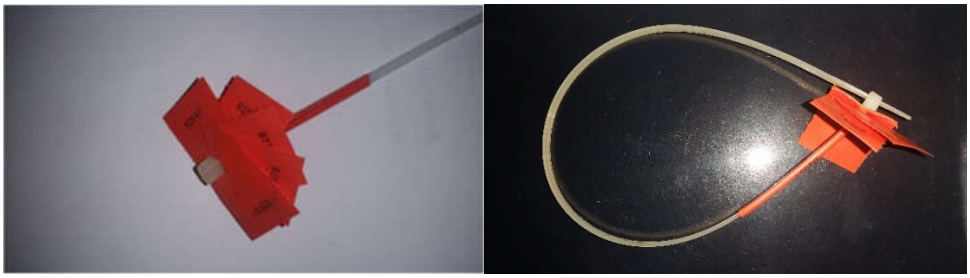


Figure 1. Photos of the cable tie tag that is issued to observers with unique numbers on them.

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 a. (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 dolphinfish 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

Standards for training of observers in biological sampling have been updated and accepted into the PIRFO training standards (see Appendix I for the most recent PIRFO Biological Sampling Competency Standard). Theoretical modules in understanding scientific sampling requirements and data collection have been updated, giving further skills to the observers in interpreting information from multiple sampling strategies. A video on swordfish head collection (e.g., for onshore processing for otoliths) has been developed, and is now provided 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 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 currently under revision to include new training procedures.

Training for debriefers in biological sampling has been developed and is currently 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. Dolphinfish otolith extraction pictures and practical for otoliths extraction for dolphinfish and wahoo are now part of the biological sampling upgrade trainings. No additional observers were trained in 2017-18, although several refreshers were undertaken as below (number of observers trained to date is 480). In 2017-18, to increase sampling quality, new debriefing forms have been developed requiring specific training. Materials and standards for training of debriefers in biological sampling have been developed and tested, and nine debriefers were trained in 2017-18. Table 1 provides a summary of samplers trained during 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	46 ~~31~~	Palau	12
Federated States of Micronesia	62	Solomon Islands	63
Kiribati	48 ~~47~~	Chinese Taipei	33
Marshall Islands	40 ~~39~~	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	2
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

2.2 TTB SAMPLE COLLECTIONS IN 2017-18

Samples continue to be collected by national "at sea" and "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 (SPC-OFP, 2018).

In 2017-18, an additional 6,052 samples were collected from 1,112 fish and deposited in the TTB (see Table 4a). This comprised 345 yellowfin, 288 skipjack, 105 bigeye, 293 albacore, 7 swordfish, 16 wahoo, 32 mahi mahi, 13 rainbow runner, and 13 other species of fish. The provisional total SPC Marine Specimen Bank incorporating the WCPFC TTB sample holdings to 30 June 2018 include 74,372 available samples from 25,662 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 (e.g. muscle tissue from different positions on the body, otoliths, gonad samples in different storage). 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.

In 2017, an additional 949 fish were collected by the observers at sea which represent 85 % 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 2012-2017 in Figure 3. The sampling effort in 2017 is similar to the sampling effort in 2016, with both improvements on 2015 although below 2013-2014 (Figure 3).

The distribution of samples by tissue type provided in Nicol et al. (2015) is now available via BioDaSys (see Section 3.4) and accordingly are no longer plotted in this paper. 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), *Appendix VI* Certificates of Appreciation). To continue this recognition we selected observers from each country that contributed most to the sampling collection during the year 2017. A dedicated special printed shirt was distributed to each selected observer (see Appendix II *Tee shirt for the Best Biological Sampler of the Year 2017)*. This initiative was well received by the sampling network and it is planned to continue this initiative in 2018.

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.

Table 4a. Summary of 2017-18 additions to the WCPFC Tuna Tissue Bank (01 Jul 2017 – 30 Jun 2018).

Species		Hard-parts		Reproduction	Multi-purpose				Diet
	Curated	Otoliths	Spines	Gonads	Blood	Muscle	Liver	Fin	Stomach
Bigeye	105	106	78	121	2	105	69	0	67
Yellowfin	345	346	288	402	0	344	266	0	260
Skipjack	288	282	277	288	0	287	287	0	287
Albacore	293	288	248	365	0	290	202	0	201
Swordfish	7	7	0	4	0	4	4	6	4
Wahoo	16	16	8	8	0	16	8	0	8
Mahi mahi	32	23	1	13	0	28	13	0	13
Rainbow Runner	13	9	1	13	0	28	13	0	13
Other#	13	6	5	9	0	10	8	1	11

Table 4b. Total holdings in SPC Marine Specimen Bank incorporating the WCPFC TTB (30 Jun 2018).

Species		Hard-parts		Reproduction	Multi-purpose				Diet
	Curated	Otoliths	Spines	Gonads	Blood	Muscle	Liver	Fin	Stomach
Bigeye	4055	2723	588	3351	83	2887	1573	0	649
Yellowfin	7484	4590	1491	5331	197	5959	4507	0	1871
Skipjack	4636	1758	1193	1966	114	4389	4356	0	1674
Albacore	3578	2719	1127	2760	24	1541	1361	0	544
Swordfish	103	18	10	33	9	64	93	23	40
Striped Marlin	89	0	1	25	23	82	67	0	7
Wahoo	267	45	9	20	0	223	229	0	21
Mahi Mahi	259	22	1	34	13	240	205	0	44
Rainbow Runner	239	9	1	20	0	233	235	0	33
Other#	4952	3762	15	3226	38	869	2876	78	50

#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, sergent 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.

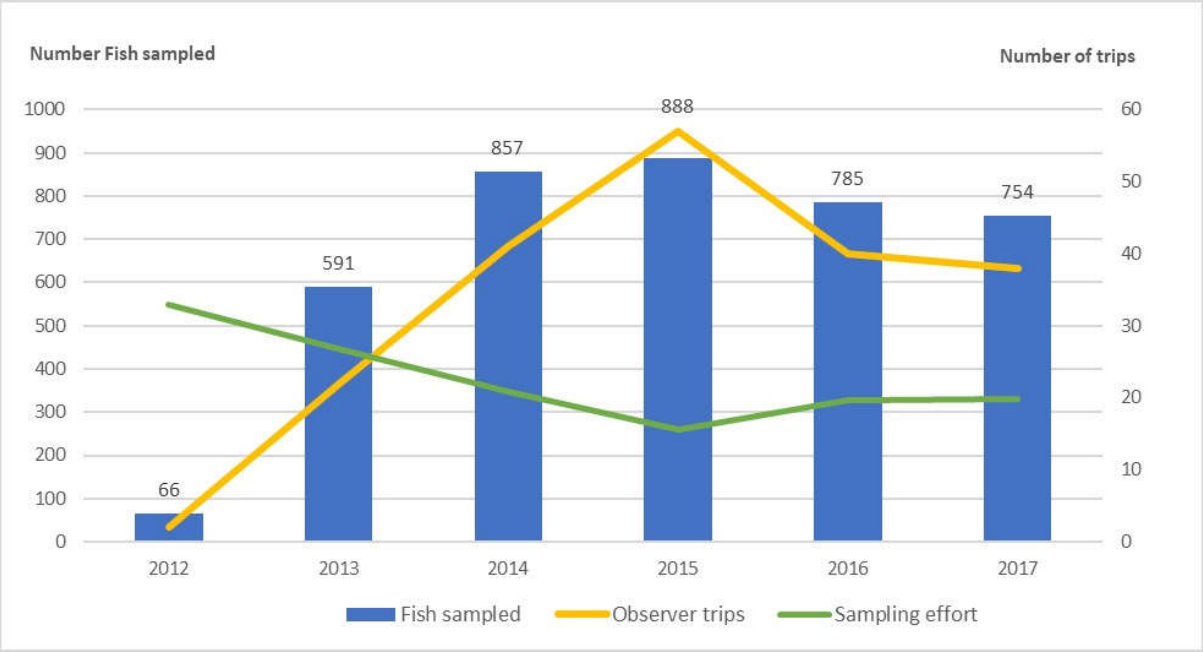


Figure 3. Number of fish sampled by observers, and number of trips at sea where biological samples were collected 2012-2017.

The storage in Noumea has been expanded again this year by an additional 11% to cope with demand. 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 facility infrastructure.

Numerous short-term/staging storage facilities in the key ports of the WCPO have been established, with no changes in 2017-18 identified (see Table 5) except for the replacement of an existing freezer in Pohnpei. Note that strategic investment in a super-cold storage facility will be required within a few years 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 and the WCPFC TTB (now eight 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	Federated States of Micronesia	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	8.1 ~~7.3~~ 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 2017-18 are identified below.

2.4.1 Key Features

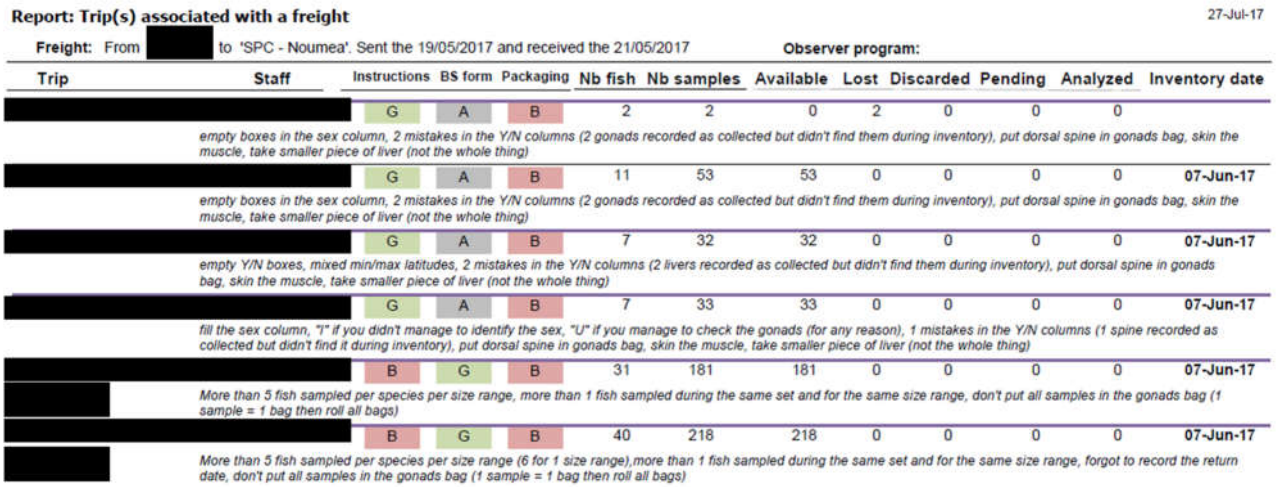
Two data processes in BioDaSys keep track of:

- orphan samples – samples arriving at SPC without data such as catch position, catch date, species identification, etc.
- lost samples – samples supposed to be stored in Brisbane but not found during the inventory on site, which could be explained by unrecorded freight to another location, or samples that were noted as sampled on the biological sampling form but missing during final inventory at Noumea or Brisbane.

Tracking these processes allows quick feedback to affected staff and thus promotes a higher chance to retrieve missing information (see Figure 4 for an example).

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

Meta-data about the fishing/sampling trip that the sample came from is also included. A third aspect of the database 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.) and who undertook the analyses and their contact details). 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.



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.

2.4.2 Tracking of Samples

The sample database (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). 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 and to coordinate payment for samples. 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 5). 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 and the coordinators and quality control reports per member countries are generated after the inventory of the samples.

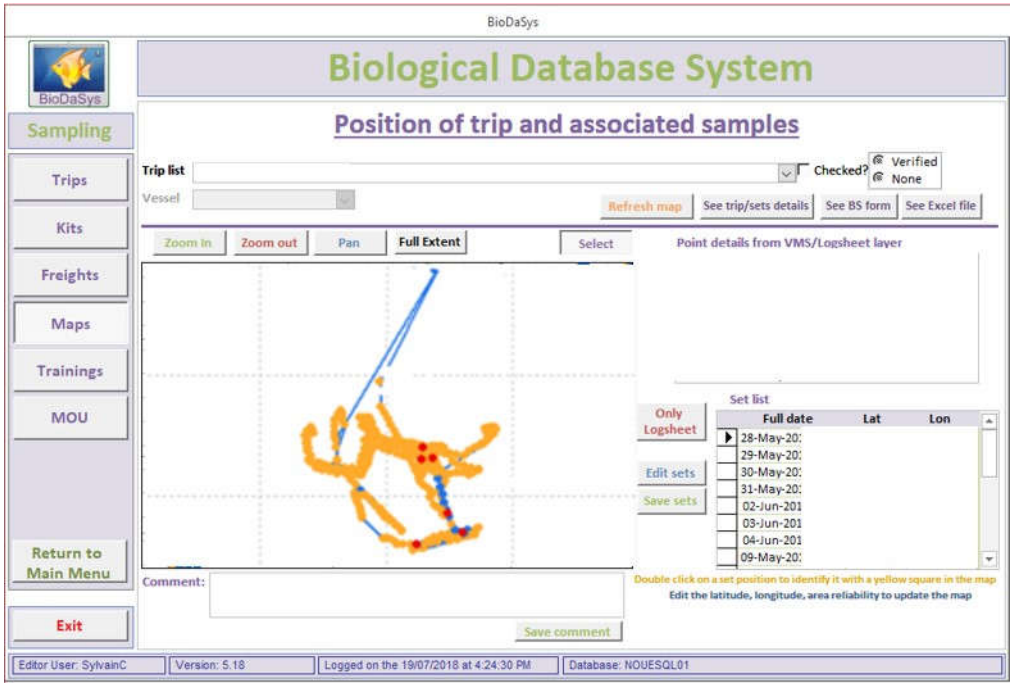


Figure 5. Example of trip information in BioDaSys as used by sampling coordinators to monitor and improve sample collection and data quality.

2.4.3 Web Accessibility

A dedicated web-based portal has been implemented to allow 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 6). An 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 6). Authenticated users can also have access to additional sections (sampling objectives, staff, freight, and sampling material stock). The web portal is currently available at: www.spc.int/ofp/PacificSpecimenBank. The on-line query tool has been accessed by over 4,400 unique users from all over the world (Figure 7). Since the release of the standalone web portal in February 2017, it has been used by 203 unique users, mostly from the Pacific area with over 4,095 pages viewed.

The web interface will be progressively updated in the following months using responsive and advanced technologies to better disseminate information and improve the user experience. It will also reflect the refactoring of the BioDaSys backend system, which has been completely redeveloped in order to support the WCPFC TTB. Moreover, as appropriate it will be connected to external APIs to enhance the diversity of information made available online.

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, samples movements and pending analysis. A range of developments continue including developing 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.

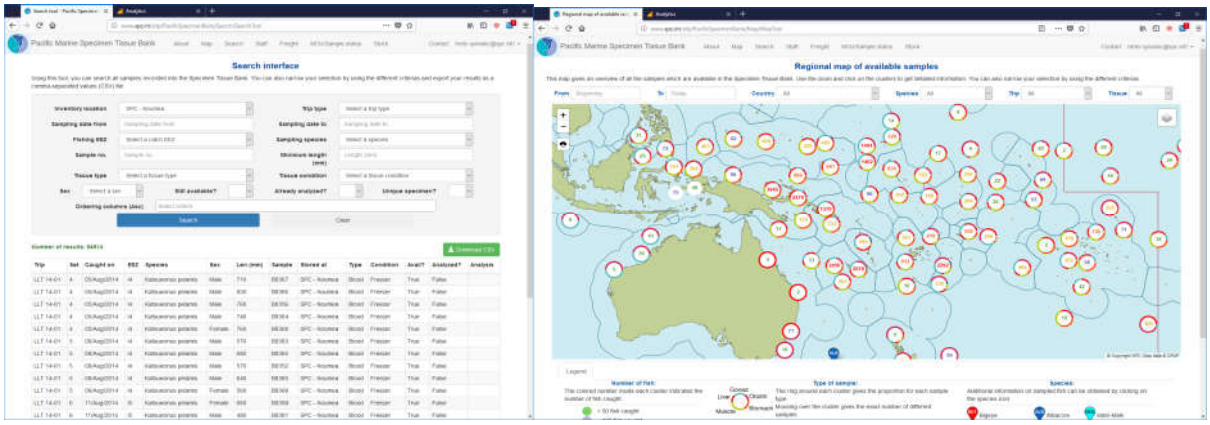


Figure 6. Search interfaces for the WCPFC Tuna Tissue Bank web portal.

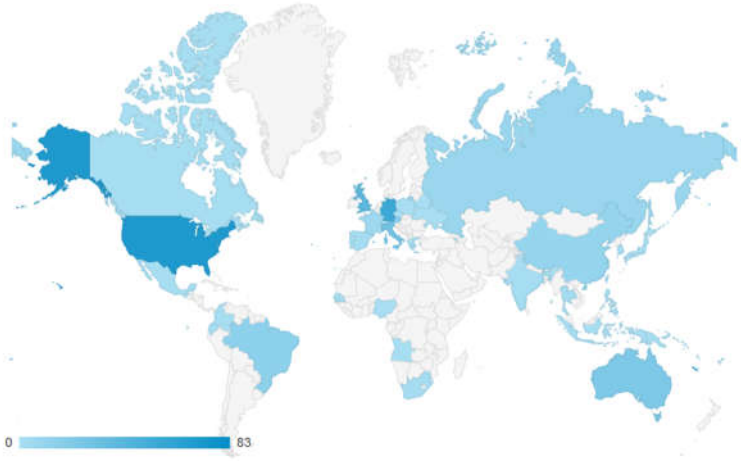


Figure 7. Global distribution of Pacific Tissue Bank web portal users by country (noting that for 27% of users, no country of origin is available).

At present the more detailed information – as is generally needed to design research studies – is not available without an approved login. After the decisions at SC13 the Scientific Services Provider is now able to provide an 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. However to appropriately manage BioDaSys with respect to the WCPFC data access rules several features of BioDaSys remain accessible only to approved SPC-OFP staff.

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 maybe 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 tuna tissue bank by third parties were refined based on Smith et al. (2016) in at SC12 (Anon., 2016) and were subsequently endorsed by the Commission (Anon., 2017b). They are also available for researchers and interested parties online on BioDaSys at: www.spc.int/ofp/PacificSpecimenBank/Home/About. In 2017 at SC13 and approach to streamlined the application process was adopted by the Research Sub-Committee (Anon., 2017a). Experience in 2017-18 has been that this revised procedure is working effectively.

3.2 ACCESS IN 2017-18

Apart from pre-approved WCPFC projects (e.g. CSIRO work on bigeye tuna under Project 81 and on yellowfin tuna under Project 82, ongoing work by the Scientific Services Provider), there have been three new request to withdraw samples from the TTB in 2017-18, up from one in 2016-17 (SPC-OFP, 2017). The three requests were sent to the WCPFC Research Sub-Committee for approval, with two of the proposals subsequently approved and one pending further review at the current time. Sample extraction for the two approved projects and for Projects 81 and 82 have been completed. Table 6 outlines the projects that have previously and/or are currently accessing the TTB for WCPFC work, including the three recent requests.

3.3 REPORTS BASED ON THE TUNA TISSUE BANK PUBLISHED IN 2017-2018

All researchers with current projects withdrawing specimens from the TTB in 2015-16 through 2017-18 (five) have provided annual progress reports to the WCPFC Secretariat. Two papers have been submitted to the scientific committee of the WCPFC to report the results on the age, growth and maturity of the bigeye tuna in the WCPO, and yellowfin tuna in the WCPO (Farley et al., 2018a [SA-WP-01]; Farley et al., 2018b). One has been submitted to report the results of genetic analyses (Evans et al., 2018 [SA-IP-03]). One of the five current projects withdrawing specimens from the TTB submitted its final report in 2018 with the results reported in Williams et al. (2017). 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 2017-18, and identifies a range of enhancements (e.g. observer training, storage and data curation in Section 2).

3.4.1 Additional Enhancements in 2017-18

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. This work will be more fully reported in 2019.

Table 6. Projects that have previously or currently access the WCPFC Tuna Bank (new for 2017-18).

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**	**81**
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
Ecosystem and species Biogeography	Stomach	Diet Analyses	SPC University of Tokyo	TBP
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 Provenance				
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

3.4.2 Cost Recovery in 2017-18

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 costs (e.g. freight from storage to their lab).

In 2017-18, 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 has signed an agreement with respect to the costs. Although this is a significant step forward for the TTB, it also highlighted many issues with engaging in cost recovery. Some on 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 analyses is destructive testing or not (e.g. otoliths), and the age of samples (both with respect to quality and value). Additional work in this area will continue with the WCPFC Secretariat in 2018-19.

3.4.3 Future Maintenance and Enhancements

This project is intended to be ongoing. Given the success of the TTB to date, consideration should be given to incorporating the budget into the 2020-21 indicative budgets. The following additional work arises from this report on the TTB in 2017-18. Note that most should be completed within the existing proposed budget. Where additional resources would be required, they are identified.

In addition to maintaining and operating the TTB, in 2017-18 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 the TTC, but does not require additional resourcing at this time;
b. 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, but does not require additional resourcing at this time;
c. Further development of protocols for standard TTB extraction approaches and having such protocols stored on BioDaSys (e.g. for otoliths for sectioning);
d. Further 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;
e. Development of protocols for managing the longevity of specimens in the bank;
f. With the WCPFC Secretariat and input from the Research Sub-Committee, conduct a review of the pprocedures for granting access to the WCPFC Tuna Tissue Bank by third parties for consideration at SC15;
g. With the WCPFC Secretariat further consider and develop cost recovery approaches for third party applications;
h. Consider moving the management of the TTB with the annual SC meeting to a format more similar to the Pacific Tuna Tagging Programme in 2019 (e.g. with an annual open meeting of a Steering Committee and a report from that committee to the SC);
i. Seek technical advice to inform the development of protocols and procedures to ensure that the WCPFC TTB considers and is aligned with the key elements of the Nagoya Protocol, noting this may need additional resourcing; and
j. Designing and seeking funding for strategic investment in a super-cold storage facility, required to ensure the longevity and relevance of the WCPFC Tuna Tissue Bank (see Smith et al., 2017), noting that the cost of some initial the design work has been met by New Zealand.

4. RECOMMENDATIONS

The following recommendations arise from this report on the TTB in 2017-18. Note that most should be completed within the existing proposed budget, or existing WCPFC resources. 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;
- As the WCPFC Tuna Tissue bank is intended to be ongoing, and given its success and measured quality to date, incorporate the identified budget into the 2020-21 indicative budgets;
- SC participants should visit www.spc.int/ofp/PacificSpecimenBank and provide feedback inter-sessionally to SPC-OFP;
- In addition to maintaining and operating the WCPFC Tuna Tissue Bank in 2018-19, the work plan in Section 3.5.2 a.-g. should be pursued by the Scientific Services Provider;
- Support the proposal to begin to manage the process of the TTB during SC in a similar manner to the PTTP, and
- Support the proposal to seek technical advice on the implications of the Nagoya Protocol for the WCPFC TTB, noting this may need additional resourcing; and
- To ensure the longevity and relevance of the WCPFC Tuna Tissue Bank, especially with respect to super-cold storage for tissue samples, support the initiative identified in Smith et al. (2017).

5. ACKNOWLEDGEMENTS

For 2017-18, 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 and National Research Institute of Far Seas Fisheries (NRIFSF) in Japan for access to fish and providing support to observer biological sampling.

The following observers and samplers are highlighted for their significant role and their award as the best samplers for the year 2017:

- Lui Bell, Samoa
- David Charlie Abel, Vanuatu
- Taani Ulupano, Tonga
- Jude Piruku, Solomon Islands
- Frazer Riogano, Solomon Islands
- Robert Ano, Papua New Guinea
- Jerry Etiric, Papua New Guinea
- Charles Cuewapuru, New Caledonia
- Thomas Auger, New Caledonia
- Teraivetea Grassin, French Polynesia
- Billy Joe Olter, Federated States of Micronesia
- Apenisa Sauturaga, Fiji, and
- Tevita Rokuta Wereivalu, Fiji.

Material for this report was provided by: C. Sanchez, F. Roupsard, S. Caillot, V. Allain, L. Bell, D. Brogan, S. Fukufoka, M. Hosken, B. Leroy, T. Park, T. Peatman, A. Portal, A. Receveur, N. Smith, and E. Vourey.

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APPENDIX I

Biological Sampling Competency Standard

Excerpt from Pacific Community. 2016. PIRFO TRAINING FRAMEWORK 2016 for FFA/SPC. Prepared by Grant Carnie. December 2016 Version 2. 140 pp.

PIROBS3.06E – Carry out biological sampling of catch

Functional area	**Observer and port sampling operations**
Prerequisites	**PIRFO Observer, Port Sampler or Fisheries Officer**

Descriptor

This unit covers the performance outcomes, skills and knowledge necessary for a person to identify anatomical parts of a fish, carry out biological sampling of catch, store and record collected samples, deploy tags and record and report relevant details of a tagged species.

Elements	Performance criteria
1. Demonstrate knowledge of catch sampling and tagging programmes	1.1 Understand the importance of biological sampling of catch, the types and use of information collected in catch sampling programmes and the role of a sampler in collecting samples 1.5 Understand the importance of regional tagging programmes, the ways that information from tagging is used and the recording and reporting information from tags 1.6 Understand the purpose and protocols of tag seeding
2. Identify key internal organs and fish body part commonly collected in sampling programs	2.4 Locate and identify the main internal organs and hard parts in selected species 2.5 Determine the sex of selected species using established sex identification methods
3. Collect biological samples from selected species	3.1 Use the correct tools to remove biological samples 3.2 Dissect selected species and remove organs and hard parts using techniques in accordance with pre-determined biological sampling protocols 3.3 Label collected samples, store and record in accordance with specified procedures
4. Deploy tags in selected species	4.1 Insert tags in accordance with specified protocols 4.2 Record, track and report the deployment of tags in accordance with specified protocols
5. Record and report the landing of a tagged species	5.1 Identify tagged species from landed catch and follow specified procedures to collect relevant information 5.2 Record and report relevant information pertaining to the tagged species in accordance with specified protocols

Evidence guide

Each unit of competency has an evidence guide that relates directly to the performance criteria. Its purpose is to guide assessment of the unit in the workplace and/or training program. The following components provide information to assist this purpose.

Required knowledge

The essential knowledge and understanding a person needs to perform work to the required standard include:

- Sampling and tagging programmes in the Western & Central Pacific Ocean fisheries
- Use and importance of information collected from sampling and tagging programmes
- Key internal organs and hard parts collected for sampling programmes
- Procedures for deploying tags in selected species
- Procedures for collecting, storing, recording and reporting biological samples and tagged species

Required skills

The essential skills a person needs to perform work to the required standard include:

- Locating and identifying the main internal organs and hard parts collected for biological sampling programmes
- Dissecting selected species and removing selected biological samples safely and correctly
- Deploying tags in selected species in accordance with agreed protocols
- Recording data, labelling and storing biological samples in accordance with agreed protocols
- Recording and reporting correctly the deployment and the landing of tagged species

Literacy skills used for:

- Interpreting information relating to sampling and tagging programmes in accordance with agreed protocols
- Collecting data and information
- Completion forms correctly

Numeracy skills used for:

- Recording data

Critical aspects of competence

Assessment must confirm the ability to:

- Identify the sex of a selected species
- Dissect the selected species, identify and remove key organs and label and store correctly
- Record information required for a biological sampling and tagging programme
- Record and report information gathered from selected species

Assessment must confirm knowledge of:

- Major sampling and tagging programmes in the Western & Central Pacific Ocean fisheries
- Procedures for collecting, storing, recording and reporting biological samples from selected species

APPENDIX II

Tee shirt for the Best Biological Sampler of the Year 2017