

## Tuna tissue bank for ecosystem management in the Pacific

### What is the tuna tissue bank (TTB)?

Since 2001, SPC's Oceanic Fisheries Programme (OFP) has been coordinating the collection of biological samples of pelagic species from all over the Pacific Islands region on behalf of its member countries. Initially, this collection was focussed on stomach, muscle and liver samples to understand the trophic structure of the pelagic ecosystem (i.e. who eats who, where, and when); however, this has expanded to include gonads (reproductive organs), otoliths (ear bones), spines and blood, giving the opportunity to study reproduction, age, growth and contaminant concentrations. The collection is ongoing thanks to the partnership with the fisheries observer programmes operating in the western and central Pacific Ocean (WCPO).

A group of experienced senior "at sea" observers and port samplers participate by collecting samples from each trip or unloading they participate in. Rather than collect numerous samples from a single trip or unloading, they collect samples from a small number of individuals from each sampling session. This ensures that the sampling activity does not take too much time and that many more fishing trips and vessel unloadings are sampled to achieve OFP's collection targets.

OFP aims to have approximately 2,000 fish sampled for each species in order to allow Pacific-wide studies to be undertaken. The ongoing status of the collection means that as some samples are withdrawn from the collection for scientific analyses others are deposited to maintain the collection for future analyses. The collection is also supplemented by scientific surveys that are undertaken by SPC and other organisations.

Presently, sampling activities are coordinated in the Philippines, Palau, Papua New Guinea, Solomon Islands, Federated States of Micronesia, New Caledonia, Vanuatu, Fiji, Marshall Islands, Kiribati, Samoa French Polynesia and Japan.

### How the collection is used

The application of ecosystem-based management in the WCPO means that decisions are made by balancing positive and negative impacts of proposed actions on the ecosystem. To assist decision-makers with this balancing, the tuna tissue bank (TTB) has been used to analyse the trophic structure of the western Pacific in order to construct ecosystem models to explore the effects of fishing and environmental variations.<sup>1</sup>

Assessing the status of tuna stocks is also reliant on the estimation of the species' biology. The TTB has recently been used to estimate the length-at-age relationship and reproductive biology of the albacore stock in the South Pacific.<sup>2</sup> This was the first stock-wide analysis of these parameters for a tuna stock in the WCPO. Similar analyses are underway for bigeye tuna in the WCPO.<sup>3</sup>

The French Institute for Research and Development is currently implementing a study to determine the origins of mercury and its accumulation and distribution in top predators, and is withdrawing muscle and blood samples from the TTB. Mercury levels are used to track tuna foraging habitats and tuna migration as well as revealing possible public health problems.

An important area that the TTB will contribute to is the emerging application of fisheries forensics to assist with the validation of catch documentation, traceability and surveillance for illegal, unreported and unregulated fishing activities. Genetics, genomics, chemistry and forensics are becoming well-established tools for this purpose. They are also increasingly valuable tools for indirectly monitoring movement, stock structure and reproductive dynamics. Recent withdrawals from the TTB have been used to examine movements and spawning locations in South Pacific albacore using elemental and isotope chemistry.<sup>4</sup> Withdrawals have also recently been made to understand the genetic structure of albacore, skipjack, bigeye and yellowfin tunas in the western Pacific.<sup>5</sup>

<sup>1</sup> Examples of these models can be sourced from the following links:

<http://www.wcpfc.int/node/3230>

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0036701>

<http://cdn.spc.int/climate-change/fisheries/assessment/chapters/4-Chapter4.pdf>

<sup>2</sup> <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0039318>

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0060577>

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0083017>

<sup>3</sup> <http://www.wcpfc.int/node/19010>

<sup>4</sup> <http://www.sciencedirect.com/science/article/pii/S0967064514000472>

<http://www.sciencedirect.com/science/article/pii/S0967064513004499>

<http://www.sciencedirect.com/science/article/pii/S0165783613001859>

<sup>5</sup> [http://www.int-res.com/articles/meps\\_oa/m471p183.pdf](http://www.int-res.com/articles/meps_oa/m471p183.pdf)

<http://aciarc.gov.au/project/fis/2009/059>

# SPC ACTIVITIES

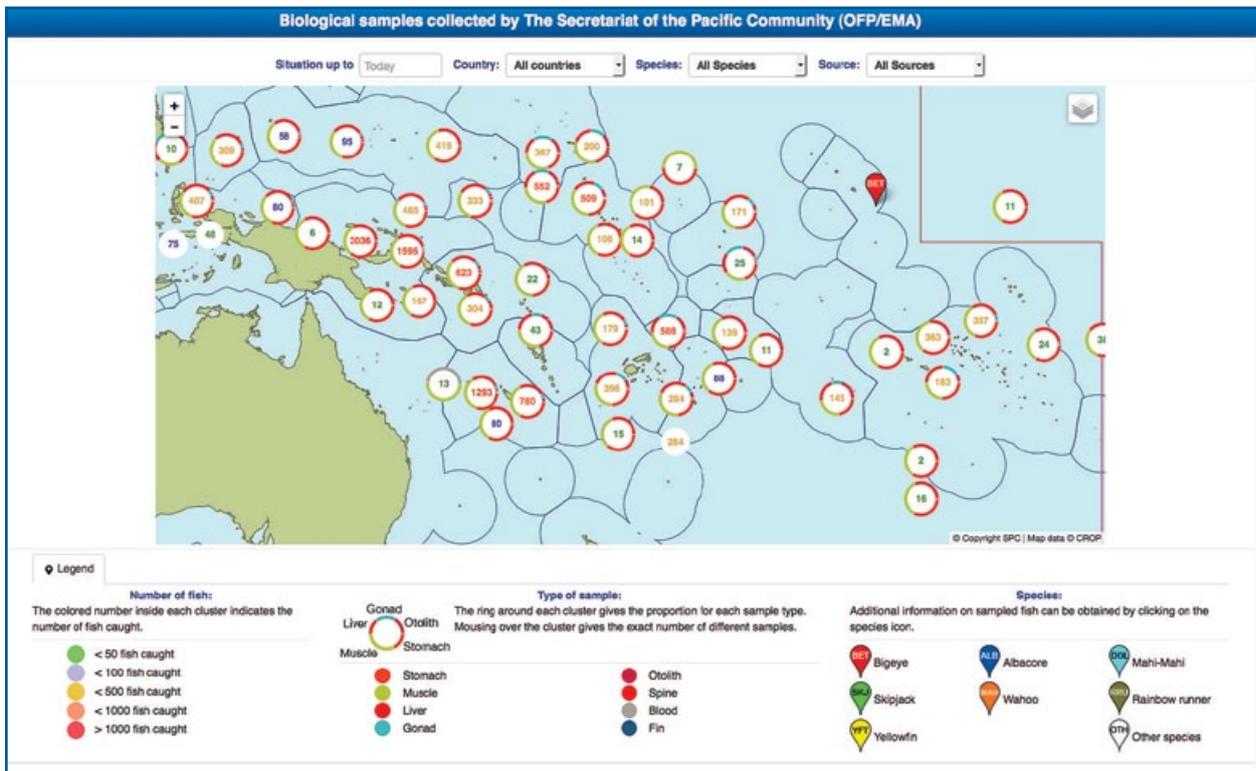


Figure 1. A screen shot of the interface of the web query tool for the tuna tissue bank.

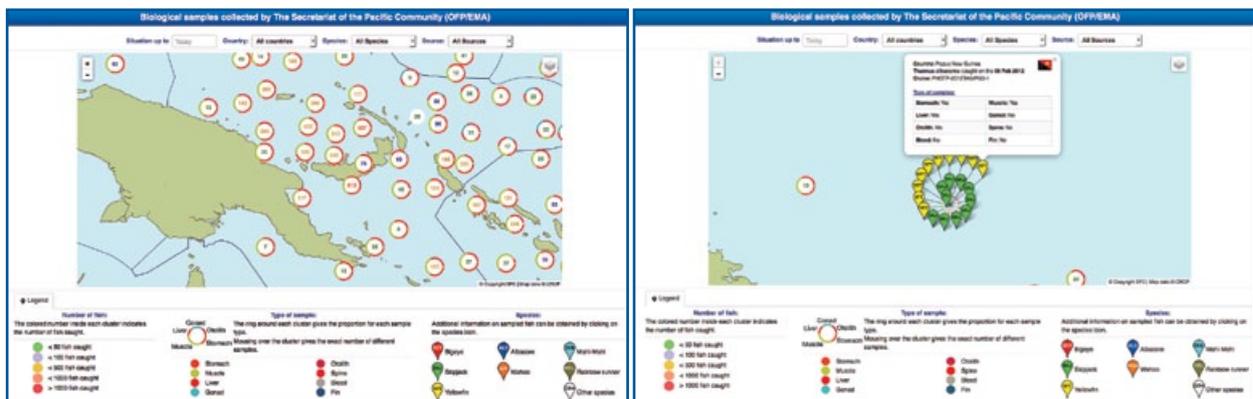


Figure 2. Two screen shots showing the increased display of information provided by the web query tool for the tuna tissue bank with zooming on the map. Left panel shows the increasing detail of samples for Papua New Guinea when zooming in on this exclusive economic zone. At maximum zooming, the details of each sample can be viewed (right panel).

## How to check the TBB balance

A relational database has been established to store all information on the samples that is currently housed at SPC in Noumea. Web-based tools have been developed to allow the database to be queried online.<sup>6</sup> These tools include interactive maps (Fig. 1) where the user can obtain information on the number, type, species and length classes of samples collected from particular exclusive economic zones or high seas areas. More detailed information on each sample (e.g. date and location of sample and types of samples taken from the

individual, sample quality, the reference to the analyses if it has already been withdrawn from the TTB) can also be viewed by zooming in on each location (Fig. 2).

## Making deposits to and withdrawals from the TTB

The TTB is designed to be inclusive and encourages collaboration with other organisations collecting samples or with an interest in undertaking analyses of Pacific Ocean ecosystems. Contributions to the TTB do not

<sup>6</sup> <http://www.spc.int/tagging/webtagging/BioDaSys/BioDaSys/Samples>

need to be housed centrally and generally remain with the collecting organisation. Organisations collecting samples can contribute by providing the metadata associated with the collection of their samples (e.g. type, condition, species, location and date of sample collection) to the TTB.

The withdrawal process is slightly more complicated because many contributions to the TTB have contractual requirements associated with them or are attached to specific projects. To ensure that access to the TTB is fair to all contributors, some straightforward rules and procedures have been developed for withdrawals. These are not onerous, but those wishing to use samples from the TTB are requested to provide a written application that specifies the project's objectives, number of samples to be withdrawn from the bank (e.g. number, type, species, any location/sex/date limits), the methods for processing and analysis, intended collaborators, timelines and intended outcomes and proposed reporting. Because the Western and Central Pacific Fisheries Commission (WCPFC) has been an initiating organisation for the TTB, the researcher or organisation is requested to also provide an annual report to WCPFC's Scientific Committee on the study's progress. In cases where the analyses involve the preparation of secondary products, such as sectioned otoliths and histological slides, preference may be given to studies where these products are to be provided to the WCPFC at the completion of the study for future comparative reference. In instances where the sample size is small for particular spatial or temporal sectors, consideration may be given to the sequencing of analyses. In such cases, priority will be given to analyses that do not modify or destroy samples (i.e. analyses that require samples to be modified or destroyed will be undertaken last to ensure that the maximum information is extracted from each sample). For example, otolith weight and morphometric analyses may be prioritised before sectioning, which may be prioritised before chemical analyses. Researchers or organisations must also acknowledge the TTB in any publication of results from the study undertaken. In

addition, preferential access to the TTB will be given to: 1) researchers or organisations who have contributed samples to the collection; 2) collaborative projects; 3) requests that are part of the WCPFC Scientific Committee's research and work plan; and 4) projects whose spatial scale is regional (in preference to local). Depending on the quantity of samples, a fee may be charged for the cost associated with preparing the samples for shipping and cost recovery for freight or transport agent fees.

### TTB partners

The TTB is the result of collaboration between SPC and its member countries, the Commonwealth Scientific and Industrial Research Organisation, WCPFC, the University of Hawai'i, the National Research Institute of Far Seas Fisheries and the French Institute for Research and Development. Additional financial support has been provided by DG MARE, the European Development Fund (SciFish and SciCoFish projects), New Zealand Agency for International Development, the Australian Agency for International Development, the Government of Korea, the National Fisheries Authority of Papua New Guinea, and the Global Environment Facility (OFM project).

#### For more information:

**Caroline Sanchez**

*Biological Sampling Coordinator, SPC-OFP*  
[CarolineS@spc.int](mailto:CarolineS@spc.int)

**Francois Roupsard**

*Biological Sampling Coordinator, SPC-OFP*  
[FrancoisR@spc.int](mailto:FrancoisR@spc.int)

**Valerie Allain**

*Senior Fisheries Scientist, SPC-OFP*  
[ValerieA@spc.int](mailto:ValerieA@spc.int)

**Simon Nicol**

*Principal Fisheries Scientist, SPC-OFP*  
[SimonN@spc.int](mailto:SimonN@spc.int)



*Observer onboard a purse-seine vessel, opening a fish to collect stomach and liver samples*