

REEF FISHERIES OBSERVATORY

Ciguatera-like fish poisoning from giant clams on Emao Island, Vanuatu

Ciguatera — a particular type of marine fish poisoning — is caused by eating tropical coral reef fish that have accumulated ciguatoxins through the marine food chain. The social and economic impacts of such intoxications are highly significant in the Pacific, where fish is an important part of people’s daily food and is one of the few sources of cash income for coastal communities.

In October 2008, during a ciguatera and marine biotoxins conference organised by SPC, the Institute of Research for Development (IRD), the Pasteur Institute, and the Papeete-based Louis Malarde Institute (ILM), a representative from Vanuatu’s Fisheries Department highlighted a severe outbreak of fish poisoning on Emao Island near Efate (see Fig. 1). Although there are six villages on Emao, only Lausake village (located on the southeastern side, see Fig. 2) was being affected by fish poisonings. People were becoming seriously ill from eating fish as well as giant clams.

CIGUATERA-LIKE POISONING FROM NEW CALEDONIA AND FRENCH POLYNESIA

Poisoning caused by eating giant clams was recently studied on Lifou in New Caledonia’s Loyalty Islands. The study found that within an area claimed to be the source of ciguatoxic fish and molluscs, there was an absence of *Gambierdiscus* sp., the dinoflagellate usually associated with ciguatera outbreaks. Present, however, were large populations of filamentous cyanobacteria identified as *Hydrocoleum*. Further *in vivo* and *in vitro* toxicological studies on samples of these cyanobacteria and giant clams showed the presence of lipid-soluble compounds that are ciguatoxin-like,

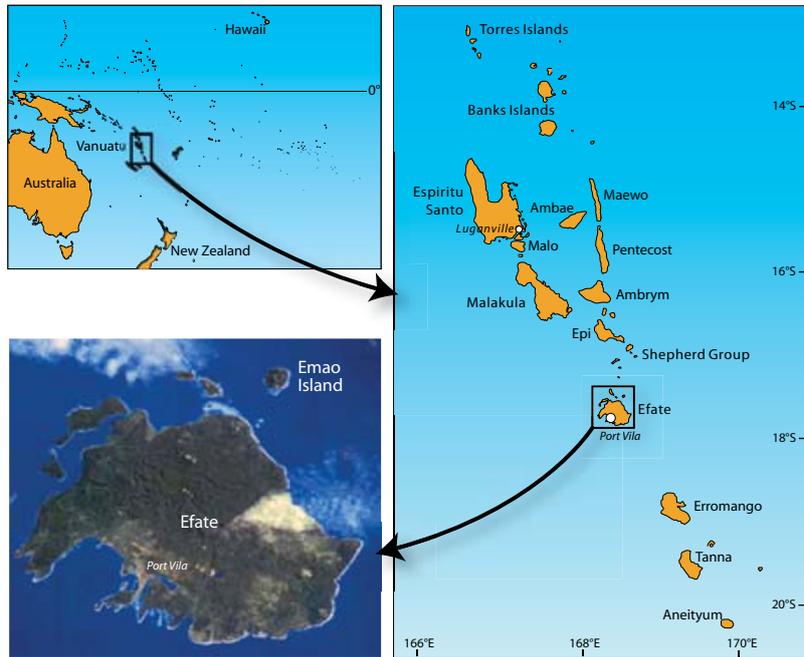


Figure 1. Vanuatu, Efate and Emao Island (Picture source: Millennium Coral Reefs Landsat Archive).

and which are associated with water-soluble paralyzing toxins such as paralytic shellfish toxins and/or anatoxin-a, and homoanatoxin-a.

Another case of poisoning from giant clams was reported from Raivavae in French Polynesia. This poisoning formed the focus of another similar toxicological study. The study revealed a strong relationship between anthropogenic impacts, the development of Oscillatoriales (cyanobacteria) blooms, and the resulting outbreak of ciguatera fish poisonings caused by eating giant clams in affected areas, all of which suggest a new trophic pathway of human poisoning via molluscs such as giant clams. Indeed, the symptoms experienced by patients included the characteristic sensation of

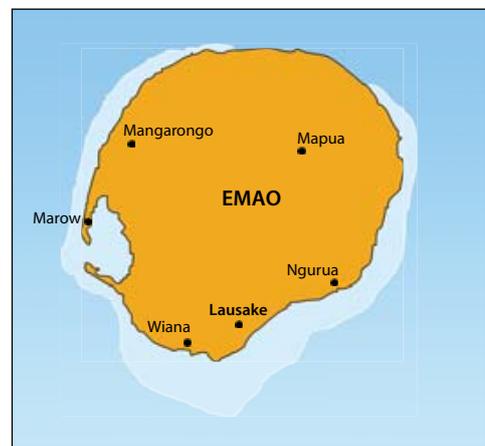


Figure 2. Emao Island and Lausake village.

temperature reversal. Therefore, the term “ciguatera” is still used for this new intoxication.

The case on Emao Island in Vanuatu provides a suspiciously curious and interesting case that could provide another possible example of cyanobacteria-related fish poisoning. The sampling and chemical analy-

ses required for a proper toxicological study will require a good experimental design and extensive field efforts. This first preliminary investigation serves as a preparatory first step toward this larger study.

#### EMAO ISLAND STUDY

In response to a request from Vanuatu's Fisheries Department, a joint SPC, IRD and ILM mission to visit Emao Island was organised in order to:

- Contact communities affected by the fish poisoning epidemic, and collect historical information on when the fish poisoning began, who was infected, which fish were implicated, and the types and duration of symptoms;
- Present the current knowledge and improve the community's understanding of ciguatera and marine-related illnesses related to eating fish and shellfish;
- Gain an idea of the extent of the infected reef area through field inspection, and evaluate the quality of the reef by taking pictures and conducting some preliminary investigative sampling;
- Conduct a chemical analysis of collected samples in order to identify the presence of ciguatera- and cyanobacteria-related toxins; and
- Use preliminary results and observations to design a more detailed research project to investigate and understand the problem.

In May 2009, SPC's Senior Fisheries Scientist, Being Yeeting, and a doctoral student working on marine biotoxins, Anne-Sophie Kebrat from IRD visited Emao Island. Being and Anne-Sophie worked with two local counterparts from Vanuatu's Fisheries Department, Sompert Gereva, Senior Fisheries Biologist and Jeremy Kaltavara, Fisheries Research Assistant.

#### FIELD METHODS

##### Informal interviews

During the visit, information on the number of ciguatera cases admitted was collected from the Public Hospital in Port Vila through an interview with the Director of Public Health, Dr Griffith Harrison.

Historical and epidemiological information was collected through consultations and informal interviews with the community of Lausake village. Only a few people of the interviewees could fully understand English, and so it was important to have the fisheries officers assist in translating questions from English to Bislama to the local people, and to translate responses from Bislama to English for us, the research team. The questions asked were generally addressed to the entire community, with more detailed questions targeted at individuals who were willing to share their experiences of their poisoning. During consultations, the team took the opportunity to give a poster presentation, explaining the ciguatera problem and the ongoing research and investigations that are being carried out to try and better understand the problem. A copy of the poster used in Bislama was given to the Vanuatu Fisheries Department for use at other ciguatera public awareness meetings.

##### Site observations

A site visit was made to evaluate reef conditions, water quality, and the size of the infected area based on information collected from fishers. Underwater observations were made using mask and snorkel, swimming in a square from the beach out to the outer reef, across the area close to the outer reef, from the outer reef to the beach and along the beach side. Photographs of corals and substrate observed were taken.

#### Collecting samples

Samples of cyanobacteria were collected by hand from various locations and different biotopes. The samples were preserved in sealed containers for later analysis. Macroalgal samples were also collected and tested for *Gambierdiscus* sp. Some reef fish species and clam specimens were also collected to analyse their toxicity.

The samples were taken to New Caledonia for analysis at IRD's laboratory. A permit to take the samples out of Vanuatu was provided by the Vanuatu's Fisheries Department. A CITES permit for export had to be obtained for giant clams, a CITES-listed species.

#### SOME RESULTS AND OBSERVATIONS

##### Informal interviews

An interview with the Director of Public Health at Port Vila Public Hospital revealed that the actual number of ciguatera cases has been increasing in recent years; and since October 2008, the hospital has recorded eight cases. Two cases involved whole families although the other family members were not admitted into hospital. A very serious case from Emao resulted in the patient being evacuated to New Zealand for treatment. Information obtained from patients indicated that the source of the ciguatoxic fish was the local fish market, where fish from Emao are sold. As a result, people in Port Vila are now avoiding fish from the market unless they are certain that the fish do not from Emao.

Also recently, there was a case of a boy who became ill and died from eating some kind of shellfish collected at the wharf in town. Yet another recent incident involved two deaths from eating mud crabs. Santo is another area with significant

numbers of ciguatera fish poisoning cases.

Lausake villagers were very interested in the study and were very cooperative during interviews, an indication of their desire for help in solving their fish-poisoning problem and to regain the seafood sources they have lost from their reefs. About 40 people were interviewed. Fish, shellfish or both had poisoned each of these people at least once. Because of the fish poisoning, villagers have stopped eating seafood from their reefs and have turned to root crops instead for food. The only fish they are comfortable eating now are tuna (which are never ciguatoxic), although catching tuna requires a boat and engine, which most villagers do not have.

The infected area seems to be localised to the reef adjacent to Lausake village, from the beach outwards to the barrier reef. The reef fish started becoming toxic 10 years ago, but giant clams, trochus, gastropods (e.g. *Nerita polita*), crabs and other shellfish (e.g. *Atactodea striata*) (Fig. 3) became toxic about three to four years ago.



**Figure 3.** *Nerita polita* and *Atactodea striata*, two invertebrate species found to be toxic off Lausake village.

One recent case was hospitalised, but thus far, no fatalities have been recorded. To test for toxic fish, villagers commonly use cats and dogs and, interestingly enough, there were hardly any cats or dogs in Lausake compared with Marow village.

Villagers noted differences in symptoms from eating toxic fish and toxic shellfish. The symptoms associated with eating toxic fish are typical of ciguatera: fatigue, nausea, diarrhoea, joint pain, and hot-cold sensory reversals. With shellfish, symptoms are quick to appear: tingling lips and burning sensations in the mouth, followed by gastrointestinal problems (diarrhoea and vomiting) that occur within the first hour, and neurological symptoms that last for several weeks (whereas with ciguatera, these tend to last for several months).

#### Field observations

The infected reef area from the beach to the barrier reef covered a distance of about 1,000 m. The reef area consisted mostly of *Acropora* spp., most of which were dead and covered with carpets of filamentous cyanobacteria (Fig. 4). The Oscillatoriales (cyanobacteria), mainly *Hydrocoleum* and *Phormidium* were seen in large and small diversified mats. At a distance of 10–20 m from the beach and along the beach over a stretch of about 100 m, gardens of *Simularia*-like soft corals were found. The coast was very tur-



**Figure 4.** Dead coral covered with carpets of filamentous cyanobacteria.

bid, especially 50 m out from the beach.

#### Samples collected

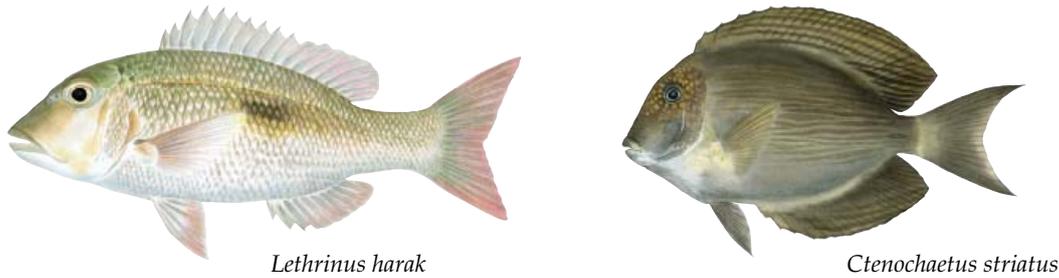
Batches of cyanobacteria — collected from different biotypes — will be properly identified in the laboratory. Several visually different coloured specimens were seen in the infected reef area (Fig. 5).



**Figure 5.** Cyanobacteria visible on different biotypes.

Three reef fish species — the parrotfish, *Hippocampus longiceps*, the emperorfish, *Lethrinus harak*, and the surgeonfish, *Ctenochaetus striatus* (Fig. 6) — and one clam specimen, *Hippopus hippopus* (Fig. 7), were collected. Chemical analyses of these samples are being conducted at the IRD laboratory in Noumea.

The results should be available soon, and will hopefully provide some insights to the cause of the fish poisoning and whether the



**Figure 6.** Two of the three species of reef fish collected for ciguatoxin testing.



**Figure 7.** A giant clam sample collected for analysis.

toxins are ciguatera-based or cyanobacteria-related. The results will also be sent to Vanuatu's Fisheries Department and the Lausake village community when they are available, and will be used to develop a larger research project to examine the problem in greater detail.

**Preliminary results from analyses**

The samples collected revealed the absence of *Gambierdiscus* dinoflagellates, which are known to produce ciguatoxins.

Chemical analyses of samples taken from i) a mat of cyanobacteria, ii) fish, and iii) giant clams were also conducted. The water-soluble and lipid-soluble compounds obtained were screened for their toxicity with mouse bioassay and cytotoxicity test respectively.

These tests revealed a strong paralytic toxicity for both the cyanobacteria and giant clam samples. In addition, ciguatoxic-

like toxins seem to be present in the giant clams collected. These results, however, need to be further confirmed. The lipid-soluble extract from cyanobacteria and the fish are currently being analysed for their ciguatoxic potential. The results of these further analyses were not ready when this article was written, but will be described in a more detailed technical report.

**CONCLUDING REMARKS**

Recently, cyanobacteria have been found to play an important role in seafood poisoning, especially in relation to giant clam poisoning. Studies in Raivavae, French Polynesia and Lifou, New Caledonia have shown that it is possible for cyanobacterial toxins to enter the food chain directly through grazing fish (e.g. parrotfish) or via molluscs through molluscivorous fish (e.g. emperorfish).

Although the results of the chemical analyses of the Emao samples are not yet known, the presence of mats of cyanobacteria in the area of Lausake village certainly provides a strong possibility that cyanobacteria is the cause of the food poisoning currently occurring on Emao Island.

It was also interesting to note that the symptoms reported by Lausake villagers who became sick from consuming giant clams, seemed to correspond with those of the cyanobacterial-associated giant clam poisoning cases reported in

Raivavae, French Polynesia and Lifou, New Caledonia. These symptoms are very similar to ciguatera-based fish poisoning symptoms, but seem to occur more rapidly and last only a few weeks, whereas ciguatera-based fish poisoning symptoms can last for several months.

It should be noted that such cases of seafood poisoning could be more common than currently known and are often regarded as ciguatera-related fish poisoning. People who experience peculiar symptoms of fish poisoning after eating molluscs or grazing fish (e.g. parrotfish) and molluscivorous fish (e.g. emperorfish) should contact their medical doctor or nurse, or the Fisheries Department. Such information could improve the understanding of seafood poisoning from different marine biotoxins.

**ACKNOWLEDGEMENTS**

SPC, IRD and ILM thank the community of Lausake village for their hospitality and co-operation during the visit, and the Vanuatu Fisheries Department for its support. Funds for this study were provided by the Pacific French Fund through ILM; French Polynesia, covered airfares and some fieldtrip expenses.

For more information, please contact:

**Being Yeeting**, Senior Fisheries Scientist (Live Reef Fish), SPC  
Email: BeingY@spc.int