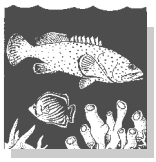
revoked by the Fisheries Department and the Kiribati Government.

In order to meet our target of 14 tonnes per shipment we have set up three bases on three separate islands to minimise the impact on the resources in any one location.

We are happy to share our experience in more detail, and possibly co-operate to some extent commercially with ventures in other parts of the Pacific. In the first instance contact should be made with our marketing associates (their contact number are given, bottom page 16).



Cyanide fisheries: Where did they start?

by Don E. McAllister[1], *Prof. Ning Labbish Caho*[2] *& Prof. C.-T. Shih*[3]

Ornamental fishes and cyanide

The marine aquarium or ornamental industry began in 1957 when Earl Kennedy began exporting fishes from the Philippines (Fleras, 1984). Fishes were caught with cotton nets and traps placed on coral reefs. In 1962, a little-known fish collector named Gonzales began to spray sodium cyanide on reefs to stun ornamental fishes, making them easy to capture (Rubec, 1988). That approximate date is supported by Ireland and Robertson (1974) who reported that Graham F. Cox (pers. comm., 1973) had stated that cyanide collecting had been used in the Philippines for the last 10 years. Ireland and Robertson (1974) also suggest that the widespread and virtually uncontrolled use of cyanide to eliminate unwanted fishes in milkfish ponds led to the application of this chemical in coral fish capture and cited a 1970 FAO review (Lennon *et al*., 1971). When one of us (D.E.M.) was in the Philippines in 1986, it was reported that cyanide was still being used to clean milkfish ponds of unwanted fish before restocking. Cyanide was also used later as a fish eradicant to get rid of undesirable exotic fishes in lakes in Canada (Leduc *et al*., 1973), but its use was discontinued.

The stunning of aquarium fishes with cyanide spread through the Philippines and its usage grew up to at least 150 000 kg per year (McAllister, 1988), and spread from there to Indonesia. The use of poisons, including cyanide, to capture fishes is illegal in the Philippines and Indonesia, as it is in most countries. For more information on the ornamental cyanide fishery and measures to introduce alternatives, consult reports of Ocean Voice International, the Haribon Foundation for Conservation of Natural Resources, International Marinelife Alliance (IMA), and publications in the bibliography on cyanide toxicity to fishes and corals (McAllister, 1998).

Live food fishery and cyanide

While the use of cyanide in the ornamental fishery has been an open secret, little had been reported on the use of cyanide in the live food fish trade until the report by Johannes and Riepen (1995) and subsequent publicity by The Nature Conservancy and IMA. However, there were earlier reports. A fisheries and law enforcement report by Lt. Col. Rodante Joya mentioned the cyanide ornamental and live food fishery and was released at the 1987 Baguio Fisheries Conference in the Philippines. The first issue of the first volume of *Sea Wind*, published in 1987, showed photos of a seized ship and its live wells used to transport cyanided fish for the live food trade from the Philippines to Hong Kong. Steve Robinson prepared a manuscript report on the live reef food fish trade in 1986. Johannes and Riepen (1995) document the spread of the use of cyanide in this trade through Indonesia and elsewhere in Southeast Asian waters.

Origins of cyanide fishing

The reader will have noticed that the early records reported for cyanide use in ornamental and live food industries were in the Philippines. This might suggest that cyanide fisheries began in the Philippines as early as 1962 and spread out from there. Galvez *et al.* (1989) suggested that plant poisons were used for fishing in the Lingayan Gulf area of the southern Philippines, before the introduction and use of sodium cyanide. Cyanide was subsequently introduced there by two immigrant fishers from the Visayas, but who both learned the

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technique in Mauban, Quezon. It has been suggested (Steve Robinson in Rubec, 1986), that a marine fish collector named Gonzales learned about the 1958 work of Bridges in Illinois, U.S.A. Bridges was seeking a fish toxicant (poison), and found that fish were apparently able to recover from low doses. That hypothesis suggests that a Filipino fish collector read a special scientific report of the US Fish and Wildlife Service and learned to apply the technique to capture ornamentals on reefs. Alternatively, a collector might have learned the technique from those who used cyanide to eradicate undesirable fishes from milkfish ponds in the Philippines.

But there is another possible origin of cyanide fishing in the Philippines. One of us (C.-T.S.) heard of cyanide fishing in Taiwan as an undergraduate student from 1954 to 1957. That is at least 5 years before cyanide fishing was used in the Philippines and one year before Bridges' study. Cyanide fishing is now illegal in Taiwan, but some divers still use it. Another of us (N.L.C.), as a student, was asked by his professor to buy potassium cyanide at the local chemical store, and to use it for a fish collecting project. The cyanide was sold to the student without any questions. Four or five of the potassium cyanide tablets, the thickness of round crackers and about 5 cm in diameter, were wrapped in cheese cloth and tied to the tip of a 2-m pole. The tip of the pole was then waved around coral heads or poked into crevices. Specimens of butterflyfishes (Chaetodontidae) were collected in this manner for an undergraduate thesis in the summer of 1965. At that time cyanide fishing was probably the easiest way for local fishers to catch reef anchovies which were dried for food.

A search of records in the Fisheries Bureau of Taiwan showed that the first prosecution for cyanide use occurred 22 December 1990, with nine additional cases up until the last one, 7 February 1994. Most of these cases were in the southern waters of Taiwan. So cyanide was apparently in fairly common use in Taiwan before the Philippines. This suggests the cyanide fishing technology might have been transferred from Taiwan to the Philippines. According to the Fisheries Act of Taiwan (last amended 1 February 1991), Chapter 3, Article 48, the use of poisonous materials is not permitted in collecting (including fishing) aquatic plants and animals. We have not been able to locate scientific papers on the use of cyanide for fishing in Taiwan.

It is highly probable that cyanide was used for capture of food fishes in Taiwan, not for marine aquarium fishes; the commerce in marine aquarium fish had not even begun in the early 1950s. Where did the cyanide come from? The most likely source was from mining activities. Gold is found near Sincheng (Shinjo) on the east coast, and alluvial gold is washed out in the Keelung and Zuiho rivers (Encyclopaedia Britannica, 1957, 9: 521).

Which cyanide? Choose your poison

A number of authors refer to the poison simply as cyanide. But there appears to be two distinct cyanide chemicals in use, sodium cyanide (NaCN) and potassium cyanide (KCN).

Sodium cyanide is the form in common use in the Philippines, and potassium cyanide seems to be the one in use in Taiwan. Johannes and Riepen (1995) mention the use of sodium cyanide in the live reef fish trade in Asia and the western Pacific, though most of the time specifying simply cyanide. Cesar (1996) for Indonesia and Barber and Pratt (1997) for Southeast Asia, mention the use of both sodium and potassium cyanide, while Nokome Bently, in a report in press on exploitation and trade in live reef fish in Southeast Asia mentions only sodium cyanide.

It is not certain why a user applies one of the two different forms of cyanide. It may be a question of availability. It is possible that it may be a question of price; one reference suggests that sodium cyanide is cheaper. While most authors fail to specify size (weight) of the tablets used, some do.

Ocean Voice International recommends that observers specify which kind of cyanide is in use and how many tablets there are per kg, as well as the price, when this is possible. Knowing brand names or photographing original containers, if this can be found out without risk, would also be desirable. This information would help track down sources of the chemicals. Enforcement officials should be advised that either form might be in use.

As far as the fish are concerned, both chemicals are potent toxins. Stunning capacity may not differ significantly, given the variable in the application—diminishing size of tablets as they dissolve in the squirt bottle and differing wave action or currents, and differing lengths of stay in the vicinity of a cloud of cyanide solution.

Possible conclusions

Firstly, we cannot be sure where the technology originated from, either the U.S., Philippines, or Taiwan. However, on the basis of geographic proximity and the chronological sequence, the Taiwanese origin seems more likely. On the basis of political connections the American origin is possible. But is should not be overlooked that there might be an older origin and source for the tech-

nology in an other country. We would appreciate any input from readers.

Secondly, the evidence in hand suggests that it is likely that the technique of fishing with cyanide began with food fisheries, rather than with marine aquarium fisheries, rather than the other way around.

But whatever the origins of cyanide fishing, the results were sad. They included:

- Useless death of desired target species of food and aquarium fishes from reef customer;
- Loss of employment for fishers and income for coastal communities;
- Loss of economic sources of protein, minerals and vitamins for coastal and inland communities, fostering malnutrition;
- Loss of coral reef habitat, leading to secondary loss of target species and biodiversity;
- Degradation of coral reefs, lowered attractiveness of reefs to tourists, reduced beach sand generation, and lessened protection of coasts from storm waves. This adds to the degradation caused by sedimentation, use of explosives for fishing, eutrophication and other forms of pollution, extraction, and more;
- Exposure of fish harvesters and their families to cyanide skin rashes and other afflictions, and occasional deaths;
- Growth of aquarium industry using unsustainable harvest methods;
- Lowered profits of collectors, fish buyers, exporters, importers, dealers—dead fish don't sell well in the ornamental and live food fish trade; and
- Lowered reputation and market potential with stressed fish; dissatisfaction of ornamental fish hobbyists and live fish trade consumers; and lack of customer confidence in the industries.

These demerits can be reversed, if new resources and effort are put into solving the problem. As indicated elsewhere, an integrated approach is required, one which involves participation by the harvesters. The simple solutions often proposed just don't work. Just regulation obviously doesn't work. Preaching doesn't work. Organising the community, using former cyanide fisherfolk as trainers in the community, helping provide alternatives, in-depth education involving all causes of reef destruction, making available appropriate educational tools, and providing incentives for conversion, seem to work the best. Assisting communities to establish marine protected areas helps involve them in decision making about their own future. All of this takes time, and patience, a rare commodity amongst people of industrialised countries, who seek a quick technical fix.

Fisherfolk, often marginalised, would like a better life. Opportunities in coastal villages are often few. The reef, if its health is sustained, is the biggest resource villagers have.

The bigger challenge has been to catalyse the industries and governments involved. It has taken two decades for NGOs to increase awareness of the issues and to mobilise significant resources.

But governments and the enlightened sectors of the ornamental fish industry are now on board. Ornamental Fish International, Rolf C. Hagen, Segrest, and the American Marinelife Dealers Association are amongst those who have joined the challenging task of finding an alternative to cyanide fishing.

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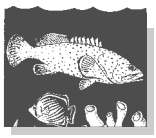

A note on cyanide fishing in Indonesia

by Jos S. Pet[1] & Lida Pet-Soede[2]

In Indonesia reef fish stocks are declining as a result of over-fishing and destruction of habitats. The latter is caused by the dying of corals from cyanide and by the breaking of corals around holes where fish are hiding. In the capture of a single grouper, more than a square meter of corals is destroyed when the fish is removed from its hiding place. In areas where cyanide fishing has been practised intensively, the reef is mostly dead, overgrown with algae, and has only very few animals still living on it. The target fish species in the cyanide fisheries are all species which aggregate at specific sites to spawn. Groupers and Napoleon wrasse migrate many miles each season to aggregate at the sites where they reproduce. Spawning aggregation sites are extremely vulnerable since experienced cyanide divers are skilled in locating them. Wiping out the fish in one aggregation site equals the elimination of top predators from several square miles of reef. Spawning aggregation sites of grouper and Napoleon wrasse therefore need to be protected wherever possible.

There are several types of cyanide fishing operations in Indonesia: large-scale operations working mostly in remote and pristine areas, and small- and medium-scale operations working in more densely populated and exploited reef areas. The large-scale operations use motherships with skiffs, and have crews of some 20 persons. These boats make one-month trips after which the catches are transferred to floating cages or to concrete basins on shore. The fish from the cages are transported by Live Fish Transport Vessel (LFTV) to Hong Kong. The fish from the concrete basins are air-freighted out. The medium-scale operations employ 5 crew of which a minimum of two dive with hookah gear. They make three-day trips. The small-scale operators, with only a single fisherman, free-dive from outrigger canoes and are thus confined to shallow reefs. Small- and medium-scale operations sell their fish from floating live fish cages.

When a large-scale cyanide mothership with working boats enters a pristine coral reef area the operators are only targeting prime species such as Napoleon wrasse, barramundi cod, coral trout and large groupers. The divers are especially keen to spot a grouper spawning aggregation. By the time a mobile large-scale operation has taken its quarry from a reef, local fishermen have learned the practice and start fishing with cyanide. This continued poisoning prevents new coral recruits from successfully settling on the dead reefs.

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