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Project 35b: WCPFC Pacific Marine Specimen Bank

WCPFC-SC18-2021/RP-P35b-01

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SPC-OFP

Revision 1:

Revision 1 of this paper includes an updated Table 1a with correct numbers of samples collected during the time period July2021-June2022, as well as updated numbers in paragraph i) of the executive summary and in the second paragraph of section 2.1.1.

EXECUTIVE SUMMARY

The WCPFC Pacific Marine Specimen Bank (PMSB) operations are supported by the WCPFC through Project 35b. Under this project, the Scientific Services Provider (SPC) is tasked with maintaining, developing and expanding the PMSB. This paper updates SC18 on Project 35b activities undertaken since SC17 (as they pertain to the 2021-22 work plan endorsed by SC17). A work plan and budget for 2023, and indicative budgets for 2024 and 2025 are provided for this ongoing project. Key topics covered include:

Biological sampling and PMSB progress during the period 1 July 2021 to 30 June 2022

i. 28,121 new biological samples, taken from 5,018 fish, were added to PMSB holdings. SPC now houses 175,857 biological samples taken from 48,749 individual animal specimens.
ii. Training for observers, debriefers, and observer trainers continued. Eighteen staff undertook training in biological sample collection this year, with a total of 664 samplers trained to date. In addition to PIRFO-related training, sampling training and refresher courses were run in Cook Islands, Fiji, Tonga and French Polynesia.
iii. New training resources were released. For example, the update of the Longline Observer Guide and the Purse Seine Observer Guide.
iv. The renovation and extension of the PMSB laboratory in Nouméa commenced in June 2022. By the end of 2022 / early 2023, the surface area will have increased from 75m² to 210m². The extension will include fully equipped laboratories for genetics, histology and otolith processing and a wet laboratory. Cold storage capacity will also increase with the purchase of two 10 ft refrigerated containers.
v. The biological sampling feature in the *OnShore* app is now being used in New Caledonia, Western Samoa, French Polynesia, Federated States of Micronesia and Philippines. The same feature was developed in the *OLLO* app and is currently in use in New Caledonia, Cook Islands and French Polynesia.

PMSB Access and Use during the period 1 July 2021 to 30 June 2022

Two formal requests were received from third parties to withdraw samples from the PMSB. Several enquiries have been received to organise the extraction of samples from the PMSB prior to formal requests being made to WCPFC.

At present, 25 projects are classified as 'ongoing' in using PMSB samples for WCPFC-related work. Thirty-two projects are listed as 'completed' as at 30 June 2022. Seven Information Papers or Research Papers linked to the PMSB will be submitted to SC18 this year. Six other books, peer-reviewed articles, conference papers or popular articles associated with PMSB work were published.

The following recommendations arise from this report. We invite SC18 to:

- Continue to support initiatives to increase rates of observer biological sampling, noting that this contribution is essential to the ongoing success of the WCPFC's work.
- Incorporate the identified budget into the 2023 budget and the 2024-25 indicative budgets, as development of the WCPFC PMSB is intended to be ongoing, and is considered essential.
- Support efforts to obtain further super-cold storage capacity to ensure longevity of PMSB samples.
- Endorse that the work plan in Section 4 of this report should be pursued by the Scientific Services Provider, in addition to standard duties associated with maintenance and operation of the WCPFC PMSB in 2022-23.

1. INTRODUCTION

The WCPFC Pacific Marine Specimen Bank (hereafter, PMSB) is a repository of biological samples from marine specimens collected from across the western and central Pacific Ocean (WCPO). The PMSB is focussed primarily on samples from bigeye, yellowfin, albacore and skipjack tunas, but also houses biological material from other pelagic species (e.g. swordfish, mahi mahi). The PMSB also contains a broad diversity of samples from micronekton, seabirds, deep-water benthic and coastal fishes, among other taxa.

The PMSB was officially established in 2015 (SPC-OFP 2017, 2019), though samples have been systematically collected since 2001. Through the PMSB's creation, the WCPFC aimed to provide research institutions access to the biological samples needed to advance our understanding of the dynamics of tunas and related species in the WCPFC region. The initiative has proved highly successful, the PMSB and its associated Biological Data System 'BioDaSys' database fostering inter-agency collaboration and strengthening research capacity across the region, as evidenced through ongoing and productive research partnerships involving PMSB samples (see ANNEX 1, Table A4 for examples).

PMSB operations are currently funded by the WCPFC through Project 35b. Under this project, SPC, as the Scientific Services Provider, is tasked with maintaining and developing the PMSB and with expanding the inventory of samples held through national and regional biological sampling programmes.

Due to COVID-19 related travel restrictions in place during 2021, the 3rd meeting of the PMSB Steering Committee was held via video conference through Microsoft Teams in early August 2021, ahead of SC17. At this meeting, the PMSB Steering Committee acknowledged that ongoing contributions to the PMSB was critical to the success of WCPFC's work, and recommended that financial support be continued to implement the 2021-22 work plan, as set out in the 2021 Report of the Tuna Tissue Bank Steering Committee (TTB Steering Committee 2021). SC17 endorsed the work plan for 2021-22, as well as the proposed 2022 budget and indicative budgets for 2023-24.

Previous papers to the SC (SPC-OFP 2017, 2018, 2019, 2020, 2021) detail the history, developments and key objectives of Project 35b. This paper aims to update SC18 on Project 35b activities over the past 12 months (July 2021-June 2022), as they relate to the agreed 2021-22 work plan, and outlines planned actions for the next phase of work.

2. BIOLOGICAL SAMPLING AND PMSB PROGRESS (2021-22)

This section summarises progresses between 1 July 2021 and 30 June 2022 on:

1) sampling activities, and PMSB holdings as at June 30 2022;
2) training for biological sample collection;
3) the status of new sampling approaches;
4) recent developments regarding collaboration with the tuna industry;
5) the current status of sample storage facilities; and
6) recent developments regarding the BioDaSys database.

We refer readers to SPC-OFP (2021) [SC17-2021/RP-P35b-01] for background on sample collection protocols, associated observer training standards, and the key features of the BioDaSys database.

2.1 SAMPLING ACTIVITIES AND PMSB HOLDINGS

2.1.1 Overview

The COVID-19-related restrictions on WCPO observer duties have disrupted normal biological sampling activities since early 2020. Despite these disruptions and thanks to the efforts from the still-operating observer programmes and port samplers, the number of samples collected between July 2021 and June 2022 exceeds the number of samples collected during the previous reporting year (Figures 1, 2).

In 2021-22, 28,121 new biological samples were collected from 5,018 fish and added to the PMSB. Table 1 provides species-level breakdowns of the 2021-22 additions (Table 1a), together with total fish sample holdings as at 30 June 2022 (Table 1b). When all samples (e.g. seabirds, micronekton) are included, the PMSB now houses 175,857 biological samples taken from 48,749 individual animal specimens.

2.1.2 Observer-based sampling

Annual figures on the total number of fish sampled, the number of observer trips on which biological sampling occurred, and changes in mean sampling rate per trip compiled over the past nine years, are shown in Figure 1.

Following the peak in activity in 2015, the number of observer trips involving biological sampling has gradually declined, with predictable consequences for sample numbers returned to the PMSB. Signs of recovery were evident in 2019, with sampling rate rising sharply and a 64% increase in sample returns compared with 2018. From early 2020 onwards, WCPO-wide restrictions on observer coverage (due to COVID-19) have effectively removed opportunities for onboard sample collection in most countries. However, the number of fish sampled in 2020 continued the increasing trend observed in 2019. While the number of observer trips during 2021 matched 2020's numbers, the sampling rate, and consequently the number of fish sampled were both lower in 2021. The 2022 first half-year results are back on the 2020 trajectory (Figure 1).

2.1.3 Port sampling

Data on the number of port sampling events and samples collected are provided in Figure 2. As mentioned in SPC-OFP (2020) [SC16-2020/RP-P35b-01] and SPC-OFP (2021) [SC17-2021/RP-P35b-01], SPC's plan was to increase efforts on biological sampling at port to compensate for the ongoing uncertainty around at-sea sample collection. In 2020, this plan saw the number of fish sampled return to a level similar to the 2015-2016 reference years. The number of fish sampled in 2021 increased again by about 60% on 2020's numbers, and the 2022 first half-year results are already similar to totals for all of 2021. These achievements were possible thanks to our partnerships with MRAG Asia Pacific Pty, Soltuna Cannery in the Solomon Islands, DR Fishing Ltd in Papua New Guinea and SOCSKARGEN Federation of Fisheries and Allied Industry Inc. / Bureau of Fisheries and Aquatic Resources (SFFAII/BFAR) in the Philippines.

Table 1a. Additions to the PMSB between 1 July 2021 and 30 June 2022. Note the number of samples may sometimes exceed the number of specimens (e.g. gonad samples for yellowfin). This occurs when multiple samples of the same tissue are taken from one specimen.

Species	No. of specimens	Hard parts		Reproduction	Multi-purpose				Diet	
		Otolith	Spine	Gonad	Blood	Muscle	Liver	Fin	Stomach	Fatmeter*
Skipjack	2145	2056	2057	2070	0	2188	2047	52	2067	12
Yellowfin	1881	1805	1689	1874	0	1994	1658	57	1696	58
Bigeye	445	417	419	437	0	1074	405	31	404	184
Albacore	440	91	61	79	0	271	58	300	58	0
Mahi mahi	20	3	5	17	0	39	19	0	19	0
Silky shark	20	0	0	0	0	0	0	20	0	0
Wahoo	17	14	12	17	0	32	17	0	17	0
Striped marlin	10	6	0	10	6	14	10	0	4	0
Blue marlin	9	4	4	9	4	13	9	0	5	0
Oceanic white-tip shark	9	0	0	0	0	0	0	9	0	0
Rainbow runner	6	4	0	6	0	12	6	0	6	0
Swordfish	5	2	0	4	0	8	5	1	5	0
Short-billed spearfish	4	1	0	4	1	7	4	0	3	0
Black marlin	3	3	0	3	3	3	3	0	0	0
Moonfish / opah	2	0	0	2	0	4	2	0	2	0
Sailfish (Indo-Pacific	2	0	0	2	0	4	2	0	2	0
Total	**5018**	**4406**	**4247**	**4534**	**14**	**5663**	**4245**	**470**	**4288**	**254**

*Fatmeter is a measurement of percentage of fat, not a type of sample. Fatmeter data are included in the table but not counted as a sample

Table 1b. Samples available in the PMSB (at 30 June 2022).

Species	No. of specimens	Hard parts		Reproduction	Multi-purpose				Diet		Other *
		Otolith	Spine	Gonad	Blood	Muscle	Liver	Fin	Stomach	Fatmeter **	
Yellowfin	13270	7525	4070	8883	225	9682	7125	34	4302	1749	27
Skipjack	9927	4181	3490	4292	115	7019	6727	160	3885	2388	75
Albacore	7018	5308	3350	6381	24	4086	1531	0	1007	638	17
Bigeye	6136	4568	1606	4607	116	5079	2576	1	1507	451	25
Mahi mahi / dolphinfish	658	179	26	139	12	521	322	0	163	0	0
Wahoo	472	137	33	124	1	354	341	0	133	0	12
Rainbow runner	422	21	1	55	0	304	300	0	99	0	0
Striped marlin	182	24	30	65	29	130	108	2	36	0	8
Swordfish	140	20	10	37	9	73	99	24	45	0	11
Other#	10524	906	50	3303	66	1994	2963	665	102	0	2716
Total	48749	22869	12666	27886	597	29242	22092	886	11279	5226	2891

includes: 153 species from 60 different families (Acanthuridae, Alepisauridae, Alopiidae, Anoplogastridae, Apogonidae, Balistidae, Berycidae, Blenniidae, Bramidae, Carangidae, Carcharhinidae, Caristiidae, Chiasmodontidae, Dactylopteridae, Dalatiidae, Dasyatidae, Diodontidae, Echeneidae, Emmelichthyidae, Engraulidae, Ephippidae, Exocoetidae, Fistulariidae, Fregatidae, Gempylidae, Holocentridae, Istiophoridae, Kyphosidae, Lamnidae, Lampridae, Lethrinidae, Lobotidae, Lophotidae, Lutjanidae, Malacanthidae, Mobulidae, Molidae, Monacanthidae, Myliobatidae, Nemichthyidae, Nomeidae, Octopodidae, Ommastrephidae, Ostraciidae, Paralepididae, Pomacentridae, Procellariidae, Pseudocarchariidae, Scombridae, Scombrolabracidae, Scopelarchidae, Serranidae, Sphyraenidae, Sphyrnidae, Sulidae, Syngnathidae, Tetraodontidae, Trachipteridae, Trichiuridae) and zooplankton samples

* includes: beak, gill, vertebrae, jaw, brain, guano, skeleton, bird regurgitate, feather, heart, whole community

** Fatmeter is a measurement of percentage of fat, not a type of sample. Fatmeter data are included in the table but not counted as a sample

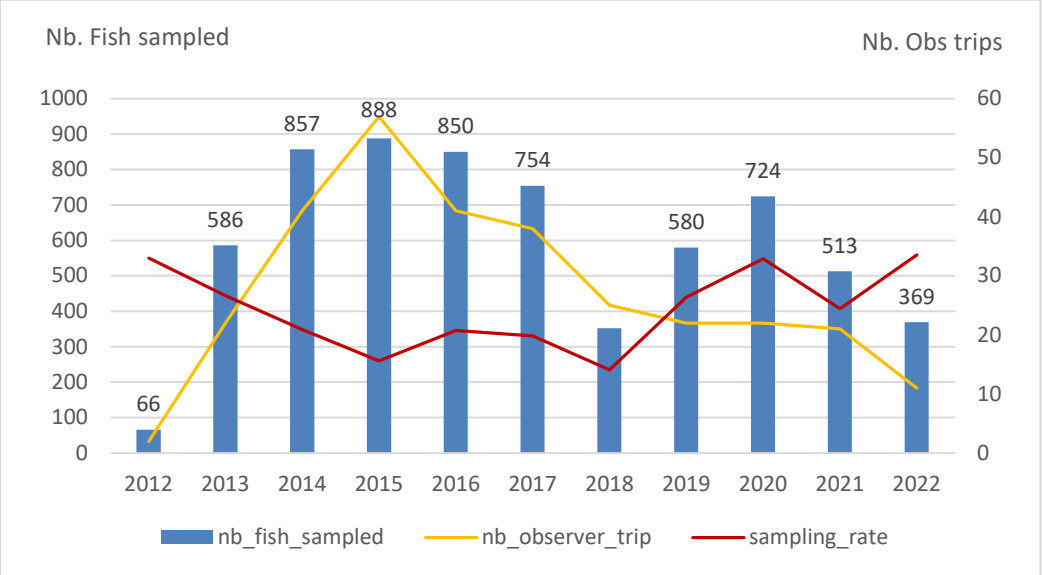

Figure 1. Total number of fish sampled by **observers** (blue histogram and numbers above); observer trips during which biological samples were collected (orange line), and the mean sampling rate per trip (i.e. mean number of fish sampled/trip) (red line) calculated annually between 2012 and 2022. Note that number of observer trips and sampling rate relate to the secondary y-axis.

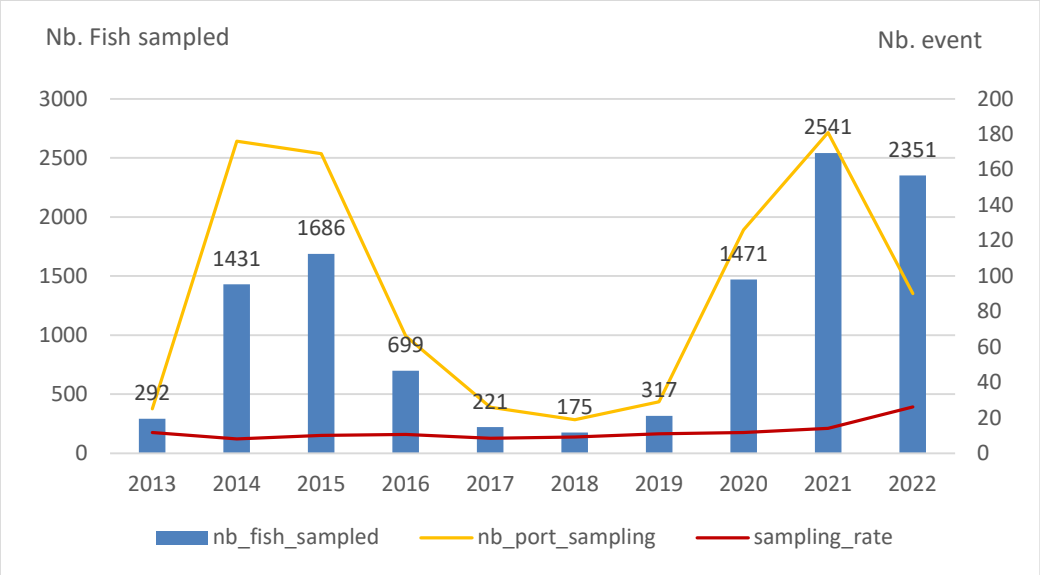

Figure 2. Total number of fish sampled by **port samplers** (blue histogram and numbers above), port sampling events during which biological samples were collected (orange line), and the mean sampling rate per event (i.e. mean number fish sampled/event) (red line) calculated annually between 2013 (when the port sampling programme started) and 2022. Note that number of observer trips and sampling rate relate to the secondary y-axis.

2.1.4 Scientific cruises

Scientific cruises continue to be an important source of biological samples for PMSB holdings, contributing 37,451 samples to date. As at June 30 2022, a total of 9,955 fish have been sampled during various SPC-led cruises, from which 12,281 samples have been analysed (ANNEX 1, Table A1). For the PMSB as a whole, SPC's tuna tagging cruises conducted through the Pacific Tuna Tagging Programme (PTTP) (see SFP-OFP 2022 for the latest update on the PTTP progress under WCPFC Project 42) have supplied 20% of the total fish specimens sampled and 21.3% of the total samples collected, with 25.9% of the analyses conducted for biological or ecological applications to date using cruise-related samples.

This contribution of biological samples adds considerable value to the tagging cruises. For example, the 2021 central Pacific cruise (CP15) added 2,706 new biological samples and 254 fatmeter records to the PMSB (collected on 334 fish). 2,546 of these samples were taken from tunas (281 individuals), incorporating a range of sample types (e.g. muscle, gonad, liver, otolith, stomach, dorsal spines) that have various downstream scientific applications (ANNEX 1, Table A1, Table A2).

During CP15, fish already slated for biological sampling were also utilised for three genetics experiments. First, 40 bigeye tuna were sampled repeatedly across hours and days in a controlled experiment to determine the rate of degradation of DNA in fish left on deck or stored in ice. The intention was to establish guidelines for when it is or is no longer effective to sample a fish for genetic research based on storage time and conditions. Second, 40 bigeye tuna were sampled to help calibrate the use of different tissue types in upcoming epigenetic aging experiments. Third, 94 bigeye were triple-sampled with a variety of tools to explore ways to take muscle samples quickly but also without cross-contamination, so that they could still be used for genetic purposes. Sampling for all three projects was completed onboard, and muscle samples have since been submitted for sequencing and initial analyses.

2.2 TRAINING OBSERVERS, DEBRIEFERS, TRAINERS AND OTHER SAMPLERS

2.2.1 Training update

Over the past 12 months, 18 observers, port samplers and fisheries officers undertook training in biological sample collection, with a total of 664 samplers trained to date. In addition to PIRFO training, samplers are also trained by local fisheries officers and fisheries scientists for specific projects. Training and refresher courses were run in Cook Islands, Fiji, Tonga and French Polynesia. Table 2a provides a regional summary of those trained in biological sampling, by nationality, and skills that contribute to the PMSB, as at June 30, 2022.

Table 2a. Number of samplers (includes at-sea observers, port samplers, debriefers, trainers, cannery employees, fisheries officers, fishing vessel captains and crew) trained or refreshed in the collection of biological samples, debriefers trained in debriefing biological sampling, and observer trainers trained to deliver biological sampling training, by nationality. Note that the number of debriefers, trainers, and samplers that were trained by fisheries officers in country are also counted in the number of samplers.

Country	No. of samplers	No. of debriefers	No. of trainers
American Samoa	7	1	0
Chinese Taipei	33	0	0
Cook Islands	4	0	0
Federated States of Micronesia	72	7	3
Fiji	51	8	0
French Polynesia	17	0	0
Hawaii	1	0	0
Japan	2	0	0
Kiribati	5	3	1
Marshall Islands	49	10	2
Nauru	9	2	1
New Caledonia	28	0	0
Pacific Community	25	2	6
Palau	18	0	0
Papua New Guinea	175	13	4
Philippines	8	0	0
Samoa	27	1	0
Solomon Islands	71	7	2
Tonga	18	4	0
Tuvalu	9	3	0
United States	10	0	1
Vanuatu	25	1	0

2.2.2 New training tools

Updated Observer Guides

The Longline Observer Guide (2021) and Purse Seine Observer Guide (2021) were revised by SPC and are now updated from the 2007 versions. The updates were necessary to reflect changes in the observer data forms (version 2018) and data collection protocols. The implementation of new regional Conservation and Management Measures (CMMs) has also changed some of the focus of the observer's role, such as an increasing focus on collecting data on species of special interest (SSIs) and mitigation measures to prevent their capture. Some shark and pelagic ray species have also had their status changed to SSIs, requiring specific catch and interaction data to be collected by observers so that flag states can report on the impact of the fishery on SSIs.

The guides include protocols for collecting length and weight measurements from individual fish that are then used to update SPC's 'conversion factor' database through WCPFC Project 90 (see Macdonald et al. 2022 for further details), and how to record information for tag recoveries.

Biological sampling tutorials

A series of 17 video tutorials documenting how to identify, extract and collect biological samples from tunas, mahi mahi, wahoo and billfish, as well as how to correctly record biological sampling data have been produced. These will be used as training material for observers, fisheries officers, fishing captains and crew, and as informative technical material for high school and university science students. The videos will soon be available for viewing on the PMSB website.

2.3 SAMPLE STORAGE INFRASTRUCTURE

The PMSB is curated at SPC Headquarters in Nouméa, New Caledonia, and at CSIRO in Brisbane and in Hobart, Australia (SPC-OFP 2019; Portal et al. 2020).

Collectively, the PMSB is equipped with:

- 1 microscope, 2 stereomicroscopes, 1 X-ray machine for fish examination, 1 low-speed, diamond-blade cutting saw to section otoliths, 1 fume hood to manipulate solvents, 1 high-precision weighing scale, 2 low-precision weighing scales, 1 photographic system, 2 fatmeters all located in Nouméa;
- 3 solvent cabinets (1 in Nouméa, 2 in Hobart);
- 5 dry cabinets for otolith storage (4 in Nouméa and 1 in Hobart);
- 2 cabinets to store collection/reference specimens in alcohol (2 in Nouméa);
- 2 dry cabinets to store gonads in paraffin and gonads and otoliths mounted on slides (1 in Nouméa, 1 in Hobart);
- 1 dry cabinet to store dorsal spines (1 in Hobart);
- 2 ultra-cold -80°C freezers to guarantee long-term quality of samples for genetic analyses (~1m^3 in Nouméa);
- ~47m^3 of -20°C cold-storage facilities at SPC and CSIRO (43m^3 in Nouméa, 2m^3 in Hobart, 2m^3 in Brisbane); and
- numerous short-term/staging -20°C storage facilities in the key ports of the WCPO (ANNEX 1, Table A3).

New access to cold-storage capacity and a biological sampling work area have been organised in Madang, RD Fishing cannery, in Papua New Guinea, with previous arrangements for storage options in other regions still in place (ANNEX 1, Table A3).

The re-development of infrastructure in Nouméa has recently commenced. Currently, SPC has 75m² of space available for the PMSB and for running other lab-based projects. With the proposed extension of the laboratory, the work area will increase to 210m², including another 20m² of cold storage space.

2.4 DEVELOPMENTS IN BioDaSys

2.4.1 Overview and access

A central feature of the PMSB repository is BioDaSys – a relational database that catalogues samples and their associated metadata, and records when changes in sample status occur, thus ensuring traceability of the work conducted. The key features of the database are reported in SPC-OFP (2019), including information and rules around access via the standalone web portal at: (www.spc.int/ofp/PacificSpecimenBank).

The website, which incorporates searching tools and interactive maps, is publicly accessible, including to WCPFC members and scientists, providing an interface for the BioDaSys database (see Fig. 7 in SPC-OFP 2019 for an example).

In agreement with WCPFC data access rules, certain information on each sample is unavailable to researchers outside of SPC-OFP, who must apply for a login (directly from SPC) to gain access. Even with a login, only those data fields necessary for designing research projects are accessible to authenticated users. Moreover, any specific requests for samples still require approval via the access protocol outlined in Section 3.1 (below) and detailed in SPC-OFP 2019.

2.4.2 Electronic Reporting (ER) links to BioDaSys – an update

The ER applications *OnShore* and *OLLO* are used by port samplers to collect data at landing sites and by longline fisheries observers to collect data during at-sea missions. Data collected were initially limited to species, length and weight, but as of 2019, new features added to both *OnShore* and *OLLO* now allow users to record data about the biological samples collected for each specimen sampled (Table 3a).

Eleven countries are currently using *OnShore* or *OLLO* on a regular basis for species/length data collection, but only five are using the biological sampling feature in *OnShore*, three in *OLLO* (Table 3b). To motivate greater use of these features, SPC will increase its efforts to ensure that all samplers (be they in port or on a longliner) have access to a tablet to record biological sampling data using *OnShore* or *OLLO.*

Data collected using *OnShore* and *OLLO* are uploaded to the regional database TUFMAN2 and then are automatically transferred into BioDaSys.

Table 3a. Biological sampling features of *OnShore* and *OLLO* – usage summary table.

	Since app's release	01/07/2021 to 30/06/2022
Number of *OnShore* users	14	8
Number of *OnShore* events	178	58
Number of fish sampled recorded with *OnShore*	2314	798
Number of *OLLO* users	5	5
Number of *OLLO* trips	22	14
Number of fish sampled recorded with *OLLO*	264	152

Table 3b. *OnShore* and *OLLO* usage per country

Country	Use *OnShore*?	Use the biological sampling feature in *OnShore*?	Use *OLLO*?	Use the biological sampling feature in *OLLO*?
CK	No	No	Yes	Yes
FJ	Yes	No	Yes	No
FM	Yes	Yes	No	No
MH	Yes	No	No	No
NC	Yes	Yes	Yes	Yes
PF	Yes	Yes	Yes	Yes
PH	Yes	Yes	No	No
TO	Yes	No	Yes	No
VU	Yes	No	No	No
WS	Yes	Yes	No	No

3. PMSB ACCESS AND USE

3.1 ACCESS PROTOCOLS

A protocol for accessing the PMSB for laboratory and data analyses by third party organisations was endorsed by the Commission in 2016 (Anon. 2016, SPC-OFP 2019).

A page dedicated to the sample requests has been created to clarify the workflow and provide more details to future applicants, details of which are available here: https://www.spc.int/ofp/PacificSpecimenBank/Home/RequestSamples .

3.2 USE OF PMSB AND PMSB SAMPLES (2009-2022)

There were two formal requests from third parties to withdraw samples from the PMSB in 2021-22. Several informal enquiries were registered from university-based researchers around sample availability and access rights in the context of future collaborative projects.

At present, 25 projects are classified as 'pending' in accessing samples from the PMSB for WCPFC-related work, led by SPC and/or other national and international organisations (Table 4). 32 projects utilising PMSB/PMSB samples are 'completed' as at 30 June 2022 (ANNEX 1, Table A4).

Fish otoliths and stomachs comprise roughly half of the biological samples analysed to date (Figure 3). Historically, SPC analysed many stomachs for dietary studies, specifically morphological and taxonomic studies of stomach contents, as well as age and growth studies using information coded in otoliths. The number of samples used for genetics analyses is steadily increasing, and this trend should continue into the future with many new genetics and genomics projects coming on line (Figure 3).

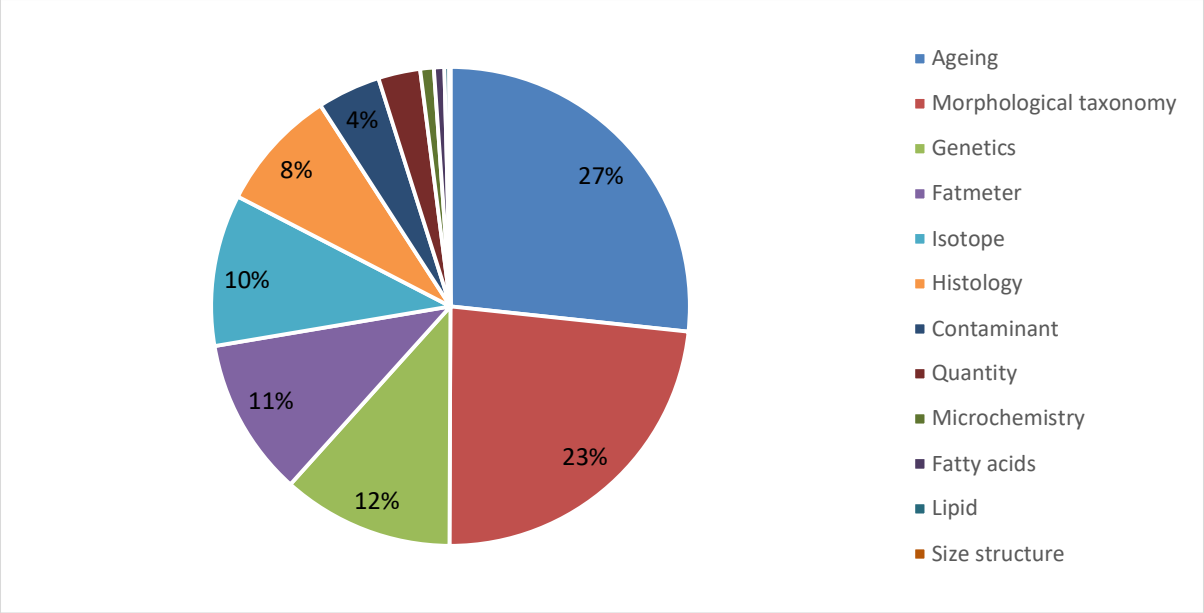

Figure 3. Distribution of samples sent for analysis, by analysis type.

3.4 OUTPUTS ASSOCIATED WITH THE PMSB (2021-22)

Seven additional papers, linked either directly or indirectly to the PMSB, will be submitted to SC18 this year as Information Papers or Research Papers. A total of six other books, peer-reviewed journal articles, conference papers or popular articles associated with PMSB work were published during the 2021-22 reporting period. These include Barbosa et al. (2022), Medieu et al. (2022), Natasha et al. (2022), Trujillo-Gonzalez et al. (2022).

Table 4. Projects that currently access the PMSB.

Project description	Samples Used	Analysis	Lead agency	WCPFC-SC Project No.	Status
Age and growth					
Using otolith growth chronologies and chemistry in deep-water *Etelis* species to answer key ecological questions in the Indo-Pacific.	otolith	otolith growth chronologies, microchemistry	University of Adelaide	TBP	ongoing
Climate impacts on Pacific pelagic fishes	otolith, gonad	microchemistry, histology	University of Melbourne	TBP	ongoing
Trophic dynamics					
Isoscapes and trophic dynamics of ocean sunfish in eastern Pacific Ocean	diet data	taxonomy	University of Victoria	TBP	ongoing
Diet diversity of the human predator	diet data, isotope data	taxonomy, isotope	University of Hawaii	TBP	ongoing
Western Tropical Pacific Ecopath model	stomach	morphological taxonomy	SPC	TBP	ongoing
Movement					
C14 analysis of WCPO-BET otoliths	otolith	ageing, microchemistry	FRA*	98	ongoing

Project description	Samples Used	Analysis	Lead agency	WCPFC-SC Project No.	Status
Spatial variation in concentrations of metal contaminants in food webs	muscle, blood	isotopes	IRD[#], SPC	TBP	ongoing
Stock structure					
Genetic structure of Pacific albacore	fin, muscle	genetics	Oregon State University	TBP	ongoing
Development of a Genotyping-in-Thousands by sequencing (GT-seq) panel to evaluate Pacific albacore tuna (*Thunnus alalunga*) stock structure and sex-specific distribution patterns	muscle, fin	genetics	Oregon State University	TBP	ongoing
WCPO yellowfin tuna stock structure	otolith	shape morphometrics	SPC	TBP	ongoing
Stock structure of tropical tunas in the Indo-Pacific	muscle	Genetics	CSIRO	TBP	ongoing
Testing the panmixia hypothesis in WCPO skipjack tuna using otolith chemistry, otolith shape, muscle stable isotopes and genetics	otolith, muscle	shape morphometrics, genetics, microchemistry, stable isotopes	SPC, IRD[#]	TBP	ongoing
Blue marlin trophic and spatial ecology	muscle	fatty acids	Macquarie University	TBP	ongoing
Biology, ecology and population structure of sailfish	muscle	genetics	University of Queensland	TBP	ongoing
Food safety and tuna flesh characterisation					
Global mercury YFT-BET	data	Chemical / contaminant determination	IRD[#]	TBP	ongoing
Mushy Tuna Syndrome	muscle	biochemistry	University of Queensland	TBP	ongoing
Fatty acid content in South Pacific tunas and swordfish	muscle	fatty acids	IRD[#]	TBP	ongoing
TIPTOP: South Pacific tunas - persistent organic pollutants and microplastics	muscle	microplastics, persistent organic pollutants	IRD[#], IFREMER°, SPC	TBP	ongoing
Spatial variation in metal contaminant concentrations in food webs of the South Pacific Ocean	muscle, blood	mercury, fatty acids	IRD[#], SPC	TBP	ongoing
MERTOX: Unravelling the origin of methylmercury toxin in marine ecosystems	muscle	mercury, isotopes, selenium, metals, nutrients	IRD[#]	TBP	ongoing
Fatmeter	muscle	fatmeter	SPC	TBP	ongoing

Project description	Samples Used	Analysis	Lead agency	WCPFC-SC Project No.	Status
Taxonomy					
Genomic and AI tools for identifying tuna species	muscle	genetics	Michigan State University	TBP	ongoing
Cryptic *Etelis* Discrimination using FT-NIRS	otolith	Fourier transform near-infrared spectroscopy scanning	NOAA Honolulu	TBP	ongoing
Maurolicus phylogeography	specimens	genetics	University of Bergen	TBP	ongoing
Epigenetic age calibration					
Foundation science and technologies to transform Indo-Pacific tuna assessment and management under climate change	muscle	genetics	CSIRO	TBP	ongoing

* Japanese National Research Institute of Far Seas Fisheries, # French National Research institute for Sustainable Development, ° French National Institute for Ocean Science

4. PMSB 2022-23 WORK PLAN

Actions planned for 2022-23, continuing from previous years, include:

- Completion of a document on standard operating procedures for the PMSB.
- Development of infrastructure in Nouméa (i.e. laboratory extension).
- Provision of training to members interested in using *OnShore* and *OLLO* for biological sampling.
- Forward for signature the "Agreement on access and benefit sharing for non-commercial research" to WCPFC members to comply with Nagoya protocol.
- Continue to update and improve training materials for biological sampling.
- Continue the development and enhancement of E-reporting apps.
- Contribute, where practicable, data collection for related projects (e.g. improvements in 'conversion factor' data collection in Solomon Islands, linked through WCPFC Project 90).

New actions planned for 2022-23 include:

- Initiate the improvement of our procedures to reach the requirements of the ISO 20387 international standard.
- Development of the PMSB website to better highlight the use of the PMSB samples and associated outputs.
- Development of a WCPO-wide sampler network for the collection of tuna genetics samples.
- Relaunch biological sampling in Marshall Islands, Federated States of Micronesia and Samoa through a Grant Agreement process.

5. BUDGET

The annual cost of supporting the WCPFC PMSB now that it is established is USD 97,200 baselined in 2018, with an annual inflation adjustment agreed by the Commission in 2018 for outyears. The

proposed budget for 2022 is USD 103,204 and the indicative annual budgets for 2023 and 2024 are USD 105,269 and USD 107,374, respectively. This comprises 60% for PMSB coordination, information management and training for samplers, 23% for sampling fees and freight, and 17% for the additional storage facility in Brisbane.

6. RECOMMENDATIONS

The following recommendations arise from this report on the PMSB in 2021-22. We invite SC18 to:

- Continue to support initiatives to increase rates of observer biological sampling, noting that this contribution is essential to the ongoing success of the WCPFC's work.
- Incorporate the identified budget into the 2023 budget and the 2024-25 indicative budgets, as development of the WCPFC PMSB is intended to be ongoing, and is considered essential.
- Support efforts to obtain further super-cold storage capacity to ensure longevity of PMSB samples.
- Endorse that the work plan in Section 4 of this report should be pursued by the Scientific Services Provider, in addition to standard duties associated with maintenance and operation of the WCPFC PMSB in 2022-23.

7. ACKNOWLEDGEMENTS

The PMSB is principally funded by WCPFC through Project 35b with additional support provided by the Pacific Community, CSIRO and the European Union. Support is also provided through the provision of storage facilities and coordination services by the agencies identified in this report.

The PMSB is reliant on the observers, debriefers, observer trainers and observer managers across the region. Support is also received from fishing companies across the region, and from research institutes for providing access to fish and support for observer-based biological sampling.

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ANNEX 1.

Table A1. Total number of samples collected from scientific tagging cruises and analysed to 30 June 2022.

Predator species		Fish collected	Total samples	Blood	Gonad	Liver	Muscle	Otolith	Spine/fin	Stomach	Fat meter	Samples analysed	% analysed
ALB	Albacore	404	1873	0	269	276	277	259	188	245	287	1121	60%
BET	Bigeye	1389	6901	63	725	1014	1884	846	648	1013	452	1401	20%
BSH	Blue shark	1	1	0	0	0	1	0	0	0	0	0	0%
BUM	Blue marlin	37	155	5	26	35	41	1	15	32	0	3	2%
CFW	Pompano dolphinfish	9	37	0	8	9	10	0	1	9	0	1	3%
CNT	Ocean triggerfish (spotted)	2	9	0	2	2	2	1	0	2	0	0	0%
DOL	Mahi mahi / dolphinfish	182	679	0	98	166	182	36	16	181	0	46	7%
EBS	Brilliant pomfret	2	10	0	2	2	2	0	2	2	0	0	0%
FAL	Silky shark	74	92	0	0	4	14	0	70	4	0	4	4%
FRI	Frigate tuna	99	309	0	4	99	99	3	4	99	1	96	31%
GBA	Great barracuda	1	4	0	1	1	1	0	0	1	0	0	0%
KAW	Kawakawa	136	322	0	1	97	97	1	0	125	1	118	37%
LAG	Moonfish / opah	2	10	0	1	2	2	1	2	2	0	0	0%
LEC	Escolar	7	41	0	7	7	8	5	7	7	0	0	0%
MLS	Striped marlin	10	45	0	7	8	12	2	8	8	0	0	0%
MSD	Mackerel scad / saba	5	15	0	0	5	5	0	0	5	0	5	33%
NXI	Giant trevally	1	1	0	0	0	0	0	0	1	0	1	100%
OCS	Oceanic white-tip shark	14	18	0	1	0	3	0	14	0	0	0	0%
PLS	Pelagic sting-ray	1	3	0	0	1	1	0	0	1	0	1	33%
RRU	Rainbow runner	212	704	0	55	205	211	21	1	211	0	112	16%
SKJ	Skipjack	4069	14216	0	571	3071	3531	733	656	3120	2388	5122	36%
SSP	Short-billed spearfish	4	20	0	3	4	5	1	3	4	0	0	0%
SWO	Swordfish	6	26	0	1	4	4	0	0	6	0	21	81%
TST	Sickle pomfret	2	13	0	2	2	3	2	2	2	0	0	0%
WAH	Wahoo	88	410	0	70	87	94	59	12	88	0	6	1%
YFT	Yellowfin	3197	11534	41	617	2477	2731	637	574	2562	1754	4222	37%
YTL	Amberjack (longfin yellowtail)	1	3	0	0	1	1	0	0	1	0	1	33%
Total		**9955**	**37451**	**109**	**2471**	**7579**	**9221**	**2608**	**2223**	**7731**	**4883**	**12281**	**20%**

¤ Fatmeter is a measurement of percentage of fat not a type of sample. Fatmeter is included in the table but not counted as a sample

Table A2. Total number of stomach samples collected during tagging cruises and analysed to 30 June 2022.

Predator species		***Collected***	**Analysed**	**% analysed**
ALB	Albacore	245	245	100%
BET	Bigeye	1013	490	48%
BRZ	Pomfrets and ocean breams	3	3	100%
BUM	Blue marlin	32	3	9%
CFW	Pompano dolphinfish	10	2	20%
CNT	Ocean triggerfish (spotted)	2	0	0%
DOL	Mahi mahi / dolphinfish	181	46	25%
EBS	Brilliant pomfret	2	0	0%
FAL	Silky shark	4	4	100%
FRI	Frigate tuna	99	95	96%
GBA	Great barracuda	1	0	0%
KAW	Kawakawa	125	118	94%
LAG	Moonfish / opah	2	0	0%
LEC	Escolar	7	0	0%
MLS	Striped marlin	8	0	0%
MSD	Mackerel scad / saba	5	5	100%
NXI	Giant trevally	1	1	100%
PLS	Pelagic sting-ray	1	1	100%
RRU	Rainbow runner	211	112	53%
SKJ	Skipjack	3129	2587	83%
SSP	Short-billed spearfish	4	0	0%
SWO	Swordfish	6	6	100%
TST	Sickle pomfret	2	0	0%
WAH	Wahoo	88	6	7%
YFT	Yellowfin	2562	2159	84%
YTL	Amberjack (longfin yellowtail)	1	1	100%
Total		**7744**	**5884**	**51%**

Table A3. Locations and cold-storage capacity in key ports for the PMSB.

Port	Country	Freezer Capacity	Comments
Noro	Solomon Islands	15 m^3 Blast freezer (-30^oC)	Soltuna Cannery
Honiara	Solomon Islands	0.7 m^3 (-18^oC)	Min. Fisheries and Marine Resources
Port Moresby	Papua New Guinea	0.36 m^3 (-18^oC)	National Fisheries Authority
Kavieng	Papua New Guinea	0.7 m^3 (-18^oC)	National Fisheries College
Rabaul	Papua New Guinea	0.3 m^3 (-18^oC)	National Fisheries Authority
Lae	Papua New Guinea	0.36 m^3 (-18^oC)	National Fisheries Authority
Madang	Papua New Guinea	0.7 m^3 (-18^oC)	National Fisheries Authority
Wewak	Papua New Guinea	0.7 m^3 (-18^oC)	National Fisheries Authority
Koror	Palau	0.1 m^3 (-18^oC)	Natural Resources, Environment, Tourism
Yaizu	Japan	15 m^3 (-18^oC)	National Research Institute of Far Seas Fisheries, Shimizu
Pohnpei	FSM	0.7 m^3 (-18^oC)	National Oceanic Resources Management Authority
Majuro	Marshall Islands	0.7 m^3 (-18^oC)	Marshall Islands Marine Resources Authority
		15 m^3 Blast Freezer (-30^oC)	Marshall Islands Fishing Venture
		15 m^3 Blast Freezer (-30^oC)	Pan Pacific Foods cold storage
Honolulu	USA	10 m^3 (-18^oC)	NOAA
		4 m^3 (-18^oC)	Chill Space (commercial storage)
Aiwo	Nauru	0.15 m^3 (-18^oC)	Fisheries and Marine Resources Authority
Tarawa	Kiribati	15 m^3 Blast Freezer (-30^oC)	Kiribati Fish Limited
Papeete	French Polynesia	0.7 m^3 (-18^oC)	Resources marine et minières
Pago Pago	American Samoa	0.5 m^3 (-18^oC)	NOAA
General Santos	Philippines	0.5 m^3 (-18^oC)	SOCSKSARGEN Federation of Fishing and Allied Industries, Inc
		15 m^3 Blast Freezer (-30^oC)	Well-Delight Network Corporation
Apia	Samoa	0.5 m^3 (-18^oC)	Min. Agriculture and Fisheries
Suva	Fiji	0.7 m^3 (-18^oC)	Min. Fisheries and Forests
Port Villa	Vanuatu	0.2 m^3 (-18^oC)	Min. Agriculture, Livestock, Forestry, Fisheries Biosecurity

Table A4. Projects that have previously accessed the PMSB.

Project description	Samples used	Analysis	Lead agency	WCPFC-SC Project No.	Completion date
Age and growth					
Albacore growth curve - extension project	Otolith	ageing	CSIRO	100b	2021
Striped marlin ageing project	Otolith	ageing	CSIRO	99	2021
Yellowfin growth curves	Otolith, spine	ageing	CSIRO, SPC	82	2018
Bigeye/yellowfin ageing comparison	otolith	ageing	CSIRO, IATTC		2018
Bigeye growth curves	otolith	ageing	SPC, CSIRO, Sun Yat-Sen University	35, 81	2016
Swordfish growth curves	Otolith, spine	ageing	CSIRO	71	2016
Deepwater snapper project	otolith	ageing	SPC	?	2015
Albacore growth curves	otolith	ageing	SPC, CSIRO	39	2012
Reproductive biology					
Bigeye maturity ogives	gonads	histology	SPC, CSIRO	35	2016
Deep water snapper project	gonads	histology	SPC	?	2015
Albacore maturity ogives	gonads	histology	SPC, CSIRO	39	2012
Albacore reproductive biology	gonads	histology	SPC, CSIRO	39	2012
Trophic dynamics					
Ecosystem effects of fishing	stomach, muscle	diet analyses, DNA metabarcoding, Taxonomy, fatty acid	SPC, University of Canberra Curtin University, CSIRO	37, 46	2014
FAD impacts on trophic dynamics	muscle	isotopes	SPC University Southampton	37	2013
Size-based Food Web	muscle	isotopes	Rhodes University		2013
Movement					
Pacific Bluefin tuna movement dynamics	Muscle, otolith	isotope microchemistry	Texas A&M University Galveston		2019
DNA microbiome	stomach	DNA microbiome	University of Canberra, SPC		2018
Deepwater snapper project	muscle, fin	DNA	University of Canterbury		2015

Project description	Samples used	Analysis	Lead agency	WCPFC-SC Project No.	Completion date
PFRP tuna trophic & movement	muscle	mercury isotopes	Louisiana State University, SPC		2007
	muscle	isotopes	Louisiana State University, University of Hawaii, SPC		
South Pacific albacore	otolith	microchemistry	SPC	38	2012
Ecosystem monitoring					
BIOPELAGOS: pelagic biodiversity	micronekton	morphological taxonomy	SPC, MNHN Concarneau		2019
	seabird stomach regurgitate	DNA	University of Canberra, SPC		
	fish eye	DNA	IRD, SPC		
	acoustic data	acoustic	IRD, SPC		
Stock structure					
Population genomic variation in North and South Pacific albacore	muscle	DNA	Oregon State University		2019
Bigeye and wahoo ocean basin attribution	muscle	DNA	Thünen Institute of Fisheries Ecology		2018
WCPO tuna stock structure	muscle	DNA	CSIRO		2018
WCPO tuna stock structure and movement (albacore, skipjack, yellowfin and bigeye)	muscle	DNA	University of the South Pacific		2016
Black marlin	muscle, liver	DNA	University of Queensland		2016
Global tropical tuna stock structure	fin	DNA	University of Bologna		2014
Albacore	muscle	DNA	AZTI		2012
Blue shark and Mako shark	fin	DNA	University of Aberdeen		2011
Indonesia-west Pacific tropical tuna stock structure	fin	DNA	CSIRO		2009
Food Safety and tuna flesh characterisation					
Omega-3 project	muscle	lipids	CSIRO		2010
Selenium and mercury in yellowfin and bigeye tuna	muscle	mercury, selenium	University of Washington		2009