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FISH POISONING IN TONGA, NIUE, WESTERN SAMOA AND AMERICAN SAMOA

by

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FISH POISONING IN TONGA, NIUE, WESTERN SAMOA AND AMERICAN SAMOA*

By R. BAGNIS**

INTRODUCTION

The purpose of this survey, which was conducted under the SPC Special Project on Fish Poisoning (502i) in conjunction with the Health Departments of Tonga, Niue, Western Samoa and American Samoa, was to determine the incidence and health implications of fish poisoning in each of the territories concerned.

In the broadest meaning of the term, fish poisoning takes the form of a combination of polymorphous clinical phenomena caused by the consumption of fish species which, while edible under normal circumstances, may in some cases contain in their tissues chemical substances of biological origin, which, on reaching a certain level of concentration, become toxic to man as well as to many animals. The origin, nature and number of the incriminated biotoxins are still far from being fully explained.

Nevertheless, following Halstead's definition, it has become customary to distinguish, amongst others, between poisoning by ciguatoxin, Clupeidae and puffer-fish. The production of toxin is, in each case, apparently different (1).

In the third case, for example, the toxin concerned - tetrodotoxin- has now been synthesized. It is produced by the gonads of puffer-fish, is particularly active when the fish reach sexual maturity, and is concentrated predominantly in the genital and digestive viscera, as well as in the integuments.

Clupeotoxism and ciguatoxism, on the other hand, are related to the feeding patterns of the fish. In the former case, the toxin appears to stem from plankton, whereas for ciguatera the first links in the toxic food chain are undoubtedly miscellaneous micro-organisms living on the sea bed, and which proliferate when the coral ecosystems are subjected to natural or artificial aggressions (2).

^{*} Report on the survey carried out from 8-20 November, 1975.

^{**} Head of the Department of Medical Oceanography at the LMMRI, SPC consultant on the epidemiology of fish poisoning.

Our methods of inquiry were as follows:

- Contact with heads of departments and organizations involved with problems of fish poisoning.
- Collection of existing offical data on both morbidity rates and types of fish found and consumed.
- Gathering of further epidemiological information from all easily accessible local health centres.
- Questioning of fishermen and patients; the fish responsible were identified by reference to the species described and illustrated in "Poissons de Polynésie" (9).
- Examination, where possible, of work previously carried out on fish poisoning.

In most of the islands concerned, using the material thus obtained from a wide range of sources, I was able to:

- draw up an inventory of the genera, the families, and often of the species, of reputedly toxic fish;
- secondly, assess true morbidity as distinct from official fish poisoning statistics provided by the public health departments of the territories concerned.

- 3 -

1 - INTRODUCTION

The survey lasted from 8-13 November 1975, and coincided with the end of the ceremonies commenorating the centenary of the declaration of independence of the Kingdom of Tonga. A substantial part of the population of the outlying islands had come to Nuku'alofa for the celebration, and I was therefore able to meet both medical and official representatives of practically all the inhabited islands. The result was a very comprehensive epidemiological survey of the state of fish poisoning at the end of 1975 over the whole of the territory.

2 - VISITS

In addition to Nuku'alofa, I visited Kolovai, Mua and Houma on the island of Tongatapu.

3 - PERSONS CONSULTED

10 NOVEMBER

- Dr. Foliaki, Director of Public Health
- Dr. Tili Puloka, Medical Officer for Infectious Diseases
- Mr. Riechelmann, Deputy Secretary to the Prime Minister
- Mr. Wilkinson, Director of the Fisheries Division, Ministry of Agriculture
- Mr. Etuate Sakalie, Health Inspector
- Representatives of the islands of Niua, Foou, Uiha and Eua.

11 NOVEMBER

- Dr. Mapa, Chief Medical Officer, Public Health Department
- Dr. David Puloka, Principal Medical Officer, Tongatapu
- Dr. Kefu, Medical Officer, Mua Clinic
- Dr. Tevita Tonga, Physician, Kolovai Clinic
- Dr. Moengangongo, Medical Assistant, Vaiola Hospital
- Dr. Mamui Tatola Medical Officer, Family Planning
- Dr. Viramu Tagi, Medical Officer, Vaiola Hospital

12 NOVEMBER

- Dr. Bill Tufui, Principal Medical Officer, Ngu Hospital (Vava'u) Representatives of Ha'ano
- Dr. Martin, Peace Corps
- Mr. George Aho, Assistant Secretary to the Minister of Health.

3 - EXISTING DATA

Available information was extremely scanty, and concerned for the most part cases of poisoning by puffer-fish and Clupeidae, which had already been described by Matheson and Puloka (3) and by Helfrich and Banner (4). There was virtually no information on ciguatera.

4 - STATISTICS

The 1974 Annual Report mentions 71 cases of poisoning caused by seafood (15 at Tongatapu, 5 at Eua, 38 at Niuatoputapu, 13 in the Ha'apai group). However. these cases are described by the registry of notifiable diseases as merely 'fish poisoning"; no indication is given of the species of fish responsible. In 1973 31 cases of fish poisoning were recorded.

5 - EPIDEMIOLOGICAL DATA (Figure 1)

- 5.1. After contacting doctors and inhabitants of various parts of the Kingdom, we were able to draw up a fairly accurate picture of:
 - fish and fishing grounds, known to have had harmful effects in the past;
 - species known to have caused clear cases of fish poisoning in 1974 and 1975, together with the locality concerned.
- 5.2. This provided us with the vernacular names of the various species responsible for cases of fish poisoning recorded in 1974.
 - TONGATAPU: two species were identified; two cases involving a moray
eel (Toke) affecting two and five people respectively, and
a barracuda (Ono), which affected eight people.EUA: A mollusc locally known as Mafana was responsible for all
 - of the five cases reported.
 - <u>NIUATOPUTAPU</u>: The 38 cases reported all resulted from consumption of the liver of a 16-foot shark (Anga).

Of the thirteen cases reported at Ha'apai, ten were due to the liver of a shark caught at Uiha, and three to a snapper (Fagamea) from Foa.

- 5.3. The causes of fish poisoning in 1975 were: a Taa in Lofaga (Ha'apai group), a Toke at Niuafo'ou and Ulukau at Vava'u. On the latter island, thirty persons were also affected following the consumption of a giant garfish (Haku moana) at the beginning of the year.
- 5.4. In each of these cases, we were able to fairly accurately identify the place where the fish had been caught. Virtually all were taken near the coastal or barrier coral reefs which run along or around the islands. A very small number of cases of moray poisoning originated around the coral growths inside the lagoons, but this was extremely rare.

With the exception of morays, no toxic species were reported along the coastal, or inner reefs of Tongatapu. The few toxic specimens found came from along the two outer reefs located some distance off the north-western and north-eastern coasts of the island.

In the Ha'apai group, which is said to frequently provide the fish sold on the Tongatapu market, only a few species, originating around the western volcanic islands, are occasionally toxic. This was stated to me on many occasions, and confirmed by the Director of the Tongan Fisheries Department. The species concerned is Fagamea, which is considered poisonous around Kao and Tofua, but edible in the eastern coral islands. However, the inhabitants of one of these islands (Ha'ano), whose information I consider reliable, mentioned that a serious case of poisoning had been caused by a Fagamea caught off the barrier reefs of their island.



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In the Vava'u group, with its deeply indented coastline, several periodically suspect fishing places were pointed out. Figure 1 gives the names of islands or villages near which poisonous fish have been caught over the last ten years.

Table 1 contains all available epidemiological information on Tonga.

6 - OBSERVATIONS

- 6.1. No island group is entirely free of fish poisoning.
- 6.2. The three basic types of fish poisoning described in the introduction ciguatera, and poisoning by puffer-fish and Clupeidae are to be found, and have been responsible for fatalities in the past.
- 6.3. Ciguateric endemicity is low, and affects only fish at the lower levels of the food chain. The only species reported to be dangerous are a few generally large, fish-eating predators.
- 6.4. Of the toxic species, which belong to approximately ten families, the most commonly mentioned is <u>Lutjanus bohar</u> (Fagamea). However, the local name also covers other types of red snapper; local fish names are not as exhaustive as in French Polynesia. Various types of morays, sharks and barracuda are often considered suspect. However, the widely consumed emperor, groupers and rock cod are practically never incriminated.
- 6.5. The volcanic islands undoubtedly harbour a greater number of potentially toxic species. However, most of these are scavengers and predators, which means that it is difficult to define specific areas as either wholly safe or permanently toxicogenic. The areas reputed to be highly toxic are often those with a high fish density and which are therefore often visited by large fish. However, when a given island features cliffs alternating with reefs, risks are generally found to be greatest in reef-bound coastal areas with a high coral density.
- <u>6.6.</u> All information on fish poisoning morbidity at Tongatapu appears to indicate that:
 - It is at present in a period of decline.
 - The few cases occurring tend to be large-scale poisoning episodes involving a single large fish eaten during village or family festivities.
 - A number of rudimentary forms no doubt continue to escape medical attention, but such cases are increasingly rare.
 - There are several reasons for the decline in the number of cases of fish poisoning; more information received by villagers, wariness of species having previously caused fatalities, and diversification of diet. Imported mutton, which often sells for less than fish, has become a common dietary item, and is beginning to take pride of place over fish in many families in the capital of Tonga. There is little subsistence fishing in Tongatapu; most inhabitants buy their fish either directly from professional fishermen or from retailers.

TABLE 1: GEOGRAPHIC DISTRIBUTION OF POTENTIALLY TOXIC SPECIES IN TONGA

(+): WIDELY ACKNOWLEDGED AS TOXIC - (x): HAVING RECENTLY CAUSED FISH POISONING

	CDECIEC	LOCAL	ISLAND OR GROUP													
FAMILY SPECIES		NAME	TONGATAPI		 	HA'APAI										
					Volc Isla	anic nds		RAL ISI	-	VAV						
_			TTP	Eua	Kao	Tofua	Haano	Fao	Lifuka	Uiha	Femerea	Lofaga		Niua fo'ou	Niua toputapu	
(LUTJANIDAE (Lutjanus bohar L. argentimaculatus	Fagamea		Ŧ	X +	x	x	x					+	+		
(LETHRINIDAE	L. monostigmus Lethrinus sp.	Taa _{or} Fata Koango vai				X		+				.1				
SERRANIDAE MURENIDAE (CARANGIDAE SPHYRAENIDAE (Epinephelus sp. Gymnothorax sp. '' javanicus Caranx ignobilis Sphyraena barracuda S. forsteri	Gatala Toke '' Gatala Tafauli Ono ''	x	+	+	+ +	+	+					 X	+		
CARCHARHINIDAE ((MYLIOBATIDAE BALISTIDAE (Ablennes hians Prionace glauca Isurus glaucus Himantura sp. Pseudobalistes fuscus Balistes capistratus	Haku Moana Anga Aho Anga Neiufi Fai Pee Pee Moana	+		+ +		. ‡ .	+		x			x +		x	
TETRODONTIDAE ((Arothron sp. Lagocephalus oceani- cus	Teetee Atu Teetee		+			+	+		+ +	++		+	÷		
C LUPEIDAE	Harengula zunasi	Ulukau				+					+	k.				

- 6.7. While no mention is made of seasonal flare-ups of ciguatera, the risk of poisoning by Ulukau appears to be greatest during the summer months from September to January. This confirms earlier indications that poisoning by Clupeidae is more widespread during the season in which the water is warmest, and in which ecological conditions are most conducive to the proliferation of the toxin-bearing plankton which are the cause of this type of fish poisoning.
- <u>6.8</u>. The forms of fish poisoning having the most serious clinical effects in some cases fatal were caused by the consumption of viscera, either as such (Anga liver for example), or together with the rest of the flesh (digestive tracts of Ulukau, gonads of Atu teetee, liver the gall bladder having not been wholly removed of Fagamea, Toke, Ono and others).

NIUE*

During a brief stopover at the airport I conversed with Dr. H.T. Nemaia, Director of Health, and Mr. Tohu Vaka, Chief of Police, and obtained the following information on fish poisoning in Niue:

- Ciguatera in Niue is at present in a stationary phase.
- Endemicity is thought to have been much higher during the Pacific war and the ten years following it.
- Toxicogenic species belong essentially to the <u>Lutjanidae</u> (in particular <u>L</u>. <u>bohar</u> and <u>L</u>. <u>monostigmus</u>), Sphyranidae (<u>S</u>. <u>barracuda</u>), and <u>Murenidae</u> (<u>Gymnothorax</u> javanicus).
- Cases of fish poisoning ascribed to the latter two species have recently been observed at Alofi Hospital.
- In addition, the toxic fish involved were caught in Alofi Bay and its immediate surroundings. Elsewhere around the island, ciguatera appears practically non-existent.
- It was agreed with the Director of Public Health that if forms could be sent to him an epidemiological survey would be carried out in 1976.

^{*} When planning the survey, we were unfortunately unable to allot the time required for a stay of several days on Niue.

WESTERN SAMOA

1 - INTRODUCTION

In Western Samoa, where I stayed from 12 to 15 November 1975, I visited Apia and a number of outlying villages in which cases of fish poisoning had been reported over the past two years. In addition, on the request of the Acting Deputy Director of Health, I gave a talk on various aspects of fish poisoning to physicians and health officials of the General Hospital of Apia.

2 - LOCALITIES VISITED

The districts of Putasi, Fusi, Lefaga, Falelatai and Leuleumoega, all of which are on the island of Upolu (Figure 2).

3 - PERSONS CONSULTED

13 NOVEMBER

- The Honourable Seiuli Taulafo, Minister of Health
- Dr. Solia Tapeni Faaiuaso, Acting Deputy Director of Health
- Mr. Faapoi Asai, Private Secretary to the Minister of Health
- Dr. Thieme, Acting Medical Superintendent
- Dr. Sale Ieremia, Head of the Public Health Division
- Dr. Y.T. Kuo, WHO Liaison Officer-in-charge of the WHO Health Programme
- Dr. T.W. McKendrick, Director of Health

14 NOVEMBER

- Mr. O. Gulbrandsen, FAO Fisheries Adviser
- Dr. Karena Salomona, Poutasi Hospital
- Mrs. Masina, Nurse at Fusi Hospital
- Mrs Sisi Burgess, Nurse at Falelatai
- Drs Michaele Fepulia and Josepha Mapusua, Leuleumoega Hospital

4 - EXISTING INFORMATION

The only information available is a report by Helfrich and Banner (2) based on information provided by A.L. Philipp and Kome Kurasa in 1964, stressing the localised but considerable toxicity of two snappers, <u>Lutjanus bohar</u> and <u>L. argentimaculatus at Upolu</u>, the more widespread toxicity of the large barracuda, <u>Sphyraena barracuda</u>, and describing a few cases of poisoning by Clupeidae at Savai'i.

5 - STATISTICAL INFORMATION

The official reports for 1974 and 1975 (up till the end of October) mention 92 and 19 cases respectively. One hundred and eight of the 112 cases (i.e. more than 95%) were recorded by health or medical centres on Upolu. Monthly distribution for each centre during this period is indicated in Figures 3 and 4.













6 - EPIDEMIOLOGICAL INFORMATION

6.1. By visiting the villages with the highest ciguatera morbidity rates, we were able to identify the fish responsible for 88 of the cases officially recorded in 1974 and 1975. The families involved were for the most part Sphyraenidae (42%), Lutjanidae (38%), Carcharhinidae (15%), Carangidae and Holocentridae (2.5%). Only seven species were incriminated; Sao sao (34 cases), Sapatu (3 cases), Aa (20 cases), Mu (13 cases), Malie (13 cases), Ulua and Malau.

Fish suspected of having caused either recent or past pathological affections are indicated in Table 2.

I was also informed that two cases of food poisoning had resulted from the consumption of a crab.

6.2. It is difficult to delineate ciguateric areas with any degree of accuracy, since most of the fish incriminated in 1974 and 1975 are relatively mobile. The only exception was the Malau, which was caught at Fusi. From an epidemiological point of view, it is interesting to note that there were cases of poisoning by crab and soldier fish in the area during the same period. This is due to the fact that some Malau feed on crustacean, and are particularly fond of crabs. In addition, it should be noted that all the toxic fish concerned were caught on the outer slopes of the barrier reefs.

7 - OBSERVATIONS

- 7.1. The three basic forms of tropical fish poisoning ciguatera, puffer-fish poisoning and Clupeidae poisoning appear to be present both in Upolu and Savai'i. Upolu has the higher ciguateric morbidity, but is still well below French Polynesia in this respect.
- 7.2. However, only the most serious cases are seen in rural or urban hospitals and clinics.
- <u>7.3.</u> In addition to the customary clinical syndromes of fish poisoning, we noted several forms involving hypersensitivisation.
- 7.4. Red snapper and barracuda above a certain size are considered dangerous for human consumption. The sale of Mu, which represents 10% of the bottom fish caught by local line fishermen, is forbidden on the Apia Market.
- 7.5. Concomitant toxicity in crabs and red mullet (rouges) was noted around Fusi from which it may be inferred that there is possibly an unusual toxic food chain on the sea bed within a limited biotope, since it is extremely rare to find toxic Holocentridae in conjunction with a very low level of ciguatoxicity. On the other hand, there have been cases of fatal crab poisoning in this area.
- 7.6. Poisoning by shark liver is frequently aggravated by the consumption of alcohol.

ĩ	FABLE 2 :	FISH	CONSIDERED	POTENTIALLY	TOXIC
			IN WESTER	N SAMOA	
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FAMILY	SPECIES	LOCAL NAME	CASES					
			Recent	Past				
SPHYRAENIDAE	S. barracuda S. forsteri	Sapatu Sao Sao	+ +					
LUTJANIDAE	L. bohar L. argentimaculatus	Mu Aa or Aka Aka	+ +					
SERRANIDAE	Epinephelus sp.	Ata Ata		+				
CARANGIDAE	C. ingnobilis	Ulua	÷					
HOLOCENTRIDAE	Myripristis sp . or Holocentrus sp.	Malau	+					
CARCHARHINIDAE	C. amblyrhyncus C. melanopterus	Malie ''	+					
MUR ENIDA E	Gymnothorax undulatus '' javanicus '' flavi- marginatus	Pusi Pusi maoae Pusi gatala	+	+ +				
TETRODONTIDAE	Arothron sp.	Sue		+				
C LUPEIDA E	Harengula zunasi Sardinella sp.	Pelu pelu Uga vau		+ +				

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7.7. Work has recently begun on the construction of a path through the Tuasivi Reef (Savai'i) to facilitate access to the wharf. This may, within the next few years, result in a temporary increase in the incidence of fish poisoning in the area, although ciguateric endimicity is for the moment very low.

AMERICAN SAMOA

1 – INTRODUCTION

Following the advice of public health officials, I concentrated my investigation, which lasted from 16 to 20 November 1975, on Pago Pago. Most of the epidemiological and clinical information presented here was obtained from the records of the Emergencies Department, the Archives Department and the physicians of the L.B. Johnson Hospital.

At a meeting organized by the Director of Health, and following a description of clinical cases of fish poisoning by the Director of the In-patients Department, I gave a talk on the present state of fish poisoning research to the department heads of the L.B. Johnson Hospital.

2 - PERSONS CONSULTED

17 NOVEMBER 1975

- Dr. Turner, Acting Director of Public Health
- Dr. McCuistion, Director, In-patients Department, L.B. Johnson Hospital
- Mr. Charles McCuddin, Director, Comprehensive Health Planning Department
- Drs Matagi and Josepha, In-patient Department, L.B. Johnson Hospital
- Mrs Diana Pilitati, Chief, Public Health Nursing Staff
- Mrs Elaine Tuatoo, Director, Medical Archives
- Mr. Juchy Paynes, in charge of the Archives Room
- Mr. Stanley Swerdloff, Director of Marine Resources, Fisheries Department
- Mr. Makaivi, Owner of the Pago Pago Fish Market

18 NOVEMBER

- Mr. Andy Puletasi, Assistant Director, Comprehensive Health Planning Department
- Mr. Don Graf, Ecologist, Government of American Samoa
- Dr. Siliga, Public Health Division
- Drs. Hugo and Verne, Physicians at the L.B. Johnson Hospital

19 NOVEMBER

- Dr. Thompson, Emergencies Department, L.B. Johnson Hospital
- Dr. E. Reid, Director, Pediatrics Department, L.B. Johnson Hospital
- Mr. Dick Wass, Ichthyologist, Fisheries Department

In addition, I met the village Chiefs of Tutuila at their monthly meeting held at the Pago Pago Meeting House. They provided me with information on the situation in their respective districts.

3 - EXISTING INFORMATION

The first reports on poisonous fish in Samoa were the work of Jordan (5 and 6) who listed nine different causes of poisoning, and Spear (7).

Following this, Banner and Helfrich in their 1964 report (2) on the distribution of ciguatera in the tropical regions of the Pacific, stated that fish poisoning is a serious

problem in Samoa. They also delcared that the reports from the hospitals of Pago Pago and Apia do not reflect true morbidity, since most Samoans prefer to resort to traditional native medication. They also pointed out five major toxicogenic areas along the southern coast of Tutuila, listed reportedly toxic species in these areas, and noted that seven ciguatera-type cases were recorded in the official reports of the Pago Pago Hospital in 1963.

At the 1968 SPC Symposium on Fish Poisoning in Tahiti, E. Thompson (8) delivered a paper dealing with clinical aspects, and in which he explored a pathogenic hypothesis connnecting the toxicity of Mu (<u>L. bohar</u>) with the consumption of a form of algae known as Aga.

From 1973 to 1975, Dr. Dawson made an as yet unpublished study of various aspects of fish poisoning.

4 - STATISTICAL INFORMATION

Consulting the Register of the Department of Emergencies and the clinical records of the In-patient Department of the L. B. Johnson Hospital for the period from 1 October 1974 to 19 November 1975, we noted that accurately recorded ciguateric syndromes represented 30% of the cases of food poisoning resulting from the consumption of sea foods (Table 3).

5 - EPIDEMIOLOGICAL INFORMATION

- 5.1. The species responsible for ciguateric-type poisoning were identified in only 13 cases out of 20; Mu (5), Gatala, Pusi Malie (2), Sapatu, Taiva (1).
- 5.2. Experience has shown, however, that depending where they are caught, the following may be potentially toxic; two snappers, the Malai and the Uiui, found at Tutuila, emperors, locally known as Filoa, soldier fish (Malau), barracuda (Sao sao), two other species of grouper generically known as Gatala, leatherjackets (Falala), surmullets (Vete), and various sharks (Malie), puffer-fish (Sue), and trigger-fish (Sumu).
- 5.3. We were unable to define the origin of any of the fish having recently caused cases of poisoning. However, officials of the Fisheries Department stated that poisonous fish are practically always bought at the market, which is mainly supplied with fish caught either near Capes Taputapu and Matatula (Figure 5), or off the eastern and western tips of the island of Tutuila, or off Rose Island.
- 5.4. In the rare cases in which we were able to trace cases of fish poisoning to a given fishing place, we discovered that the fish involved had been taken along the outer slopes of the coral reef around Tutuila, mostly in the vicinity of Pago Pago Bay and Leone Bay (Figure 5).
- 5.5. Table 4 gives a summary of all potentially toxicogenic fish in American Samoa.

TABLE 3:BREAKDOWN OF CASES OF FISH POISONING RECORDED BY THE
EMERGENCY AND IN-PATIENT DEPARTMENTS OF PAGO-PAGO
HOSPITAL FROM 1-10 TO 19-11-1975

TYPE	Out-patients	In-patients
FOOD POISONING:		
 Gastroenteritic syndromes following consumption of fish '' of shellfish 	6 10	2
- '' '' of lobsters - '' '' of palolo	1 21	3
2. Allergies - following consumption of octopus - "" of non-identified sea- food	1 3	1
3. Holothurian poisoning	1	1
4. Anemone poisoning	3	2
5. Confirmed ciguateric poisoning	20	6
TOTAL	66	15
POISONOUS WOUNDS	,	
1. Caused by stone-fish	1	1
2. Caused by rabbit fish	1	1
TOTAL	2	2



FIGURE 5: AMERICAN SAMOA

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TABLE 4: FISH CONSIDERED POTENTIALLY TOXIC IN AMERICAN SAMOA

FAMILY	SPECIES	LOCAL NAME	CASES				
			Recent	Past			
LUTJANIDAE	L. bohar L. monostigmus L. gibbus L. rivulatus	Mu Taiva Uiui Malai	+ +	+-++++			
LETHRINIDAE	Lethrinus miniatus	Filoa		+			
SERRANIDAE	Cephalopolis argus Cephalopolis sp. Epinephelus sp. Variola louti	Gatala moana Gatala ''	+	+ + +			
SPHYRA ENIDAE	S. barracuda S. forsteri Sphyraena sp.	Sapatu Sao Sao	+	+ +			
CARANGIDAE	C. ignobilis	Malauli, Ulua	+				
MULLIDAE	Upeneus vittatus	Vete		+			
MURENIDAE	Gymnothorax undulatus Gymnothorax javanicus Gymnothorax flavimarginatus	Pusi pule pule Pusi maoae Pusi gatala	+	+ + +			
BALISTIDAE	Balistes sp. or Balistapus sp.	Sumu		+			
ALUTERIDAE	Alutera scripta	Falala		+			
TETRODONTIDAE	Arothron sp.	Sue		+			
CLUPEIDAE	Harengula sp. Sardinella sp.	Pelu pelu		+			
CARCHARHINIDAE	C. melanopterus C. amblyrhynchus Galeocerdo cuvieri	Malie ''	+	+ +			
	Triaenodon obesus	Mahe		+			

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- <u>6.1</u>. Clinical in-patient records show conventional symptomatology identical to that found in French Polynesia for complete ciguatera forms. I was also given a detailed description of hallucinatory poisoning caused by surmullets caught in Pago Pago Bay.
- 6.2. Official morbidity figures are low, but probably do not reflect true ciguateric endemicity. Many patients suffering from simple forms continue to apply home treatments using medicinal plants.
- <u>6.3.</u> According to Fisheries Department officials in Pago Pago, adult fish off the southern coast of Tutuila have been overfished. Consequently there is relatively little subsistence fishing, and the fish caught are small, with low potential toxicity.
- <u>6.4.</u> In addition to ciguatoxicity recorded around Tutuila, I was informed of cases of poisoning caused by barracuda caught near Canon Island.
- 6.5. In addition to forms of fish poisoning caused by endogenous or exogenous biotoxins in fish, relatively frequent gastro-enteritic disorders caused by other sea foods have been noted. These appear to stem from contamination of faecal origin (confirmed coliforms). In particular, we noted an increase of such disorders after consumption of Palolo, the genital product of annelides. This is not surprising, considering that this sea food, greatly appreciated by the Samoans, is often collected along the beaches where it has been carried by currents, and where bacteriological pollution reaches its highest level.
- 6.6. Lastly, it is most important that all clear cases of fish poisoning, or at least those which are officially recorded, be declared to the South Pacific Commission on a monthly basis. If we may judge by the recently established annual report on infectious diseases, this was not the case from October 1974 to September 1975.
- 6.7. Some frequently consumed marine invertebrates such as certain holothurians and anemones occasionally cause serious clinical disorders.
- 6.8. In both American Samoa and Western Samoa, the islanders stress the fact that in cases of poisoning by the Mu the gall bladder is a key factor.
- 6.9. A further point worthy of interest is that a small ship was wrecked on the reef west of Pago Pago several years ago. Although there has been no mention of increased endemic ciguatera in the vicinity of the wreck, a number of people well acquainted with the surroundings have pointed out the small size of surgeon fish found there, and the scarcity of parrot fish.
- 6.10. In this respect the importance of the apparent lack of toxicity in fish at the lower levels of the food chain generally the primary vectors of ciguatoxin cannot be overstressed.
- 6.11. It was agreed with the Director of the Marine Resources Division of the Fisheries Department of American Samoa that, to obtain a more accurate appraisal of toxicity at the upper stages of the food chain at sea-bed level, approximately ten kilogrammes of livers of <u>L</u>. <u>bohar</u> from various regions would be placed in cold storage. Their exact level of toxicity will be determined at the Louis Malarde Institute of Papeete by biochemical assay.

GENERAL REMARKS

- 1. In all those with whom I worked, and in all the islands I visited, I met with a firm readiness to co-operate in finding the most effective ways of gaining deeper insight into the various aspects of the problem of fish poisoning. Using present statistics, it is difficult to make an accurate appraisal of true ciguateric endemicity, and even more so of the pattern which it follows in time and space. Most of the existing epidemiological information is too confused and incomplete to be scientifically interpreted. Information is too often obtained by superficial or unreliable methods, and fails to reflect the situation correctly. Nonetheless, our contacts with local health and administrative authorities and the willingness to help shown by all concerned have enabled us to complete the requisite groundwork and define a joint policy for the collecting, classification and interterritorial exchange of information without which there can be no approriate and efficient action to bring fish poisoning under control.
- 2. The investigation led to a number of concrete results:
 - 2.1. A list of species known to be toxic, or potentially toxic, with the most frequently used local names, and a scientific classification indicating the genus, and often the species. Using this list, a comparison of endemic fish poisoning in the various territories may be made.
 - 2.2. Descriptive documentation on the sea bed in the vicinity of the main islands of the territories investigated. Geomorphological aspects are known to determine ecological aspects; by studying them in detail, it should be possible to develop an initial assumption as to the reason for epidemiological variations in the different areas of the Pacific.
 - 2.3. Better knowledge of the dietary habits of the inhabitants, of the origin of urban market supplies, of subsistence, small scale and commerical fishing techniques, and of the species most widely used and consumed. Analysis of this information will contribute to an explanation of the relatively low fish poisoning morbidity in this part of the Pacific.
 - 2.4. An accurate idea of how cases of fish poisoning are declared and centralized, and of ways in which better use could be made of the resulting information with minimum changes in existing systems.
 - 2.5. A rough evaluation of the amount of ciguatoxin produced in the coral ecosystems in this part of the Pacific. Wherever human activity likely to have a harmful effect on marine life around the reefs is limited, production of toxin is very low. Under these conditions, fish feeding on plants, coral or detritus - i.e. fish at low trophic levels - do not store up a sufficient amount of biotoxins to be pathogenic in man. This is why the only clinically toxic fish noted in the islands we visited were large fish-eating predators which accumulate increasing amounts of toxin.
 - 2.6. The discovery that several different toxic food chains at sea bed level may be involved in the appearance of ciguatoxicity.

- 3. In view of these remarks I believe that several recommendations may appropriately be made. All of them are concerned with the need for more thorough collecting and use of basic epidemiological data.
 - 3.1. A simplified clinical and epidemiological questionnaire, a copy of which is appended, has been prepared for use by all medical staff (physicians, health officials or nurses) both in central hospitals and in outlying centres. One or more copies have been given to each of the public health officials contacted during the investigation. It is recommended that public health authorities distribute these questionnaires in all inhabited islands, including the most remote. They are extremely simple, and can be filled out quickly. Having been standardized, they could in the future be used in other Pacific territories. Their interpretation is also intended to be standardized. I am prepared to centralize and collate the questionnaires, and to inform the territories involved in the SPC Special Project of the results. For the system to be effective, questionnaires should be sent to me at least once every six months.
 - 3.2. In the list of notifiable diseases, fish poisoning should be entered under a separate heading from food poisoning. Whenever possible, the local name of the fish and the approximate area in which it was caught should also be indicated.
 - 3.3. In monthly and annual reports, the international reference E.868 used by WHO and by the member countries of the South Pacific Commission, should be applied solely to cases of fish poisoning, excluding any other form of food poisoning caused by marine animals and involving secondary bacterial contamination.
 - <u>3.4</u>. It is further recommended that liver samples of toxic fish banned from city markets be deep frozen and periodically sent to the Malardé Institute by air or sea for evaluation of their toxicity. The results of toxicity tests could be used to advise local fisheries departments on the risks incurred by those consuming the fish concerned. All too often, perfectly edible fish are discarded on the strength of their outdated reputation, or of a reputation justified only in the case of much larger specimens.
 - 3.5. Health education measures could be taken for the benefit of local island populations, stressing that certain parts of fish - the digestive and genital viscera, peridigestive fats, and the head - are invariably highly toxic. In the case of carnivorous fish, for example, the liver is often 50 to 100 times more toxic than the fillet. However, many Polynesians and Melanesians prefer to cook their fish ungutted, as they consider that this gives the fish more flavour.
 - 3.6. Fish poisoning in general has existed since antiquity, and ciguatera has been known for several centuries in the Pacific. On the other hand, it has only recently been discovered that, by the damage he inflicts on the coral island environment, man himself plays a hand in aggravating the
 situation. Consequently, we cannot overstress the importance of providing the most effective protection possible for the reef and lagoon ecosystems of the islands concerned, and of taking unceasing action against the risk of marine pollution of whatever type.

3.7. Finally, and in conclusion, I wish to mention the assistance which was so readily afforded me everywhere I went. My thanks go to all who helped me, and who by so doing contributed to the success of the investigation. I am also indebted to the authorities of the territories I visited, and in particular to the officials and staff of the health departments, who provided me with a warm welcome, and who did everything in their power, both personally and technically, to help me in my task.

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FISH POISONING

Name of Clinic or Nursing Station:
Name of patient (F/n if applicable):
Address:

	Day	Month	Year
Date of consumption of fish			
Date of first symptoms			

Clinical Features (Tick appropriate colum)	Yes	No
Vomiting		
Diarrhoea		
Abdominal pain		
Tingling, numbness: lips, nose, tongue		
Pin-prickling hands, feet		
Burning when contact with cold water		·····
Joint and muscle pains		
Sweating		
Body chilliness		
Giddiness, vertigo		
Itching		1
Weakness of the legs		1
Difficult to urinate		
Difficult to breathe		
Paralysis		
Eruption or rash		
Other symptom or signs		
Previous history of fish poisoning.	1	1

Epidemiological Data

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Local fish name:
Area of catch if known:
Part of fish eaten:
Number of people having eaten same fish:
Number of poisoned people:
Name of the investigator:

Place:		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Date:	•	•		•	•	•	•	•		•		•		•	•	•		•	•	•		•		

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Signature