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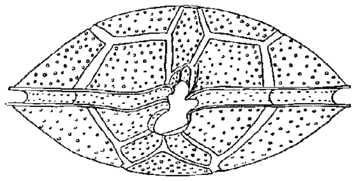


CIGUATERA

INFORMATION BULLETIN Number 1 - May 1991

Group Co-ordinator: Richard Lewis, Queensland Dept. of Primary Industries, Southern Fisheries Centre, P.O. Box 76, Deception Bay, Qld 4508, Australia.

NOTE FROM THE CO-ORDINATOR

The Ciguatera Information Bulletin is an important new initiative of the South Pacific Commission. This bulletin recognises the significance of the problem of ciguatera to many Pacific Island countries. It is hoped the bulletin will: (i) increase awareness and understanding of ciguatera in Pacific Basin countries; (ii) provide a forum for exchange of ideas on how ciguatera can be managed; (iii) facilitate more accurate reporting of outbreaks of ciguatera in the region; (iv) provide a vehicle for the documentation and dissemination of results of studies on ciguatera in the region; and (v) highlight important research findings forthcoming from laboratories investigating ciguatera throughout the world.

The first bulletin contains a wealth of practical information clearly describing ciguatera, reports on research findings and directions for two groups in the field. To those interested in ciguatera, please become a member of the Special Interest Group. Literature in the field (particularly 'grey literature') can be sent to SPC for inclusion in its already extensive bibliographic database and library.

Finally I want to encourage the submission of articles related to ciguatera to SPC (at the above address) for inclusion in forthcoming bulletins.

Richard J. Lewis

Inside this issue

PIMRIS is a joint project of 4 international organisations concerned with fisheries and marine resource development in the Pacific Islands region. The project is executed by the South Pacific Commission (SPC), the South Pacific Forum Fisheries Agency (FFA), the University of the South Pacific's Pacific Information Centre (USP-PIC), and the South Pacific Applied Geoscience Commission (SOPAC). Funding is provided by the International Centre for Ocean Development (ICOD) and the Government of France. This bulletin is produced by SPC as part of its commitment to PIMRIS. The aim of PIMRIS is to improve the availability of information on marine resources to users in the region, so as to support their rational development and management. PIMRIS activities include: the active collection, cataloguing and archiving of technical documents, especially ephemera ('grey literature'); evaluation, repackaging and dissemination of information; provision of literature searches, question-and-answer services and bibliographic support; and assistance with the development of in-country reference collections and databases on marine resources.

PIMRIS

Pacific Islands Marine Resources Information System

Ciguatera fish poisoning in the Pacific

by SPC Health Programme Staff
(SPC Information Circular # 115)

This Information Circular was prepared and produced by the South Pacific Epidemiological and Health Information Service in 1988. Because of the specific information contained in the circular, we thought it appropriate to reproduce this document, outlining the main points of interest with the aim of broadening awareness of the ciguatera fish poisoning problem in the Pacific.

Introduction

Ciguatera fish poisoning is a significant public health problem in the Pacific and a potential barrier to further development of small-scale commercial fisheries in the Pacific Islands. In recent years, over 3,000 cases of fish poisoning have been reported annually to the South Pacific Epidemiological and Health Informa-tion Service (SPEHIS). It is estimated that this total represents only 10-20% of the actual num-ber of cases of fish poisoning, which would therefore be in the order of 15,000 to 30,000 cases annually. Though death from ciguatera fish poisoning is rare, illness can be severe and recovery slow. Publicity on cases of fish poisoning can result in a decline in the consumption of fresh fish in Island communi-ties and problems in exporting fresh fish to foreign markets.

Fish poisoning can result from eating spoiled fish or from eating fresh or processed fish containing naturally occurring toxic subs-tances. Ciguatera fish poisoning results from eating reef fish that have previously consumed toxic dinoflagellates (microscopic marine organisms) or from eating predators of these reef fish. There are several types of fish poi-soning in addition to ciguatera. Some are associated with specific fish, for example clupeoid poisoning (sardines, anchovies or herring) and puffer fish poisoning. Scombroid fish poisoning occurs when certain types of fish (mackerels and tunas) are eaten after they have produced toxins through spoilage, usually because of inadequate chilling and re-frigeration.

Clinical symptoms

The major clinical symptoms that have been associated with ciguatera fish poisoning are described in Table 1. Symptoms usually appear within two to thirty hours (with an average of about six hours) after the consumption of toxic fish, and may vary with the individual and the species, the quantity and parts of the fish consumed. Usually the first symptoms to ap-pear are numbness with a prickling sensation around the lips, tongue and throat, and general weakness and nausea.

The usual progression of the illness is shown in Figure 1. There seems to be a dose-response relationship in ciguatera fish poisoning, with increased ingestion of toxic fish causing more severe symptoms. The illness may last for weeks or months, and occasionally years, depending on the severity of the symptoms. Repeat cases are usually more severe.

Death from ciguatera fish poisoning occurs in less than one per cent of the cases and is usually associated with consumption of the most toxic parts of fish (liver, viscera, organs, roe, etc.). Reported causes of death include respiratory and heart failure and shock from severe de-hydration due to vomiting and diarrhoea.

Table 1: Clinical symptoms associated with ciguatera fish poisoning (adapted from Hokama, 1988)

Digestive:

Nausea, often followed by symptoms of watery diarrhoea, ab-dominal cramps and sometimes vomiting that usually subside within 24 hours. Symptoms may cause dehydration.

Neurological :

Initially, sensitivity disturbances such as reversal of tempera-ture sensation, where cold feels hot (a burning or tingling sen-sation may also be felt) and hot feels cold, intense itching and numbness with tingling in the limbs. Severe cases may exhibit partial paralysis, convulsions, shaking and spasms. Neurologi-cal symptoms may persist from weeks to months (rarely years).

Cardiovascular:

Slow or accelerated pulse rate that is often irregular. Reduced blood pressure. Heart beats may be slightly muffled. These symptoms generally disappear in 2-3 days.

General:

General weakness, joint pain, muscle pain (especially of the legs), headache, chills, sweating and dizziness.

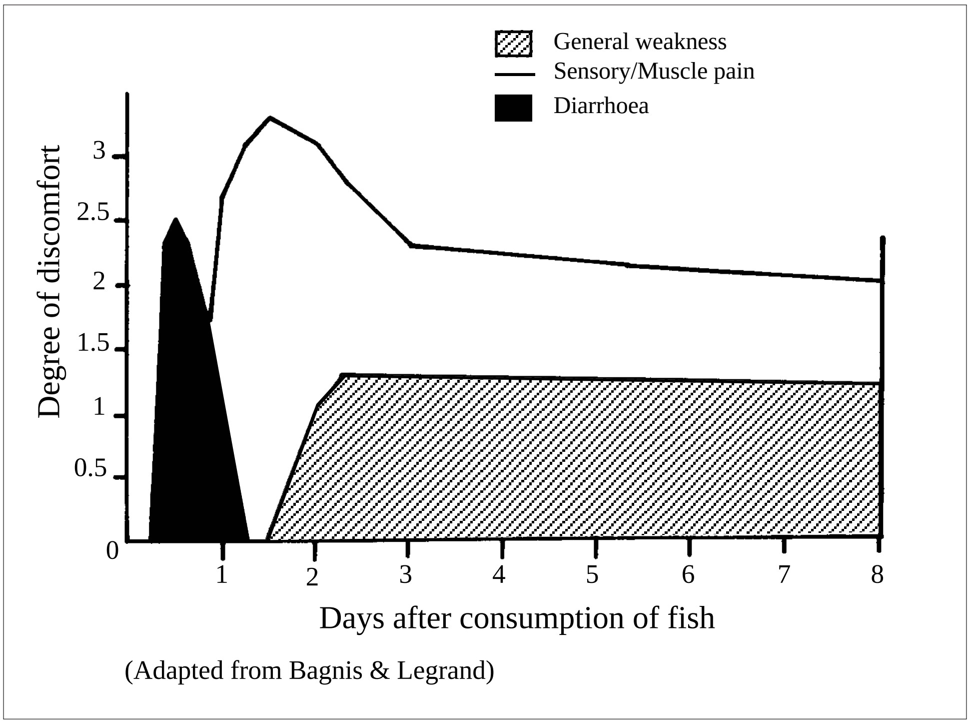


Figure 1: Severity and duration of ciguatera symptoms

Treatment

In most cases, people with ciguatera fish poisoning recover completely, and treatment of the symptoms is usually sufficient to ensure recovery. Individuals with ciguatera fish poisoning should avoid consuming any fresh or saltwater fish or shellfish products, alcoholic beverages and nut or seed products. Consumption of these foods can cause a relapse in symptoms, and increase the severity and/or duration of the illness. This observed syndrome may be due to chemical substances in these foods which mimic the fish poisoning toxins, thus causing a type of allergic reaction.

Efforts are being made to develop a possible curative treatment for ciguatera fish poisoning. A recent article by Palafox et al., in the *Journal of the American Medical Association*, reports that mannitol, an inexpensive sugar compound widely used to help the flow of urine, may be an effective treatment for acute ciguatera fish poisoning. Mannitol may work by flushing out fish poisoning toxins from the body through the urine. Studies to confirm the effectiveness of mannitol are in progress.

Causative agent of ciguatera fish poisoning

Ciguatera fish poisoning is associated with several polyether toxins, of which ciguatoxin is probably the most important, especially in carnivorous fish and in toxic fish found to cause ciguatera. Toxic *Gambierdiscus toxicus* is the source of introduction of ciguatoxin into the food chain, leading to fish poisoning inhumans. These dinoflagellates attach themselves to marine algae and are then passed up the food chain by being consumed by small herbivorous fish, which are then consumed by carnivorous fish. Humans are poisoned after consumption of either type of toxic fish.

Ciguatoxin is one of the most potent and stable marine toxins known. It is resistant to heat and acid, and cannot be destroyed by cooking, smoking, marinating, freezing, The higher fish are in the food chain, the more concentrated is the toxin in their tissues and the more severe the symptoms from eating the fish. drying, salting or freeze-drying.

Ciguatoxin and other related toxins do not alter the smell, taste or coloration of the toxic fish tissues. The cigua-toxin concentrates in the liver, viscera, organs, roe and head of the fish, which feel no ill effects from the toxin

Fish species implicated in ciguatera fish poisoning

In theory, almost any reef fish or predator to reef fish could become ciguatoxic under the right conditions. In the Pacific the majority of the implicated fish are carnivorous and include:

- groupers or rock cods
- mullets
- parrot fish
- trigger fish
- surgeon fish
- wrasses

- emperor fish
- barracudas
- snappers
- moray eels
- jacks or trevallies

Several factors may affect the toxicity of the fish. These include:

- the area fished (less important for migratory species);
- whether the fish is herbivorous or carnivorous — carnivorous fish are generally more toxic.

Prevention an control of ciguatera fish poisoning

local surveillance of fish poisoning is a key element in the prevention and control of ciguatera. More complete reporting of fish poisoning cases should be encouraged through the training of reporting sources (such as medical staff at clinics and hospitals who provide urgent care) on the diagnosis of the various types of fish poisoning and the report-ing procedures to local health officials. All outbreaks of fish poisoning and, when staff and budgetary resources allow, individual cases of fish poisoning should be investigated. These investigations are important in determinating the type of fish poisoning involved (ciguatera vs. scombroid, etc.), the number of people affected, the species of fish consumed, and where the fish was caught.

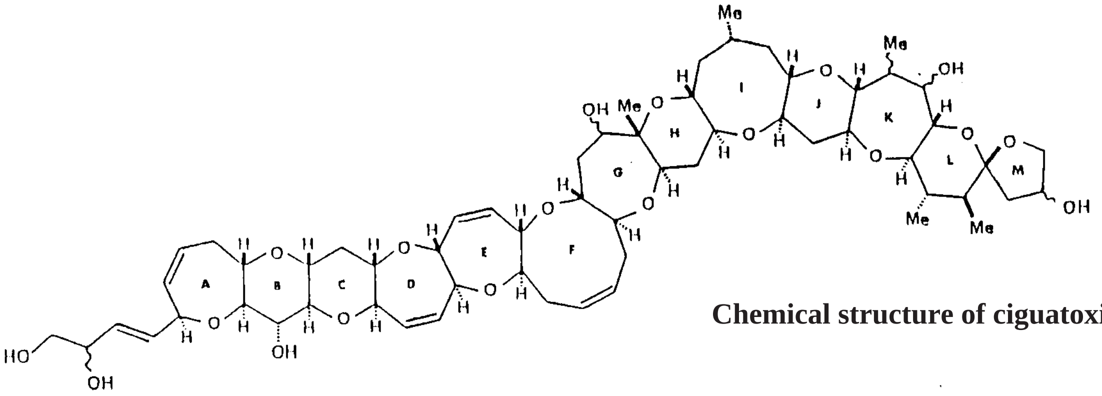
The information gathered through fish poisoning surveillance can be used in the development of ciguatera control methods. These methods might include prohibiting the sale of fish species that are known often to be toxic, that are caught in known 'hot spots' on the reef, or that are over a certain weight. Other methods include public education on ciguatera fish poisoning (especially in the avoidance of eating the viscera and roe (eggs) of fish) and in future, the screening of toxic fish. The choice of methods used will depend on the local patterns of ciguatera fish poisoning.

Ciguatera research in French Polynesia

by A.M. Legrand
Institut de Recherches Médicales Louis Malardé
Papeete, French Polynesia

Ciguatera fish poisoning is an important problem in French Polynesia as in the whole South Pacific. About 800 to 1000 cases are declared and documented every year.

The Ciguatera Unit of the Institut de recherches médicales Louis Malardé was created in 1967 by Dr R. Bagnis to study the complex situation of the various seafood poisonings observed in the Pacific Islands.



Chemical structure of ciguatoxin

Until 1979 mainly ecological research was conducted in the field in the Tuamotu, Marquesas and Gambier Islands. The purpose was to try to understand the original source of the fish toxins and the reasons for the presence of hazardous fish in the lagoons.

Based on the diversity of fish species affected, it had long been thought that the origin of the ciguatera toxins was exogenous (the toxin was not produced by the fish). First, field research focused on the algae colonising coral beds. Then, in 1977, the discovery of aboundant amounts of the dinoflagellate *Gambierdiscus toxicus* on coral beds in a ciguatera endemic area of the Gambier Island of Mangareva provided the first evidence for the unicellular origin of the toxins, ecologically related to climatic and man-made disturbances induced in coral reefs.

This important step is one of the very successful results obtained by the Institut Malardé which was associated during that period with some of the field experiments of Yasumoto's group (Tohoku University, Sendai, Japan).

Thereafter, a research programme was developed at the laboratory, the purpose of which was to establish a reliable and sensitive method to detect hazardous reef fish.

During several years this programme was hampered by insufficient knowledge about the chemical nature of the toxins involved in human intoxications.

In 1986, supplementary financial support allowed the acquisition of modern chromatographic equipment so that complete purification of the toxins was hence forth possible.

A chemical research program for identification and characterisation of the fish toxins led to a recent success in 1989: the chemical structure of ciguatoxin is now well-known. This important new result is the outcome of close collaboration between our laboratory and Professor Yasumoto's group.

As a consequence of this important progress and thanks to both scientific and financial support provided by the Pasteur Institute of Paris, a new research programme is on course to develop the reliable and sensitive assay to detect hazardous fish that every fishery service needs. We hope to succeed in that project within three years.

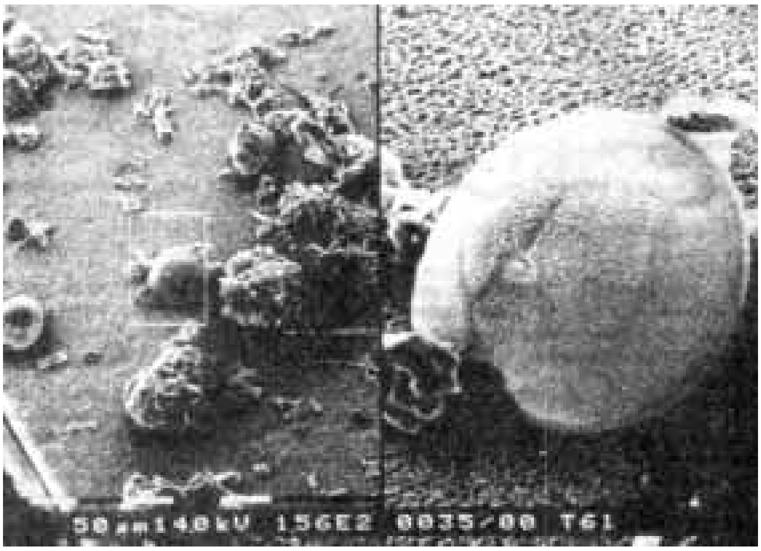
QDPI research on ciguatera

by R.J. Lewis
Queensland Dept of Primary Industries
Deception Bay, Australia

The Queensland Department of Primary Industries (QDPI) has been researching the ciguatera problem in Australia for over 10 years. A recent review of ciguatera provides a background to this work (Gillespie et al., 1986).The research group comprises myself (Richard Lewis), Michael Holmes, Ashley Hoy and Michelle Sellin. The goal of our present research is to minimise the adverse impact of ciguatera on the fishing industry and on public health. We are investigating three main areas.

Production of antibodies to ciguatera

The goal of this project is to produce monoclonal antibodies to ciguatoxin (the toxin that causes ciguatera). These antibodies will be used to develop a test kit to detect if fish are toxic or safe to eat. We have now purified sufficient ciguatoxin (mainly from moray eels from Tarawa) for the antibody production phase of this work to commence. This material will first be coupled to a carrier protein prior to immunisation, as ciguatoxin on its own



View of *Gambierdiscus toxicus*

will not induce an immune response. A success in this project will have regional and international significance.

Origin of ciguatoxin

The goal of this project is to determine how ciguatoxin enters the food chain and if environmental factors influence the quantity of toxin entering. This work has focused on culturing *Gambierdiscus toxicus*. We discovered that only two of thirteen strains of *G. toxicus* in culture actually produced ciguatoxin precursors (gambiertoxins) and no ciguatoxin was detected (Holmes et al., in press). The strain-dependent production of ciguatoxin precursors may explain why ciguatera incidence correlates with *G. toxicus* numbers in some areas but not in others.

Treatment of ciguatera

The goal of this project is to establish new treatments for ciguatera. This work has provided independent confirmation in Australia (Pearn et al., 1989) of the use-fulness of mannitol in the treatment of ciguatera. Experimental studies show mannitol is likely to reverse an oedema of Schwann cells seen during ciguatera. We are also investigating the potential of local anaesthetics as treatments and are collaborating with P. Amade and D. Laurent at ORSTOM Noumea, on a study looking at the potential of traditional remedies as treatments. Development of an orally effective treatment for ciguatera is our long-term goal.

Details of each of these projects will be presented in articles in future issues of the bulletin. In addition to these studies, we have a watching brief on other tropical marine food toxins, particularly dinoflagellate-borne toxins such as those causing paralytic shellfish poisoning.

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Excretion of ciguatoxin from fishes

by R.J. Lewis
Queensland Dept of Primary Industries
Deception Bay, Australia

Humans who eat fish in tropical and sub-tropical areas are at risk from ciguatera. This risk stems from the ability of otherwise edible fish in tropical and sub-tropical areas to accumulate ciguatoxin through the marine food chain. Species of herbivorous, detritivorous, omnivorous and carnivorous fishes have been implicated with ciguatera.

A long-standing dogma is that, once a fish becomes contaminated with ciguatoxin, it retains this quantity of toxin over its life time. However, in a recent report from our group (Lewis et al., 1991), we indicate that a population of moray eels became progressively less toxic over time. This article summarises some of the findings of this study.

The moray eels (*Lycodontis javanicus*) were collected from Tarawa, Republic of Kiribati, in an area where ciguatera has been endemic for several decades. Moray eels were captured in fish-baited cage traps set at various locations on the ocean reefs adjacent to Teaoraereke with the assistance of T. Tebano. The viscera (including liver) of each eel were removed and stored frozen prior to air dispatch to Brisbane, Australia. Viscera were pooled to a convenient sample weight for extraction (0.3 to 1.0 kg). The lipid-soluble fractions were then bioassayed in mice to quantify the toxin content of each sample of eels. During this study, eels captured from the ocean reef adjacent to the villages of Bikenibeu, Bairiki and Betio (Figure 1) were also found to be similarly toxic to the eels from Teaoraereke. However, a pooled sample of viscera from five eels from the ocean reef adjacent to Tanaea did not contain detectable ciguatoxin.

A total of 217 eels was obtained from nine collections over a 500-day period, commencing September 1987. These eels yielded a total of 35.9 kg of viscera from which were extracted 99,200 mouse units (m.u.) of ciguatoxin. The average toxicity was 2.43 ± 1.69 m.u. per g viscera and ranged from 0.59 to 7.3 m.u. per g. Interestingly, no significant regression was found between toxicity and average viscera weight, indicating that these eels did not become more toxic the larger they grew. However, the toxicity of viscera was found to decline significantly over the 500-day period of the collections (Figure 2). An exponential relationship fitted this decrease in toxicity.

The slope of the regression estimated that the half-life for the loss of ciguatoxin from the population of eels was 264 days. All eels contained detectable ciguatoxin and no seasonal fluctuations in toxicity were evident.

We proposed that this loss of ciguatoxin from eels stems from the excretion and/or decay of ciguatoxin. Excretion (depuration) comprises the loss from eels of ciguatoxin *per se*. Decay comprises the metabolism of ciguatoxin to less toxic moieties within eels.

Case history data on fish poisoning (including ciguatera) in the Republic of Kiribati collected by the South Pacific Epidemiological and Health Information Service from 1982 to 1989 (Figure 3) indicate an upsurge in poisoning in 1986/87. The upsurge was followed by a decrease in the incidence of poisoning in 1988 and 1989. This decrease coincides with the period when eels were declining in toxicity. We suggest that moray eels could be a good indicator species for assessing ciguatera levels in an area. The upsurge in fish poisoning coincides with reef disturbance associated with the Dai Nippon causeway project several kilometres to the west of Teaoraereke (Tebano and Lewis, 1990).

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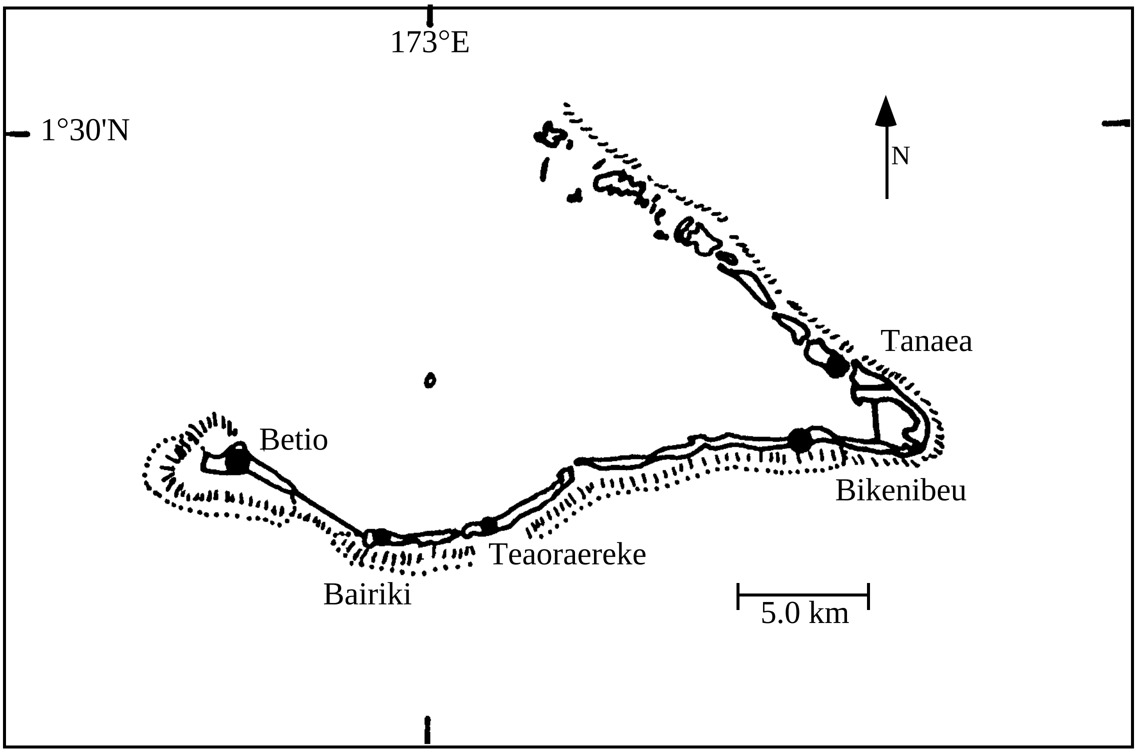


Figure 1. Map of the southern half of Tarawa, Republic of Kiribati. The dashing indicates the outer barrier reef. The areas reported toxic in 1983 are indicated by the dotted line. Eels were collected on outer reefs adjacent to Teaoraereke from September 1987 to January 1989.

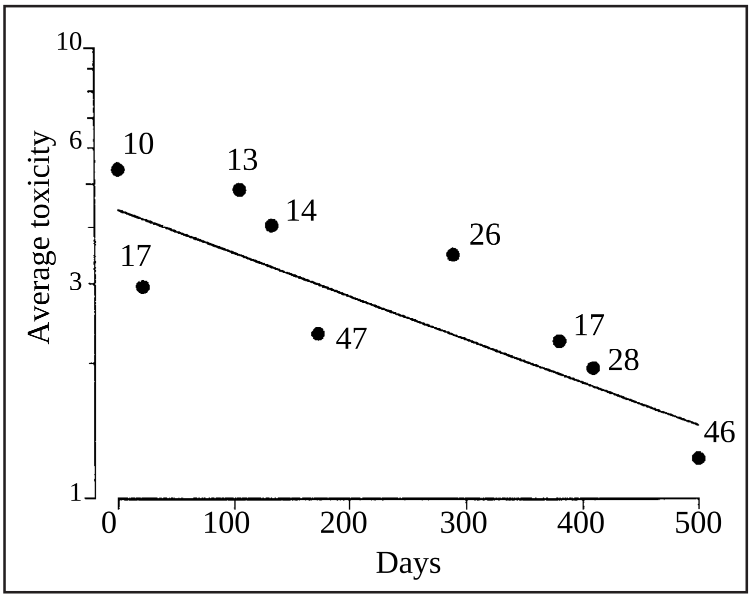


Figure 2. Toxicity (mouse units per g viscera) of eel viscera over a 500-day period. Note log scale for y axis. Numbers adjacent to each data point indicate the number of fish pooled for that collection. Toxicity declined significantly over the 500-day period.

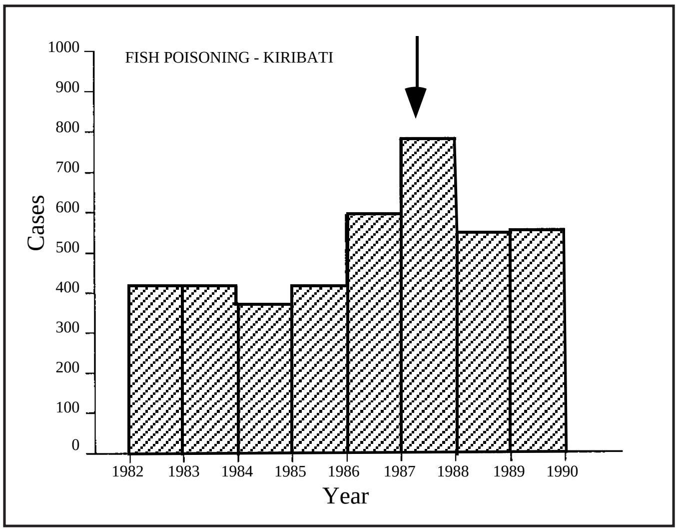


Figure 3. Annual incidence of fish poisoning in the Republic of Kiribati, 1982 to 1989. Data provided by the South Pacific Commission Epidemiological and Health Information Services and includes mostly cases of ciguatera fish poisoning. The arrow indicates the start of moray eel collections.

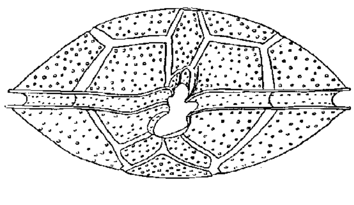
Improvement of ciguatera case history reporting

by P. Dalzell
South Pacific Commission
Noumea, New Caledonia

Outbreaks of ciguatera can have a deleterious effect on fisheries development, since fishing grounds may be closed and certain fish species prohibited for sale. This is particularly critical in the small islands and atolls of the South Pacific where economic opportunities are limited and fresh fish comprises a substantial portion of the national diet.

The South Pacific Epidemiological and Health Information Service (SPEHIS), based at the SPC, records between 3,400 and 4,700 cases of fish poisoning each year (see tables on p. 10), although not all of these are due to ciguatera intoxication. However, at present the number of ciguatera cases reported throughout the region is thought to comprise only between 10 and 20 per cent of actual poisoning incidence. That there is a need for some form of initiative on ciguatera in the South Pacific is evident. However, the effect that this fish poisoning has on island societies is largely unknown due to the poor reporting of case histories. A first step to improve the current under-reporting is to encourage both health and fisheries workers in the region to record case histories on a standard ciguatera reporting form, and to send them to SPC where they can be collated in a database. The SPC Health Programme has circulated the form attached to this bulletin to regional health workers via the SPEHIS monthly news sheet.

The form is reproduced here for fisheries workers in the region to record cases of ciguatera poisoning that they encounter. The copy (in English and in French) attached with this bulletin can be used as a template for making multiple copies, or, where copying facilities are unavailable, the SPC Inshore Fisheries Research Project will be happy to supply copies. As this form is still undergoing trials in the field, we would be glad to hear from persons who have criticisms or suggestions for improving the form. Finally, we would encourage fisheries workers in the region to work in co-operation with their colleagues in their health departments to record all incidents of ciguatera that they hear about. Only with your help can we gauge the true extent of this problem and plan and co-ordinate future work accordingly.



Monthly summary for fish poisoning for 1989 and 1990.

SPC Island member countries	Jan 89	Feb 89	Mar 89	Apr 89	May 89	Jun 89	Jul 89	Aug 89	Sep 89	Oct 89	Nov 89	Dec 89	Cum. Total 1/89 - 12/89 Cases	Rate*
American Samoa	0	4	1	2	0	0	0	5	0	0	0	0	12	0.3
Cook Islands	30	5	3	5	6	14	13	16	25	10	12	7	146	8.5
Fiji	100	79	54	37	9	52	89	74	138	65	249	79	1025	1.4
French Polynesia	81	54	55	41	73	95	89	101	88	81	54	48	860	4.9
Fed. St. of Micronesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Guam	0	1	0	0	0	1	3	1	28	2	2	0	38	0.3
Kiribati	35	29	33	26	95	39	43	28	58	73	72	22	553	8.2
Marshall Islands	11	12	13	5	6	7	5	15	2	6	7	12	101	2.7
Nauru	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
New Caledonia	0	0	0	0	0	26	0	0	0	0	0	154	180	1.1
Niue	0	0	0	0	0	0	0	0	0	0	4	0	4	1.6
North. Mariana Isl.	3	2	4	0	1	1	3	1	4	1	1	3	24	1.2
Palau	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Pitcairn Isl.	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Papua New Guinea	10	11	8	10	0	41	37	41	30	8	0	0	196	0.1
Solomon Islands													0	0.0
Tokelau	0	7	0	0	2	0	3	0	0	7	3	0	22	13.8
Tonga	0	0	0	1	0	0	0	0	0	1	0	2	4	0.0
Tuvalu	1	0	0	7	3	15	0	9	9	8	13	0	65	7.6
Vanuatu	93	54	129	75	95	80	65	45	71	87	60	34	888	6.1
Wallis and Futuna	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Western Samoa	2	1	1	0	4	4	3	4	3	4	3	4	33	0.2

* Number of active cases per 1,000 population

SPC Island member countries	Jan 90	Feb 90	Mar 90	Apr 90	May 90	Jun 90	Jul 90	Aug 90	Sep 90	Oct 90	Nov 90	Dec 90	Cum. Total 1/90 - 12/90 Cases	Rate*
American Samoa	0	0	0	0	0	0	0	0	0	0	0		0	0.0
Cook Islands	8	2	11	0	0	0	0	6	9	3			39	2.3
Fiji	17	19	62	4	68	62	39	57	64	84			476	0.7
French Polynesia	130	79	62	60	60	54	60	117	97	83	62	35	899	5.1
Fed. St. of Micronesia	1	0	0	0	0	0	0	0	0				1	0.0
Guam	0	4	0	24	0	7	0	0	2	6	2		45	0.4
Kiribati	71	224	93	93	83	235	41	100	142	144	37		1263	18.7
Marshall Islands	22	15	14	11	14	10	13						99	2.6
Nauru	0	0	0	0	0	0	0	3	0	0			3	0.3
New Caledonia	11	13	15	13	36	16	6	9	7				126	0.8
Niue	0	0	0	0	0	0	0	0	0	0	0		0	0.0
North. Mariana Isl.	2	1	1	0	0	2	10	4	3	7	2	0	32	1.6
Palau	0	0	0	0	0	0	0	0	0	0	0		0	0.0
Pitcairn Isl.	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Papua New Guinea	0	0	0	0									0	0.0
Solomon Islands													0	0.0
Tokelau	0	1	4	2	1	0							8	5.0
Tonga													0	0.0
Tuvalu	14	16	12	10	15	34	2	10	0				113	13.3
Vanuatu	46	77	11	13	82	13	27	49	38	55	23	14	448	3.1
Wallis and Futuna	0	0	0	0	0	0	0	0	38	0	0		38	2.6
Western Samoa	4	1	2	3	6								16	0.1

* Number of active cases per 1,000 population

Definition of fish poisoning: Vomiting, diarrhoea, sensory changes and/or rash or itching following consumption of fish (may be ciguatera, scombroid, or other)

(Source: SPEHIS — unpublished data)

Members of the Ciguatera Special Interest Group

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All the documents in the list below are catalogued in the Fisheries Information Project's ciguatera bibliographic database and are held in the SPC library. Some are publications, but many are internal documents, mimeo reports and other forms of ephemera. In some cases we can provide single photocopies of references free of charge to SIG members or bona fide fisheries officers in Pacific Island countries. In other cases, where confidentiality requirements or copyright restrictions apply, we may be limited to advising enquirers of contact addresses through which they may be able to obtain the document in question.

If there are documents that you feel should be added to the database, please send us a copy, or, if this is not possible, a photocopy of the cover page. Documents do not need to be formal publications - many of those in the list are not and we are keen to archive as much 'grey literature', internal reports, correspondence, unpublished data, etc. as possible.

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