BIOLOGICAL SAMPLING newsletter

SPC Secretariat of the Pacific Community

SPC-OFP Ecosystem Monitoring and Analysis Section*

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CONTENTS

Welcome to the 19th issue of *Biological Sampling Newsletter*, which provides news about the Ecosystem Monitoring and Analysis Section of the Secretariat of the Pacific Community's (SPC's) Oceanic Fisheries Programme (OFP).

In this issue we 1) look at prey commonly found in predators' stomachs, 2) provide information on a technique to identify a member of the Scombridae family, 3) provide information on otoliths, 4) present the observer training in biological sampling , 5) report biological sampling on a tagging cruise , 6) present tagging tunas in Papua New Guinea, 7) look into SEAPODYM, an ecosystem model 8) bring to your attention a discovery in wahoo stomachs and 9) present the tuna data workshop #5.

We hope you enjoy this new issue !

* **SPC** (Secretariat of the Pacific Community Section), **OFP** (Oceanic Fisheries Programme), **EMA** (Ecosystem Monitoring and Analysis) Section.
Address: BP D5, 98848 Noumea Cedex New Caledonia Tel: +687 262000, Fax: +687 263818.
Contacts: **Valérie Allain** (valeriea@spc.int)

Enoplometopidae, commonly called reef lobster

This family has 1 genus, *Enoplometopus*, and 22 species. As seen from the illustrations below, they are very colourful animals.

E. debelius

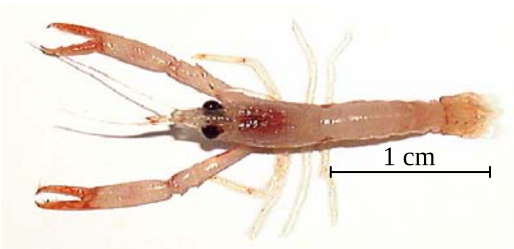
E. antillensis

E. holtuisi

E. occidentalis

Size

These are moderate to small sized crustaceans; the total length of an adult measures between 100 mm and 180 mm, depending on the species. In tuna stomachs, we have observed that larvae, juveniles and adults range in size from 8.3 mm to 160 mm (total length). Specimens found in tuna stomachs do not have the bright colors seen in adults.

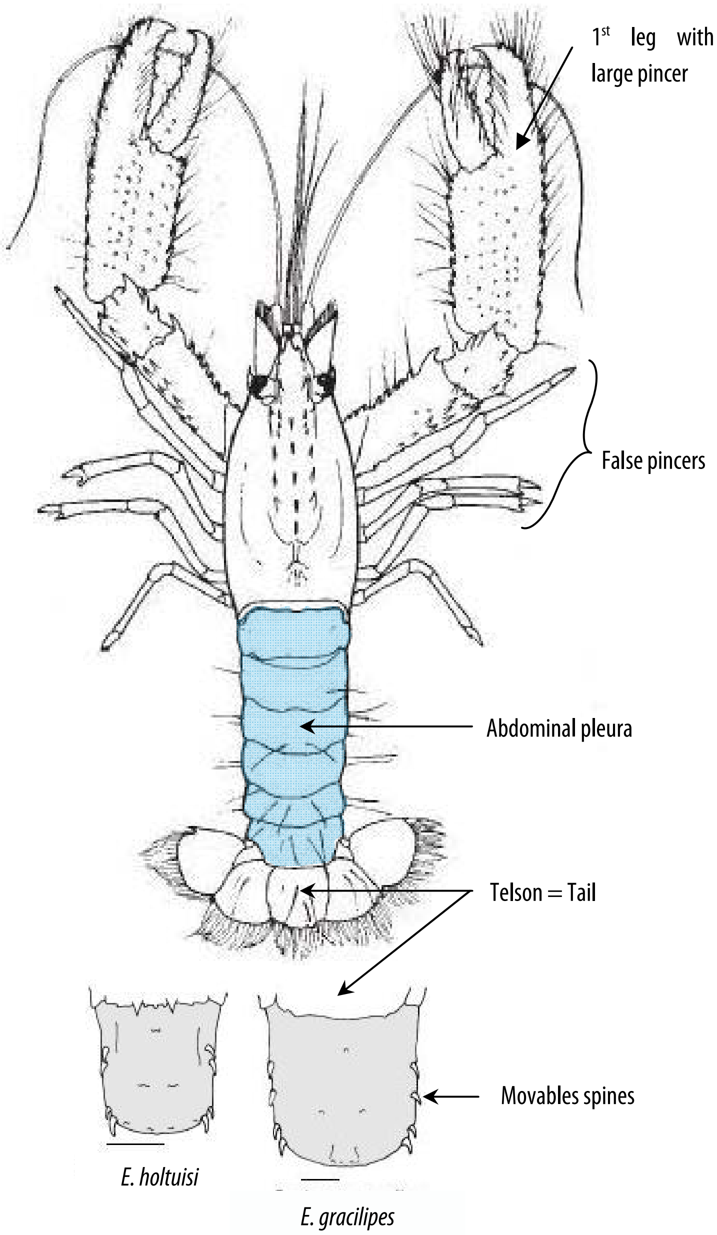


Environment

Enoplometopus sp. includes reef lobsters that usually live in coral and rocky reefs or in deeper parts of reef slopes in tropical oceans and in Japanese waters. They live from the sea surface down to 300 m. Larvae and juveniles drift in the open ocean where they are preyed upon by numerous predators, including tunas and other top level predators.

Identification

The various species of *Enoplometopus* have a tubular body; carapace with a well-developed rostrum; first pair of legs has large pincer, second and third legs are slender and form false pincers; abdominal pleura are more or less rounded and sometimes ending in a strong ventral tooth; and the telson (tail) has movable spines.



Predator

Stomach analyses reveal that this crustacean is a common prey for albacore, yellowfin, skipjack and bigeye tunas in New Caledonia, French Polynesia, Papua New Guinea and Solomon Islands.

How to identify a member of the Scombridae family by its skeleton

The Scombridae family — with more than 50 species, including bonitos, mackerels, tunas and wahoos — is found worldwide in tropical and temperate waters.

Large, top level predator species such as tunas are one of the main predators of smaller scombrid, sometimes even practicing cannibalism. According to our analyses, 286 of the 5172 analysed stomachs of albacore, bigeye, yellowfin and skipjack tunas contain Scombridae specimens.
In those stomachs, scombrid preys range from 2 cm larvae to juveniles that are up to 30 cm. Specimens are typically partially or nearly completely digested, and have damaged skin and fins. In order to more easily identify the prey species, we tend to work on hard body parts that better resist digestion. Both otoliths and skeletons are very useful in identifying highly digested fish or prey items.

Fish skeleton

Using the skeleton, we can identify specimens to the genus level such as *Thunnus* (tunas), *Katsuwonus* (skipjack) and *Scomber* (mackerels), and even down to the species level. Different characteristics of the skeleton's vertebrae can be used to identify fish species based on the complete skeleton or on parts of it (Fig. 1). Characteristics are compared to skeletons that we keep in collection and to information found in scientific papers.

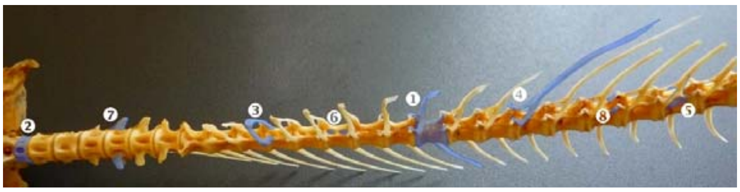


Figure 1: Characteristics of fish vertebrae used

The criteria considered include:
❶ The number of vertebrae in a complete skeleton;
❷ The size of *the atlas* (i.e. first vertebra attached to the cranium): normal or reduced;
❸ The position of the vertebrae with the first *closed haemal arch* (i.e. first vertebra with ventral closed arch);
❹ The position of the vertebrae with the first *haemal spine* (i.e. first vertebra with ventral spine), and the shape of the spine: from "normal" to flat;
❺ The presence and size of the *inferior foramen* (i.e. the hole between the vertebrae and ventral spine)

Usually, when visible, those criteria are sufficient to identify the prey, but additional information can be used if necessary, such as:

❻ The presence and shape of the *infra central groove* (i.e. the groove on the ventral side of the vertebrae);
❼ The developmental stage of the *parapophysis* (i.e. ventral transverse process of vertebra);
❽ The presence and shape of the *haemal postzygapophysis* (i.e. posterior ventral processes of the vertebrae).

As an example, below is a Scombridae skeleton with its : ❷ atlas not reduced; ❸ first closed haemal arch on 12th vertebrae; ❹ first haemal spine not flat on 21th vertebrae; and ❺ inferior foramen extremely large. This combination of criteria is enough to positively identify this specimen as a skipjack tuna.

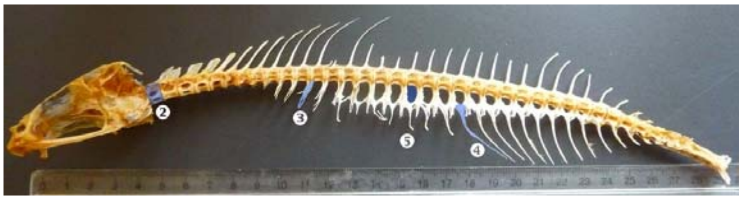


Figure 2: Skipjack skeleton (*Katsuwonus pelamis*).

Comparison of Scombridae skeletons

Figure 3: Comparison of similar sized Scombridae skeletons.
Top: *Thunnus obesus* (BET); Center: *Auxis* sp. (FRZ);
Bottom: *Katsuwonus pelamis* (SKJ)

	BET	FRZ	SKJ
❶	Not countable	39	41
❷	Reduced	Not reduced	Not reduced
❸	11th vertebra	12th vertebra	22th vertebra
❹	19th vertebra, not flat	21th vertebra, not flat	22th vertebra, not flat
❺	Small	Large on 24th to 28th vertebrae	Large on 14th to 30th vertebrae
❻	2 grooves not connected	None	None

Otoliths, an element that can help in identifying fish

What is an otolith?

The word otolith is derived from the Greek words otos (ear) and lithos (stone). They are small crystals of calcium carbonate found in the skull of the fish, just below the back of the brain.

Where are they and what are they?

They are not connected to the cranium, but 'float' freely behind the brain, inside soft and transparent ducts of the inner ear.

There are three pairs of otoliths of different sizes: a large pair (called sagitta) and two pairs of smaller otoliths (called lapillus and astericus). They all play a role in hearing and help the fish balance.

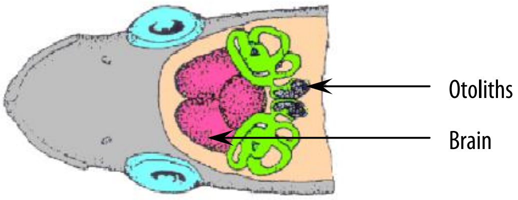
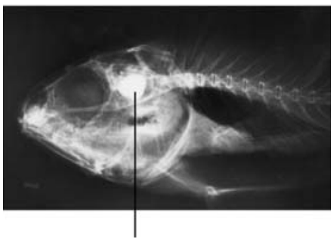


Figure 1: Anatomical position of the fish's inner ear
(adapted from Secor et al., 1992)
Source: http://www.cmima.csic.es/aforo/oto-wat.jsp



Otolith (sagitta) in lateral view

Otolith (sagitta) in ventral view

Figure 2: Radiograph of deep-water drum cranium
Source: http://nmita.geology.uiowa.edu/

Why study Otoliths?

In ichthyology (the study of fish), otoliths are considered to act as 'black boxes', recording all of the important events in the life of the fish from birth. They are the first calcified formations that appear in the embryonic or larval stage. They have growth rings, from which one can estimate the age of the fish and the history of its environment and health. They usually have a distinctive shape that is also often characteristic of the fish to which they belong. Because of their composition, otoliths are more resistant to degradation than most other tissues; therefore in stomachs they are frequently one of the only identifiable fish remains found, often allowing us to determine the family, genus or even species of the fish.

Otolith morphology

It has two faces: a concave outer one and a convex inner one dug with a furrow (named sulcus) whose location and shape differ according to species. We usually observe this inner face.

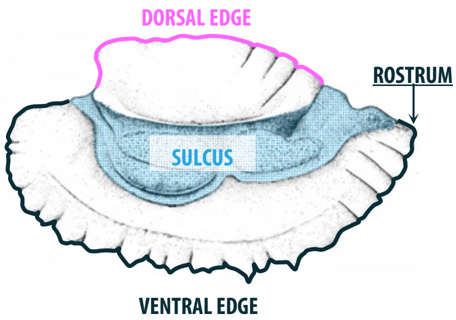


Figure 3: Picture of the **inner face** of an otolith
(adapted from Rivaton et al., 1999)

Identification

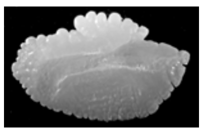
When we find prey species in fish stomachs that have been heavily degraded due to digestion, we look for otoliths in order to study their morphological characteristics and then compare them both to our own collection and to photographs of otoliths in reference books.

- When the otoliths have a shape characteristic of a family, genus or species:

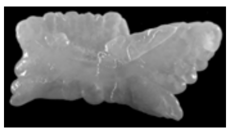
- When the otoliths don't have a sufficiently characteristic shape, but by studying them we can select a few families and then observe the other key elements such as jaws, photophores, etc.:

- When the otoliths have no particular morphological details or are in poor condition (broken or digested), and the specimen observed is too degraded due to

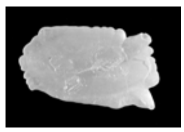
It is quite unusual to identify a specimen only through its otoliths; however, some, like the examples below, are sufficiently distinctive because of their shape.



Polymixiidae
« beardfishes »



Paralepididae
« barracudinas »



Scopelarchidae
« pearleyes »

Figure 4: Picture of otoliths of fish from different families

Observer training in biological sampling

Eighty Pacific Island regional fisheries observers (PIRFO) were recently trained in biological sampling methods. The trainings took place in Pohnpei, Federated States of Micronesia, Suva, Fiji; Kavieng, Papua New Guinea; Tarawa, Kiribati; and Honiara, Solomon Islands. Biological sampling training is an integral part of PIRFO development. These trainings provide observers with basic scientific knowledge about the necessity for sampling. Through the use of scenarios, fisheries observers were also trained in collecting reliable data without which sample analyses would not be possible. These trainings also included an important practical component to allow observers to practice the necessary skills to collect different biological organs from fish. The biological samples included: stomachs, muscle and liver tissues, gonads, otoliths and dorsal spines. In agreement with fishing companies and marine resource management agencies, fisheries observers have the possibility to sample tuna and bycatch species in areas where it would be difficult for scientists to access on a regular basis. Before being tasked with sampling work at sea, newly trained observers must first demonstrate their ability to provide reliable observer data (ensured through the debriefing process). Once the observer is efficient in this principal duty, he or she can be issued with a sampling kit and clear instructions for collecting biological samples from tuna and bycatch species caught either on longline or purse-seine vessels. This process can take time but once an observer is ready to sample, he can ask the observer coordinator to obtain some fish heads or discarded fish in order to further practice sampling techniques so that they can be fully effective once onboard. This final practice will ensure minimum disruption to fishing operations as well as the quality of samples and data. The need for biological samples is increasing because the results from their analyses provide important data for various models used by scientists, including stock assessment and ecosystem dynamics studies. As a coordinator, we would greatly appreciate hearing about which observers are doing well in their duties and who you think may be tasked with sampling duties to provide quality samples and reliable data. Please do not hesitate to contact Caroline Sanchez (carolines@spc.int) or Malo Hosken (maloh@spc.int) for any matters concerning biological sampling coordination.

Biological sampling on a tagging cruise

"Okay boys, let's keep some for sampling, 15 yellowfin, 15 skipjack and 5 rainbow runners!" This is typically heard onboard the tagging vessel *Soltai 105* after a school of fish has been tagged and released, and when enough fish unsuitable for tagging are kept aside (damaged mouth mainly). The 35 fish are arranged by species on the sampling table. "52, 50, 48, 51, 53…." One person measures each fish with a deck tape and reads out the UF (Upper jaw to Fork in tail) length to the other person writing down the data. A fatmeter is used to record the fat content of each fish before the stomach, muscle and liver samples are collected and placed inside labeled plastic bags. "**Get the bait please**". As live bait are thrown in the water to attract the fish, a sample of bait is also included with the stomach samples. This allows laboratory technicians to differentiate the natural prey from the prey used to lure in the fish. "Alright, good work guys". After 30 minutes, the sampling is over and we are ready to tag the next school of tuna. Depending on the catch of the day and sampling requirements, sampling can be conducted up to four times a day. Sampling often continues into the night, using a head lamp as the only light source. The tagging mission has just ended and about 450 samples have been collected and brought back to SPC in Noumea for analyses.

Papua New Guinea National Fisheries Authority technician Sharmaine Siaguru ready

Bait species used by pole-and-line fishermen to catch tunas.

Tagging tunas in Papua New Guinea

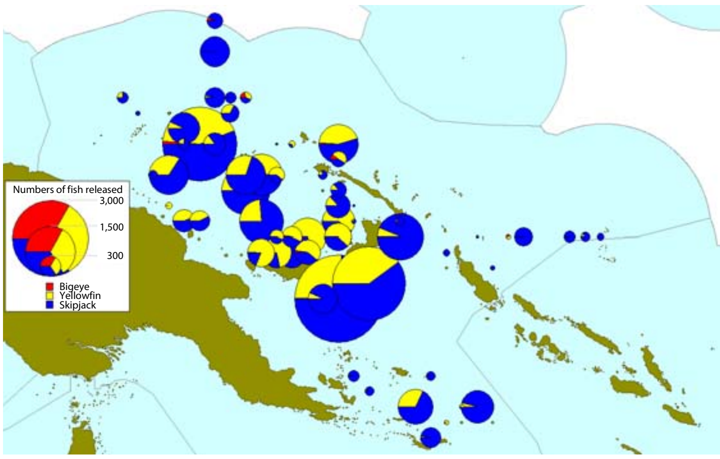
The Papua New Guinea Tagging Project (PNGTP) began on 11 April 2011 from Noro, Solomon Islands. This project, financed by the PNG National Fisheries Authority (NFA) and conducted jointly by NFA and SPC, is attempting to tag and release 30,000 tunas (skipjack, yellowfin and bigeye) during a three-month cruise in PNG waters. The tagging platform, already used with great success during the past Pacific Tuna Tagging Programme, is the Solomon Islands pole-and-line vessel *Soltai 105*. The tagging team, collaborating scientists from NFA and SPC, and 30 Solomon Islander crew members have tagged 40 628 tunas (70.9% skipjack, 28.5% yellowfin and 0.6% bigeye) during the cruise which ended on July 11th.

Released tunas are measured and fitted with either an 11 cm or 13 cm yellow plastic tag behind the second dorsal fin. For some yellowfin and bigeye tunas, a red tag is deployed, which indicates that an internal electronic tag is also inserted inside the ventral cavity of the fish. When these fish are caught, the finders are asked to measure the fish, identify the species, and note the date and position of recapture. The tag is removed from the fish and kept with the relevant information. A specially trained Tag Recovery Officer (TRO) will meet the finders to process any recovered tags and to pay rewards. TROs can be found in the PNG ports of Wewak, Lae, Madang and Rabaul. Tag returns can also be logged on to SPC's tagging website and the complete cruise reports can be downloaded (www.spc.int/tagging).

Tagging action on the bow of the *Soltai 105*.

Crew and scientist on the *Soltai 105*.

Areas where fish have been tagged include Milne Bay, the southern coast of New Britain, part of the Bismarck Sea, North of Manus Island, east of New Ireland and around the atolls east of Bougainville (see release map).



Position of tag releases during the PNGTP from April to July 2011. Releases East of New Ireland not shown.

Blue = skipjack tuna, yellow= yellowfin tuna, red = bigeye tuna.

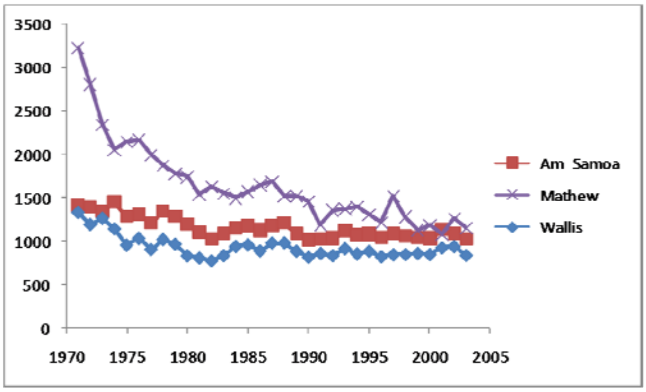
Pole-and-line fishing vessel *"Soltai 105"*.

SEAPODYM - A potential tool for the ecosystem approach to fisheries management in South Pacific.

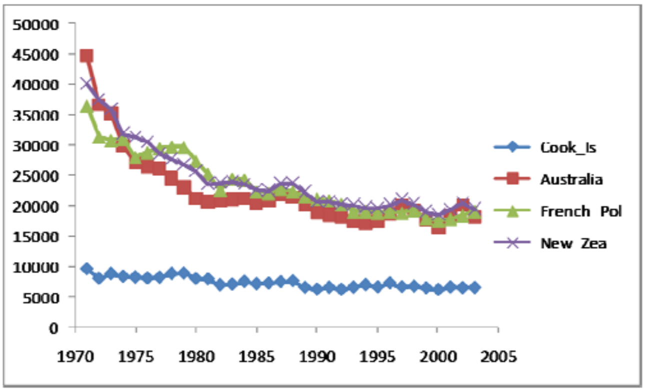
By Jesus Jurado Molina

The overall objective of the Ecosystem Approach to Fisheries Management (EAFM) is to maintain healthy marine ecosystems and the fisheries they support. This task requires the development of complex management tools and the participative inclusion of all stakeholders. Particularly in the South Pacific, the Spatial Ecosystem and Population Dynamics Model (SEAPODYM), initially developed at SPC, is a tool that integrates biological and ecological knowledge of tuna species (gained from data collected by observers) and models the reaction of tunas to fishing. The model takes space into account and includes several types of environmental data (e.g. temperature, currents, dissolved oxygen, depth of light penetration, production of phytoplankton), forage data (small fish and squid eaten by tuna) and fisheries catch and effort data. Similar to all models used in EAFM, SEAPODYM is under continuous development; however, we are confident that the recent development of this model will soon be providing useful information for fisheries management. Currently, SEAPODYM is designed for albacore (*Thunnus alalunga*) in the South Pacific. Recent SEAPODYM results agree with outputs from the stock assessment carried out with MULTIFAN-CL, thereby validating the method. Because SEAPODYM takes into account differences between areas, it can provide additional information for fisheries management. In particular, SEAPODYM is able to estimate changes in adult tuna quantities with time and quantities of tuna available within each countries Exclusive Economical Zone (EEZ). Figure 1 shows the EEZs of Pacific Island countries and territories (PICTs) that were included in the analysis; Figure 2 shows the changes with time in the quantities of tuna within PICTs. This information is useful for assessing the current status of tuna stocks and the implications for managing albacore in the South Pacific. Future work on SEAPODYM will focus on estimating the impact of fishing effort on albacore quantities.

Figure 2: Example of changes in the quantities of adult albacore in the exclusive economic zones of some Pacific Island countries and territories



Am_Samoa = American Samoa
Mathew = Mathew Hunter,



Cook_is = Cook Islands
French_Pol = French Polynesia
New_Zea = New Zealand.

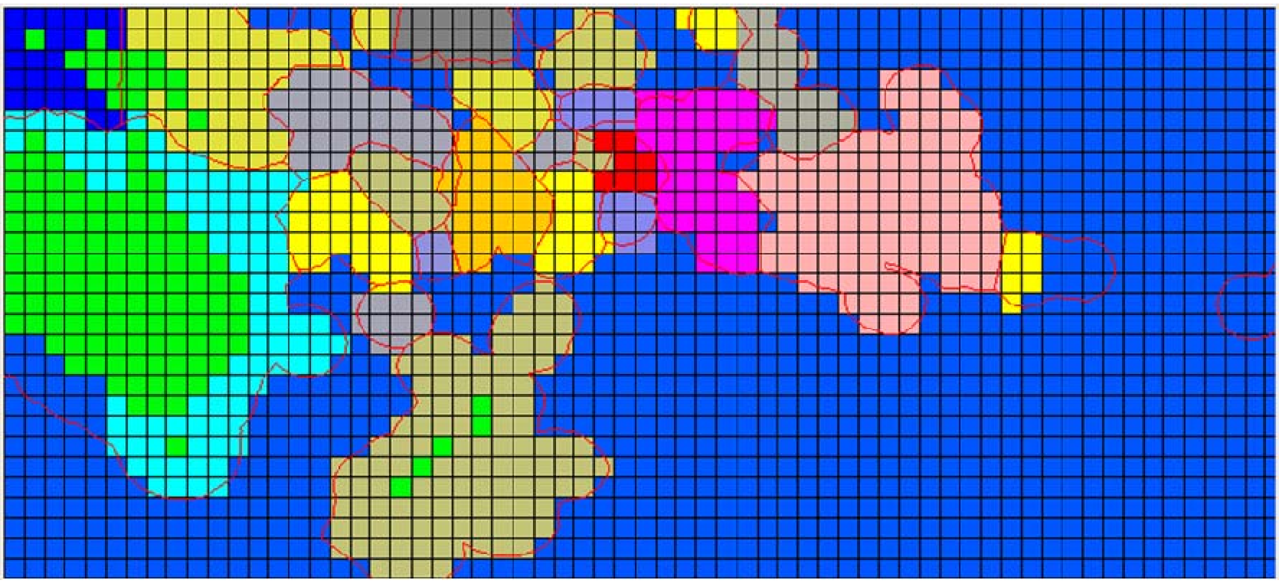


Figure 1: Exclusive Economic Zones of Pacific Island countries and territories of the Western and Central Pacific Fisheries Commission.

Wahooks !

Surprises in wahoo stomachs

Figure 1 : Picture of *Acanthocybium solandri* (Wahoo)
Les Hata; © SPC

Analyses of wahoo samples collected by an observer onboard a longliner in Fijian waters provided us with some surprises. In 2 of the 12 specimens, we found hooks! One of the predators contained 1 longline circle hook, while another wahoo had three hooks in its stomach. We observed that of the 218 wahoo stomachs analysed since the project began in 2001, 68 stomachs contained several bait species.

These observations thus lead us to believe that members of this species can learn to follow the lines and eat the bait on them, just as marine mammals sometimes eat tuna caught on a line.

In addition, this shows us that wahoo have teeth sharp enough to cut nylon

Figure 1 and 2: Picture of hooks in wahoo stomach

Tuna Data Workshop #5.

18-22 april 2011, Noumea

The regional Tuna Data Workshop is conducted on an annual basis for SPC member countries to improve their scientific tuna monitoring and data management capacity, and satisfy their data reporting obligations to the Western and Central Pacific Fisheries Commission (WCPFC).

The workshop is targeted to "National Tuna Data Coordinators (NTDC)", which are the focal points for the coordination of tuna fishery data collection and management.

During the tuna data workshop SPC invited all participants to attend to a port sampling session in Noumea fishing harbor (Figure 1). It was a good opportunity for participants to examine species uncommon in their own country and observe how port sampling was organized in New Caledonia

Figure 1: Visiting the fishing harbour of Noumea

Figure 2 and 3: Unloading of local longline tuna in Noumea

Next newsletter in October2011

We welcome your comments on the content of this newsletter – please send them to Valérie Allain (valeriea@spc.int), Elodie VOUREY (elodiev@spc.int).