

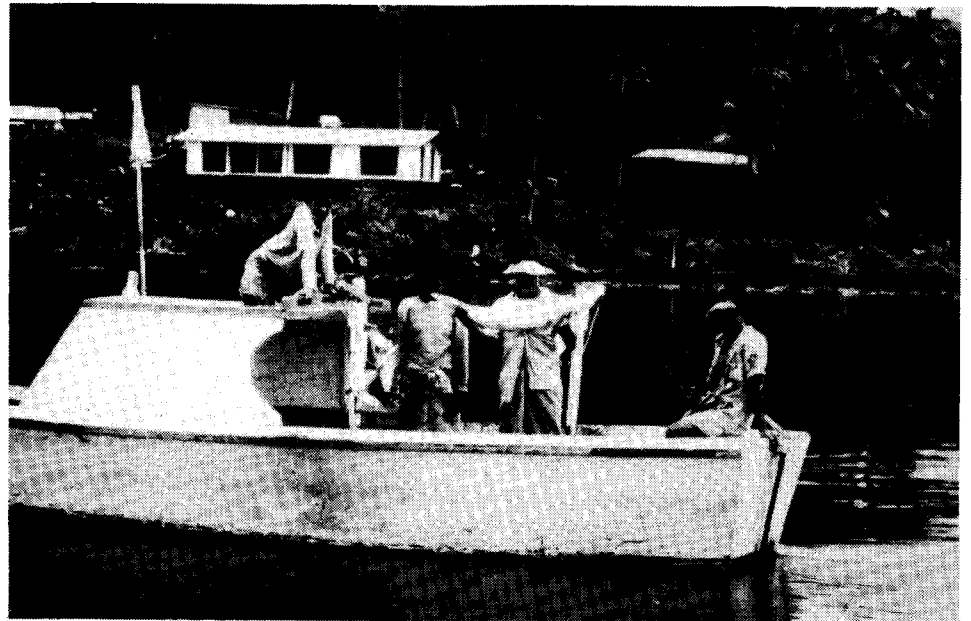
The impact of ciguatera fish poisoning in the Pacific

By NANCY DAVIS LEWIS

Fishermen the world over have, of necessity, developed a working knowledge of the toxic nature of many marine animals: the stonefish, the stinging ray, the seasonally fatal puffers, and venomous cones to mention a few. Many of the poisons and venoms of these animals serve to protect them against predators or aid in obtaining nourishment. Another common form of intoxication in the Pacific is caused by the ingestion of a wide variety of fish, from the small, bristle-toothed surgeon fish or "maito" (Ctenochaetus striatus) of the Society Islands to the very large, bottom dwelling groupers or "ata ata" (genera: Epinephelus, Cephalopolis) of the Samoas. This type of fish poisoning is known as ciguatera fish poisoning.

Chroniclers of early voyages — de Quiros, Cook and Morrison aboard the *Bounty* — recorded episodes of fish poisoning aboard their vessels, which were believed to have been caused by ciguatotoxic fish. Ciguatera probably existed in the marine world before these first reports, as toxic fish show no sign of being affected by the toxin. Except for detection by relatively sophisticated laboratory techniques, they are indistinguishable from non-toxic fish and, thus, usually cannot be detected before consumption. Because ciguatera influences a wide variety of fish, avoidance of certain fish does not always guarantee freedom from poisoning. Thus, ciguatera is becoming a significant health and resource utilization problem in man in many Pacific Islands.

The symptoms of ciguatera primarily involve the nervous system: tingling of the mouth and limbs, muscle weakness, fatigue, dizziness, itchy skin, fainting and, in severe cases, inability to breathe. Diarrhoea and nausea are also very common. The death rate has been reported to be as high as five per cent (ten per cent in one popular publication). But these elevated figures are probably taken from severe, hospitalized cases, whereas many people with fish poisoning never seek medical care.



Fishermen with catch, Asau Bay, Savai'i, Western Samoa ("Paluamalu", perhaps an Etelis sp.). This fish is said not to be toxic in Samoa although similar bottom fish sometimes are.

Those who do receive care are often unreported and the true death rate is probably under one per cent. However, ciguatera is clearly a significant cause of illness in the South Pacific as well as in other tropical islands.

The toxin causing ciguatera (ciguatoxin) has recently been identified as coming from a small marine organism called a dinoflagellate (*Gambierdiscus toxicus*). Why this dinoflagellate appears in certain parts of the Pacific is

poorly understood. Over many years, the observation has been made that man-made or natural changes in the marine and reef environment lead to an increase in ciguatoxic fish. However, disruption of the marine ecosystem does not always result in such an increase. The reasons for this are unclear. The toxin is concentrated in the flesh of small fish which feed off coral. When these fish are eaten by the larger fish, the larger become toxic. The occurrence of ciguatera varies significantly with time and location, and outbreaks can differ in severity.

French Polynesia appears to have a relatively high level of ciguatera, even in the Marquesas where reef development is limited. In Mangareva, Gambier Islands, virtually all reef fish are said to be toxic. The large number of cases reported from French Polynesia might also be attributed to better reporting of illness by health officials. The author's recent data collection, which compares French Polynesia with other Pacific Islands, supports the view that French Polynesia really has a high level of ciguatoxicity and that this is not just the result of efficient reporting.

The main island in the Cook group, Rarotonga, has no recognized ciguatoxic fish. This may be partly because of its location further south of the Equator and the limited extent of the fringing reef, hence a restricted number of marine animals. But, since areas of comparable latitudes (Hawaii and Florida), as well as islands without extensive reef development (Marquesas) experience ciguatera, these factors alone cannot explain the absence of ciguatoxic fish. Cook Islands north of Rarotonga, such as Aitutaki, Palmerston and Penrhyn, have had sporadic outbreaks.

Both American and Western Samoa report low levels of ciguatera, but research there has shown that the problem is not minor. Recently, 45 people in American Samoa were treated at Lyndon B. Johnson Tropical Medical Center on Tutuila after consuming a toxic "sao sao" (barracuda). South Pacific Commission statistics indicate that Tuvalu is currently experiencing a heightened incidence of ciguatera poisoning. Correspondence with the Chief Medical Officer confirms this. New Caledonia has long

The South Pacific Commission recognised the importance of fish poisoning to the health and economies of the region more than ten years ago when, in 1968, it organised the First International Seminar on Fish Poisoning in Tahiti. Since then, SPC has continued to be vitally concerned with investigations into the various causes of fish poisoning. Each year it contributes some thirty to thirty-five thousand dollars to collaborating groups of researchers at the Institute of Marine Biology of the University of Hawaii, the Louis Mardé Medical Research Institute in Tahiti, and Tohoku University, Japan, who are studying fish poisoning. The SPC-sponsored research work has led to important advances in the understanding of ciguatera fish poisoning.

The small one-celled organism that causes ciguatera has been discovered; it has been grown under laboratory conditions and pure ciguatera toxin has been extracted from it. This will assist scientists in their efforts to establish accurate techniques of detecting whether fish are toxic. Research is also being carried out on environmental factors likely to promote the growth of toxic fish. SPC also finances the meetings of an Expert Committee on Fish Poisoning which discusses the results of research work and makes recommendations for future investigations.

In this article, Nancy Davis Lewis of the University of California, Berkeley, describes ciguatera fish poisoning in the Pacific Islands and its effects.

been reported to have a significant number of toxic fish; in addition, Tonga, Fiji, and island groups in Micronesia also report periodic outbreaks of fish poisoning.

Considerable research has been undertaken on ciguatera. Researchers are currently investigating the identification and culture of the organism suspected to produce ciguatoxin in addition to determining its ecological requirements. Studying the pharmacology of the toxin and developing methods for detecting toxic fish are also underway. The focus of the work we have been doing is the impact of ciguatera on Pacific communities, on health in its broadest sense and on utilization of sea resources. Knowledge of the types of ciguatoxic fish is widespread in Polynesia, being more specific and known by a greater number of individuals in locations where toxic fish are more common.

Most adults in the Marquesas know about toxic fish and can identify several toxic species, such as "paahua" (*Ctenochaetus striatus*), "taivaiva" (*Lutjanus monostigma*), "ovivi" (*Lethrinus miniatus*), "puhi" (*Gymnothorax* sp.). In Western Samoa, however, a good number of the adults are unsure of the existence of toxic fish or vaguely refer to "red" fish as being toxic. This generalized response is more common in the city of Apia than in rural areas. Interestingly, in Rarotonga, despite the absence of toxic fish, many adults know the problem exists elsewhere. This is probably due to the migration of many individuals from outlying islands, where ciguatera occurs, as well as to the ubiquitous "coconut telegraph".

The knowledge of ciguatera is often accompanied by a complex of indigenous beliefs, causes, cures, toxicity tests and decisions about eating and selling suspect fish. The occurrence of ciguatera is attributed to a wide variety of things, mostly related to some change in the marine environment, from "le contamane", a "miasma" associated with the French atomic tests, to a fairly sophisticated appreciation of the idea that coral grazing fish eat a "grass" or alga that appears irregularly; for example, aga in Samoa.

The range of traditional remedies is broad and includes many purgatives. In the Marquesas an infusion concocted from unripe coffee berries has been replaced by an easier-to-prepare strong brew of Nescafé. A test to determine whether fish are toxic spans Polynesia: suspect fish are left in the open air and



Cleaning fish, Takaroa, N.W. Tuamotus

Ciguatera is probably responsible for a large amount of ill-health in the Pacific. Despite a keen awareness of the problem, the author and her family have contributed to the statistics. In general the cases are mild, with symptoms lasting from several days to several weeks followed by complete recovery. Deaths due to respiratory failure or dehydration are rare, but do occur. Often they occur in patients already in a weakened condition from other ailments. The effects on nutrition are more difficult to assess.

On an island like Mangareva in French Polynesia, where fish are the major protein source and all reef fish are reputed to be toxic, the consequences could be serious. This is especially true in areas where the family budget does not allow the purchase of adequate quantities of canned fish or

observed to see whether flies or ants are attracted to them. If not, the fish is considered to be toxic. In many locations a colour change in a ring or coin cooked inside the fish is thought to indicate toxicity. Neither of these tests has been shown to have any validity, but they are widespread.

Testing suspect fish on animal pets, such as cats and dogs, is also widespread and slightly more accurate. One young man reported that he habitually tested the fish on his mother-in-law!

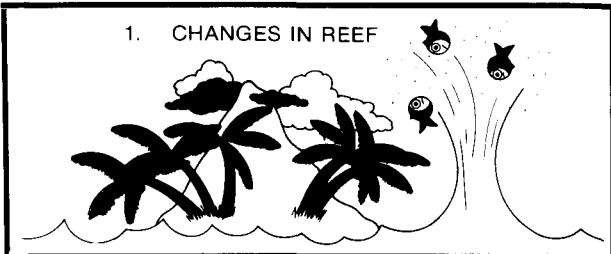
Suspect fish are frequently eaten despite the chance of toxicity. Some individuals take such chances regularly, while others never eat potentially toxic fish. In the Marquesas, children are rarely fed suspect fish. Elsewhere this prohibition is not so common. The likelihood of becoming ill decreases with time as people acquire knowledge of toxic species and locations. Potentially toxic fish are frequently sold in both local and distant markets, as in the Tuamotus-Papeete trade. The fisherman and the consumer can be separated by considerable time and space. There is some feeling that the consumer should be wise enough to recognize potentially toxic species. An observer might wonder whether it is the fisherman, seller, or consumer who is responsible.



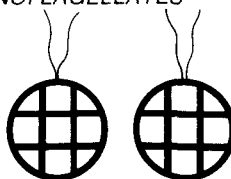
Boy holding jack, Lefaga, Western Samoa

CHAIN OF EVENTS IN CIGUATERA FISH POISONING

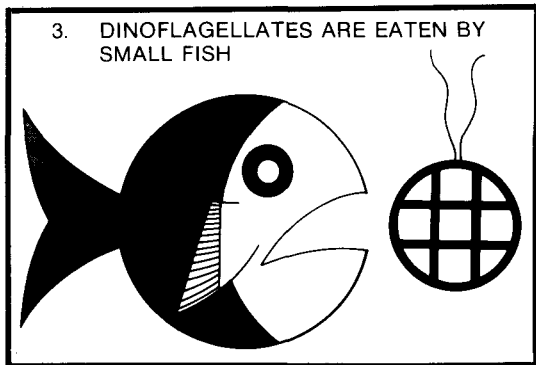
1. CHANGES IN REEF



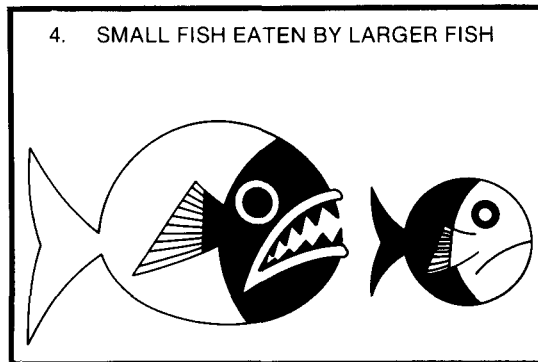
2. PROLIFERATION OF TOXIN-PRODUCING DINOFLAGELLATES



3. DINOFLAGELLATES ARE EATEN BY SMALL FISH



4. SMALL FISH EATEN BY LARGER FISH



5. FISH EATEN BY MAN



6. CIGUATERA FOOD POISONING



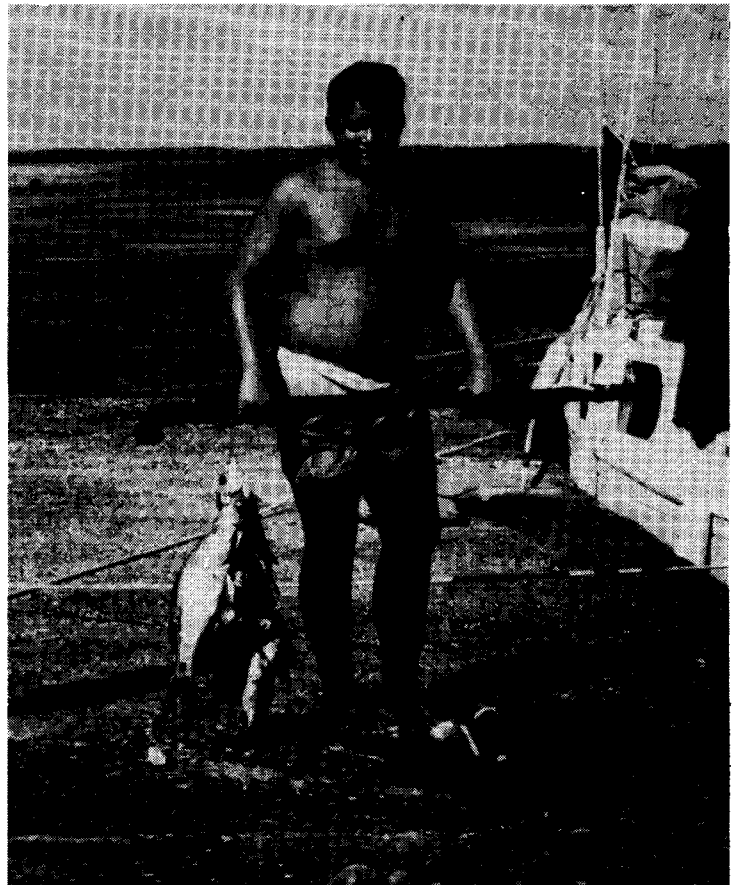
meat. The consumption of protein in general and fish in particular during recovery from ciguatera (which can last for a period of weeks to many months) can bring about a recurrence of symptoms, so protein intake is reduced during this phase.

Interestingly, in Samoa, poisoned individuals recognize no recurrence of symptoms even soon after the toxic episode. This is one of the anomalies in the ciguatera picture. In other areas people appear to become progressively more sensitive to the toxin; that is, given equal consumption, more severe symptoms appear with successive meals of toxic fish. There is some concern that fish in general, or broad categories of fish, may be avoided because of the fear of ciguatera poisoning. My research indicated no such widespread fish avoidance, even in moderately toxic areas.

All Pacific Island countries are keenly interested in developing their inshore reef fisheries to meet the needs of expanding populations and to contribute to their developing economies. The existence of ciguatoxic fish is a threat to this development. An obvious example are islands in the Northwest Tuamotus which export fresh fish to Papeete. If toxic episodes are reported with increasing frequency from traceable deliveries of fish, the islands lose an important export, often their only export except for copra. The local people are aware of this and tend to understate the problem.

In the Caribbean, a well-funded fisheries cooperative scheme failed because fishermen pooling their catch not only stopped avoiding toxic areas, but intentionally fished in them because the catch was great and the source unidentifiable.

Fishery cooperatives in the Pacific have run into many problems; ciguatera is an additional one. Projects are underway to process (for example, into cakes and sticks) fish species with a low market value, such as shark and the very large bottom fish. Some of these fish can be toxic. As the toxin is heat-



Youth with catch, Takarao

stable and unaffected by processing, a toxic product could result. Fishery officials are aware of the potential problem and will take precautions to avoid it. One official in French Polynesia expressed a concern that the ciguatoxicity of reef fishes in the area might have adverse effects on the commercial market for local pelagic, non-toxic species. The demand for such species and the sophistication of the professional buyers probably renders this a minor problem.

The effects on the economy in general are even more difficult to assess. Certainly some productivity is lost to illness. Any factor that affects the economic viability of isolated outer islands could contribute to the increasing stream of rural-urban migration. People involved in tourism are worried that the existence of toxic fish within

their lagoons, and publications about them, will hurt their trade; certainly serving toxic fish in a hotel dining room would.

In conclusion, ciguatera is a problem that affects the health and nutrition of Pacific island populations, although Islanders have developed ways of coping with it. It also has negative consequences for resource utilization, though these are more difficult to measure. However, ciguatera is not present in all parts of the Pacific and, if it could be measured, only a fraction of one per cent of the fish in the Pacific Islands would prove to be toxic to human beings. Pacific Island communities must develop strategies based on scientific advances and local knowledge to reduce the impact of ciguatera on fisheries and economic growth as well as its direct effects on human health. □

