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CIGUATERA FISH POISONING

(Paper Presented by the Secretariat)

INTRODUCTION

Poisoning from eating fish containing toxic substances has been known since ancient times. In the Pacific, ciguatera fish poisoning was first reported by European explorers in the 1600s. The English explorer Captain James Cook reported a fish poisoning episode among his crew, with symptoms similar to ciguatera fish poisoning. During World War II, ciguatera fish poisoning was a serious medical problem for both the Japanese and American military in the Pacific.

Fish poisoning can result from eating spoiled fish or from eating fresh or processed fish containing naturally occurring toxic substances. 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 poisoning in addition to ciguatera. Some types 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 produced toxins through spoilage, usually because of inadequate chilling and refrigeration.

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

Information Service (SPEHIS). It is estimated that this total represents only 10-20% of the actual number 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 (less than 1% of cases), 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 communities and problems in exporting fresh fish to foreign markets. In addition, legal suits with substantial settlements have resulted from ciguatera fish poisoning incidents in the United States and Hawaii.

CLINICAL SYMPTOMS

More than 150 clinical symptoms have been associated with ciguatera fish poisoning (see Table 1). Symptoms usually appear within 2 to 30 hours, with an average of about 6 hours, after the consumption of toxic fish, and may vary with the individual and the species, quantity and parts of the fish consumed (Figure 1). Usually the first symptoms to appear are numbness with a prickling sensation around the lips, tongue and throat, with general weakness and nausea. This is followed by digestive symptoms, primarily diarrhoea. As the digestive symptoms subside (usually within 24 hours), muscle pain, itching and sensory disturbances increase and usually peak during the second day of illness. Though itching usually disappears by the third day of illness, the muscle pain and sensory disturbances may last for weeks or even months. Also, more chronic in nature is the symptom of general weakness that often begins on the second day (Figures 2 & 3).

Though not well studied, ciguatera fish poisoning in pregnant women may be harmful to the foetus, who may suffer from newborn facial palsies (temporary paralysis). In addition, ciguatera symptoms can cause the mother pain and discomfort during breastfeeding.

Symptoms may vary from mild abdominal cramps and diarrhoea to severe cardiovascular and neurological symptoms. There seems to be a dose-response relationship in ciguatera fish poisoning with increased ingestion of ciguatoxin causing more severe symptoms. The illness may last for weeks or months, rarely years, depending on the severity of the symptoms. Repeat cases are ususally more severe. 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 relapses 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 ciguatoxin, thus causing a type of hypersensitivity reaction.

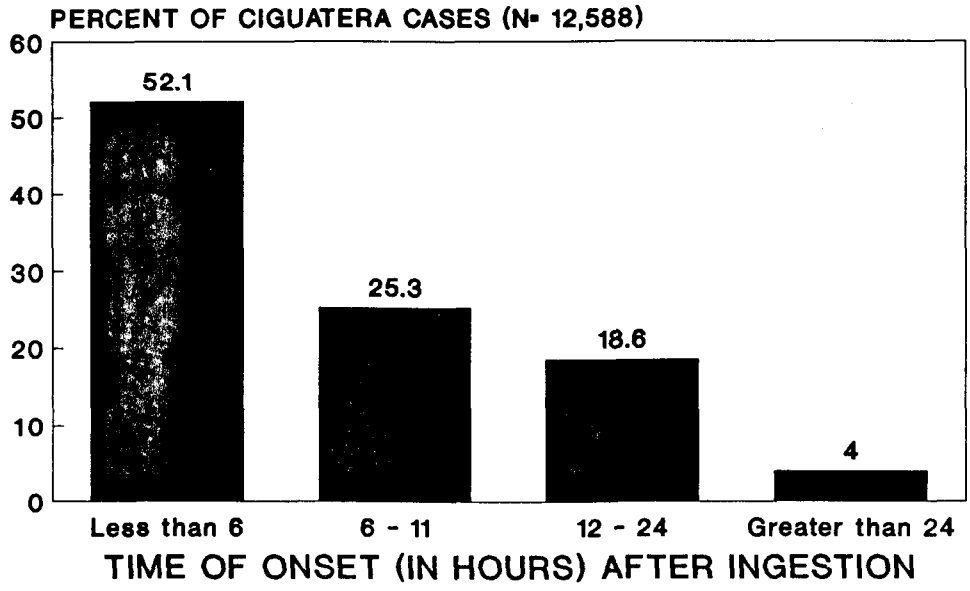
Death from ciquatera fish poisoning occurs in less than 1% of the cases and is usually associated with consumption of the most toxic parts of fish (liver, viscera, organs, roe, etc.). Reported causes of death include respiratory and heart failure and shock from severe dehydration due to vomiting and diarrhoea.

TABLE 1

Clinical Symptoms Associated with Ciguatera Fish Poisoning (adapted from Hokama, 1988)

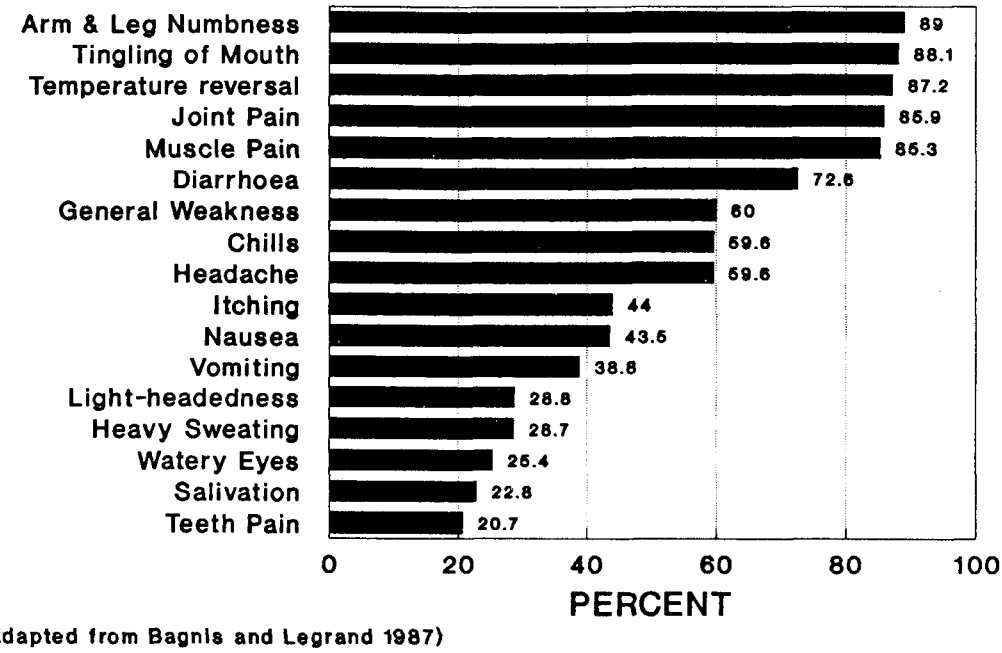
Category	Symptoms
Digestive	Nausea often followed by symptoms of watery diarrhoea, abdominal cramps and sometimes vomiting that usually subside within 24 hours. Symptoms may cause dehydration.
Neurological	Initially sensitivity disturbances such as reversal of temperature sensation, where cold feels hot (a burning or tingling sensation 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. Neurological 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	Walking difficulties, joint pain, muscle pain (especially of the legs) headache, chills, sweating and dizziness.

FIGURE: 1
TIME PERIOD FROM INGESTION OF FISH TO ONSET OF CIGUATERA SYMPTOMS



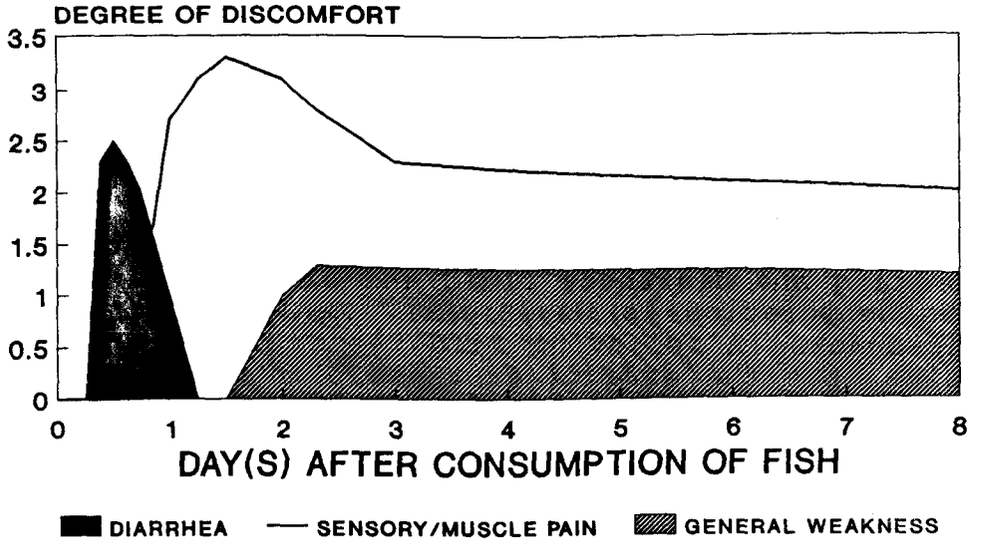
(Adapted from Bagnis & Legrand 1987)

FIGURE: 2
FREQUENCY OF CIGUATERA SYMPTOMS



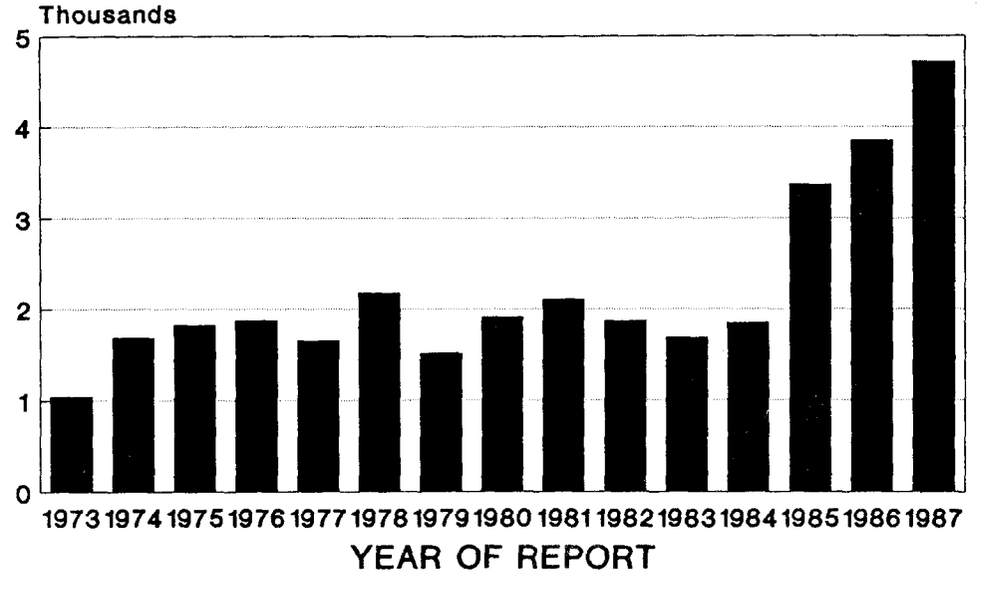
(Adapted from Bagnis and Legrand 1987)

FIGURE: 3
SEVERITY AND DURATION OF CIGUATERA SYMPTOMS



(Adapted from Bagnis & Legrand)

FIGURE: 4
FISH POISONING CASES REPORTED TO SPEHIS - 1973 TO 1987



TREATMENT

In most cases, people with ciguatera fish poisoning recover completely, and although there is as yet no cure for the disease, treatment of the symptoms is usually sufficient to ensure recovery. Vomiting should be induced at the onset of recognised symptoms, as soon as possible after consumption of the toxic fish to help rid the body of as much of the toxin-borne food in the stomach as is possible before it is absorbed in the body. Ingestion of powdered activated charcoal may assist in absorbing some of the toxin within the digestive system. In cases with severe vomiting and diarrhoea fluid and electrolyte replacement to prevent dehydration is beneficial. Medicinal plants used by Pacific islanders in relieving mild fish poisoning symptoms may be effective, but the effects of these plants may be harmful in more severe cases.

Efforts are being made to develop a possible curative treatment for ciguatera fish poisoning. A recent article by Dr. 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 ciguatoxins and other toxins from the body through the urine. Some unanswered questions remain on the effectiveness of mannitol in the treatment of this illness. Will mannitol also prove to be effective in relieving the chronic symptoms of ciguatera? Are all toxins associated with ciguatera equally eliminated from the body when using mannitol? Will mannitol prove to be as effective when used in other areas of the Pacific? Studies to confirm the effectiveness of mannitol are in progress.

CAUSATIVE AGENT OF CIGUATERA FISH POISONING

Ciguatera fish poisoning is associated with a group of fat soluble, polyether toxins, including ciguatoxin, maitotoxin, palytoxin, brevetoxin and the less toxic okadaic acid and its derivatives. Ciguatoxin is probably the major toxin involved in ciguatera fish poisoning (especially in carnivorous fish). Both ciguatoxin and maitotoxin have been isolated from a dinoflagellate collected from the ocean called Gambierdiscus toxicus and in toxic fish found to cause ciguatera. Toxic G. toxicus is the source of introduction of ciguatoxin into the food chain, leading to human fish poisoning. The dinoflagellate attaches itself to marine algae and is then passed up the food chain by being consumed by small herbivorous fish, who 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 fat soluble, resistant to heat and acid, and cannot be destroyed by cooking, smoking, marinating, freezing, drying, salting or freeze drying.

Ciguatoxin and other toxins do not alter the smell, taste or colouration of the toxic fish tissues. The ciguatoxin concentrates in the liver, viscera, organs, roe and head of the fish, who feel no ill effects from the toxin. The higher fish are in the food chain, the more concentrated is the toxin in their tissues and thus consumption of large carnivorous fish is potentially the most dangerous.

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
- parrot fish
- surgeon fish
- emperor fish
- snappers
- jacks, trevallies or crangs
- mullets
- trigger fish
- wrasses
- barracudas
- moray eels

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

1. the area fished (less important for migratory species);

2. whether the fish is herbivorous or carnivorous - carnivorous are generally more toxic;

3. the size and weight of the fish (carnivorous) - larger, heavier fish are generally more toxic.

INCIDENCE OF CIGUATERA FISH POISONING IN THE PACIFIC

The number of cases of fish poisoning reported to the South Pacific Epidemiological and Health Information Service (SPEHIS) is reported in Figure 4 and Table 2. Though this reporting is for cases of all types of fish poisoning and not exclusively ciguatera, it is assumed that the vast majority of these cases are ciguatera fish poisoning. Support for this assumption includes the high incidence of ciguatera fish poisoning compared with other types of fish poisoning in the Pacific and the distinctive sensory changes that occur with ciguatera make it easier to recognise and therefore to report it.

We do not know how accurate or complete the reporting of fish poisoning is in the various island nations of the Pacific. However, the number of cases reported over the time period from 1975 to 1987 gives some indication of the magnitude of the problem in the region and the variation between countries.

The number of cases reported from each country depends on several factors. Among these are the proportion of the population who live near the sea and their degree of dependence on reef fish, the extent of and variation in ciguatoxicity amongst locally consumed species and local knowledge of how to avoid ciguatoxic fish. Other factors relate to the level of the health and disease reporting systems in a country, including whether fish poisoning is a notifiable disease, the efficiency and coverage of disease reporting, the likelihood of those with fish poisoning having contact with the health care system and the success of ciguatera control programmes in monitoring, controlling and following-up outbreaks by local fisheries and/or health staff.

Overall, the reporting of cases of fish poisoning in the Pacific islands remained fairly constant between 1974 and 1984. However, there has been an upswing of reported cases since 1985. This upswing is probably the result of increased reporting from Fiji and Vanuatu. Both show a tenfold rise in reported annual incidence since 1985, compared to previous years. It must be noted that the annual reporting of about 2,100 cases for the region does not include Papua New Guinea or the Solomon Islands (both known to have ciguatera fish poisoning). Th s, the total annual incidence of fish poisoning in the Pacific should increase significantly once these two countries begin to report cases.

SPEHIS REPORTING PROCEDURES

The South Pacific Epidemiological and Health Information Service has been in operation since mid-1972, under the direction of the Epidemiology section of the South Pacific Commission. The primary goal of SPEHIS is to assist member countries of the SPC in their efforts to prevent and control disease. SPEHIS activites include regional disease surveillance and the dissemination of information on major diseases in the region, concerning the incidence of notifiable diseases and prevention and control measures. The aim of SPEHIS is to increase the decision-making abilities of public health professionals in member countries by providing them with up-to-date, relevant information on disease trends.

Monthly reports, written in a standard format, are collected from the 22 member countries on the incidence of fish poisoning and 39 other notifiable diseases (such as dengue, diarrhoea, gonorrhoea, AIDS, etc.) and deaths attributed to these diseases. These data are compiled at SPC headquarters and summarised into the SPEHIS

annual report of notifiable diseases that is distributed throughout the region. This activity enables health personnel in member countries to identify trends in fish poisoning and encourages routine in-country disease surveillance activities.

These monthly reports are completed by government health services staff in each member country and are mailed each month to the SPC. Reporting is voluntary and relies on the individual health departments to provide accurate and timely monthly reports. Sometimes there are delays and inaccuracies in reporting that are beyond the control of SPEHIS.

It has been estimated that only 10-20% of fish poisoning cases are actually reported to SPEHIS, and as mentioned previously, two countries are not presently reporting cases. More complete reporting of cases of fish poisoning is required for countries to develop a national policy on ciguatera fish poisoning. Each country's fish poisoning surveillance system should be evaluated and modified, to increase its effectiveness in: detecting trends in the occurrence of fish poisoning, providing estimates of illness and deaths related to fish poisoning, identifying the local risk factors associated with fish poisoning and permiting the evaluation of control measures to reduce the incidence of fish poisoning.

FISHERIES AND FISH POISONING SURVEILLANCE AND CONTROL

In-country fisheries departments can assist the local health services personnel responsible for disease surveillance by developing a useful fish poisoning surveillance system. Such a system should have the following general characteristics:

Simplicity: Simple and easy to follow information forms, procedures for diagnosis reporting, data analysis and dissemination of surveillance results are needed.

Acceptability: High participation by reporting sources (especially emergency care and clinics), quick reporting of cases and completed report and investigation forms are to be encouraged.

Sensitivity: A high percentage of actual cases should be reported and the type of fish poisoning (such as ciguatera, scombroid, etc.) specified through the investigation of reported cases.

Representativeness: All population sub-groups should be included in the reporting system, such as urban and rural, outer island, institutionalised, poor, etc., by the use of creative reporting sources such as schools, churches, etc.

Timeliness: Reports of fish poisoning should be available quickly for immediate control efforts of fish poisoning outbreaks. Where possible, reports should be telephoned in.

Because fish poisoning is under-reported throughout the Pacific and the incidence of ciguatera fish poisoning is not well known in most areas, the in-country fisheries staff can be instrumental in improving the reporting of fish poisoning through their involvement in the investigation of local cases, through assisting the local health service staff in surveys and in investigating outbreaks.

Surveys of a representative population sample (including men, women and children) can be the most accurate way to determine the types and rate of fish poisoning in the country. One caution is that of 'recall bias', that occurs when people forget or exaggerate past illnesses from fish poisoning. If only recent cases of fish poisoning are being requested in the survey (within one month or so), recall bias should be reduced significantly. Trends in fish poisoning can then be determined through the periodic resurveying of the population. When possible, fish poisoning surveys should be integrated in other planned national surveys to reduce duplication of effort and required staff and resources.

Fish poisoning outbreaks and, when possible, case investigations are very useful to accurately determine the implicated fish species, where the fish were caught, the number of people ill and their symptoms. A good knowledge of fish species is useful in determining the kind of fish poisoning. As an example, scombroid fish poisoning is limited to fish with red skeletal muscle (tunas, billfish, sardines, dolphin fish, marine salmon, etc.). A review of symptoms is also useful. Scombroid fish poisoning causes an acute allergic type reaction with flushing of the face and severe throbbing headache of less than one day's duration; whereas ciguatera has longer lasting symptoms, including neurological problems and the temperature reversal sensation. During the investigation, any remaining toxic fish should be located for disposal and/or testing.

Whether surveys or investigations are performed, it is important that a simple questionnaire be used. Detailed information should be collected on the date and place of the fish poisoning, the type(s) of implicated fish and where and when they were caught; the number of persons who consumed the fish and who were ill, hospitalised or died; the symptoms of those ill and the time between consuming the fish and the onset of symptoms. An example of a fish poisoning questionnaire is included in attachment 1.

GENERAL REFERENCES

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8. Palafox, N.A. et al. "Successful treatment of ciguatera fish poisoning with intravenous mannitol", JAMA 259 (18): 2740-2, (1988)

Table 2: Number of cases of fish poisoning reported to the South Pacific Epidemiological and Health Information Service, by country 1973-1987

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1973-1987 Total	1973-1987 Mean
A. Samoa	4	0	0	0	0	0	70	30	31	97	69	24	13	6	9	353	24
Cook Islands	0	0	0	0	0	0	0	1	2	0	-	-	0	34	28	65	5
FSM	-	-	-	-	-	-	-	-	-	0	4	15	8	6	12	45	8
Fiji	6	26	150	29	69	201	131	256	123	71	-	-	1125	1318	1683	5188	399
F. Polynesia	607	867	625	660	502	821	677	937	1145	831	789	999	901	815	856	12032	802
Guam	0	0	21	16	6	6	9	0	4	3	21	22	29	4	3	144	10
Kiribati*	101	175	187	77	41	38	78	161	286	418	414	369	412	591	780	4127	275
Marshalls	-	-	-	-	-	-	-	-	-	100	85	142	116	155	264	862	144
Nauru	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0	6	0.4
N. Caledonia	-	200	518	647	487	488	188	147	107	130	112	93	86	134	184	3521	252
Niue	7	1	35	4	0	0	0	3	3	0	-	-	3	0	1	57	4
N. Marianas	-	-	-	-	-	-	-	0	0	17	31	15	22	53	13	151	19
Palau	-	-	-	-	-	-	-	-	-	0	0	0	3	0	0	3	0.5
PNG	-	-	16	-	0	-	-	-	-	-	-	-	-	0	-	16	5
Pitcairn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sol. Islands	1	7	0	7	6	6	0	4	4	-	2	-	-	0	-	37	3
Tokelau	0	0	0	8	0	0	14	0	3	17	73	104	35	17	34	305	20
Tonga	11	58	12	17	43	13	8	7	2	29	14	6	4	2	0	226	15
TTPI**	240	364	208	313	326	296	191	217	163	-	-	-	-	-	-	2318	258
Tuvalu*	-	-	-	49	44	71	21	27	73	47	16	20	69	72	58	496	47
Vanuatu	0	0	35	28	50	53	67	-	32	12	-	-	491	541	745	2054	171
Wallis & Futuna	0	0	3	7	0	0	0	0	0	0	0	0	0	11	0	21	1
W. Samoa	65	89	15	17	81	179	62	115	127	98	59	56	60	35	47	1105	74
TOTAL CASES	1042	1687	1825	1879	1655	2172	1517	1910	2105	1870	1689	1845	3376	3843	4717		

\- No reports available

* Prior to 1976 the Gilbert and Ellice Island Colony was composed of what is now Kiribati and Tuvalu

** TTPI Trust Territory of the Pacific Islands - includes what is now the Northern Marianas, Palau, Federated States of Micronesia and Marshall Islands

Attachment 1

SPC/Ciguatera

SEA FOOD POISONING

Please tick whichever is applicable

Consumer's Name _____ Age _____ Sex _____ Village _____

Country _____ Address _____ Clinic/Hosp. _____

Food: Fish ☐ Crab ☐ Shellfish ☐ Others (specify) _____

Local name _____ Date caught/bought: _____

English name _____ Place of catch _____

Method of preservation _____ No. of people eating same fish _____

Date of consumption _____ No. of people with symptom _____

Date of onset of symptoms _____ Method of preparation _____

No. of people hospitalised _____ Date _____ Duration _____

Died _____ Autopsy finding _____

Previous history of sea-food poisoning:

Date _____ Type _____ No. of people involved _____

Hospitalised _____ Died _____

SYMPTOMS

	YES	NO		YES	NO
1. Fever or chills	☐	☐	10. Difficulty of talking.....	☐	☐
2. Vomitting	☐	☐	11. Difficulty of breathing	☐	☐
3. Diarrhoea	☐	☐	12. Difficulty of urinating	☐	☐
4. Headache.....	☐	☐	13. Special taste in mouth	☐	☐
5. Muscle cramps.....	☐	☐	14. Skin itching or redness	☐	☐
6. Joint aches	☐	☐			
7. Tingling or numbness sensations	☐	☐			
8. Pin pricking sensation upon touching water.....	☐	☐			
9. Difficulty of walking	☐	☐			

How long after eating symptoms above developed? _____

_____

Complementary brief medical data.

Pulse ☐ BP ☐ ☐

Pupils ☐ Death ☐

_____

Additional information: _____

_____

Investigator _____ Date _____

Signature _____