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Poison and Profits – Cyanide Fishing in the Indo-Pacific

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Poison and Profits

Cyanide Fishing in the Indo-Pacific

by Charles Victor Barber and Vaughan R. Pratt

Aboard the *Morning Sun* in the grey Hong Kong dawn just before Christmas 1997, a stocky Chinese stevedore stood waist-deep in a tank with dozens of furiously thrashing napoleon wrasse, one of the most spectacular of Asia's coral reef fishes. One by one, he wrestled the fish, some weighing nearly 30 kg, into a scoop net and into the hands of his co-workers on the dock above. Weighed and sold right on the dock for as much as $90 per kilogram, the fish were hustled off in minutes into waiting trucks equipped with their own holding tanks. By evening, some of them would be sold to elite Hong Kong diners willing to pay up to $180 per kilogram—and up to $225 per *plate* for the wrasse's lips, the most prized of reef fish delicacies.

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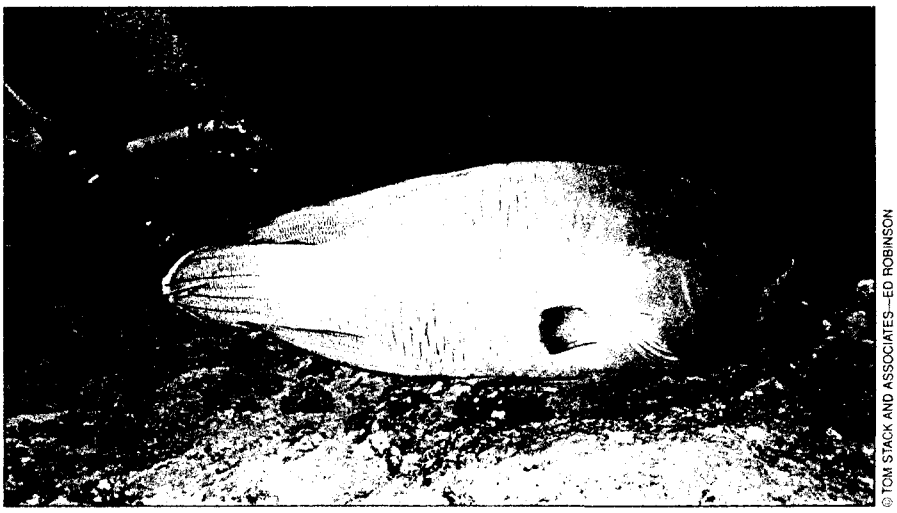
By the time the *Morning Sun* had unloaded, some 20 tons of live reef fish—8 tons of napoleon wrasse and 12 tons of assorted grouper species—were on their way to the districts where diners pick their fish from tanks at specialized shops for cooking in adjacent restaurants. The *Morning Sun*'s catch, which came from Indonesian waters, was just a drop in the bucket, however: Some 20,000 tons of live reef food fish were imported into Hong Kong in 1997.[1] The scene that December morning was just one link in a chain of poison and profits that is bringing destruction to some of the planet's most pristine and biologically diverse coral reefs: The fish on the *Morning Sun* were almost certainly captured by applying hundreds of kilograms of cyanide, the most lethal broad-spectrum poison known to science, across vast areas of Indonesia's coral reefs.[2]

In other cultures, live reef fish are prized more for their ornamental than their culinary value, and the international trade in aquarium fish—85 percent of which are captured in the Indo-Pacific—is driven by demand in Europe and North America. The impact is

the same, however, because cyanide is also the preferred method for capturing such fish. Whether it is about to be steamed with ginger sauce in a Hong Kong restaurant or it is swimming in a tank at a dentist's office in California, any live reef fish from the Indo-Pacific region was very likely captured with some form of cyanide.

Since the 1960s, more than a million kilograms of cyanide have been squirted onto coral reefs in the Philippines to stun and capture ornamental aquarium fish destined for the pet shops and aquariums of Europe and North America. More recently, the growing demand for live reef fish as food in Hong Kong and other major Asian cities has vastly increased the incidence of the practice. Strong demand has spread cyanide fishing throughout Indonesia and into such neighboring countries as Papua New Guinea and Malaysia. And in the past year, officials in countries as far-flung as Eritrea, the Marshall Islands, the Solomon Islands, and Vietnam have voiced suspicions that their fast-growing live fish export industries are also using cyanide. (See Figure 1 on this page for an indication of the probable range of cyanide fishing in the Indo-Pacific region.)

Cyanide fishing itself is fairly simple: Fishermen first crush cyanide pellets into makeshift squirt bottles filled with seawater. Then they dive down to



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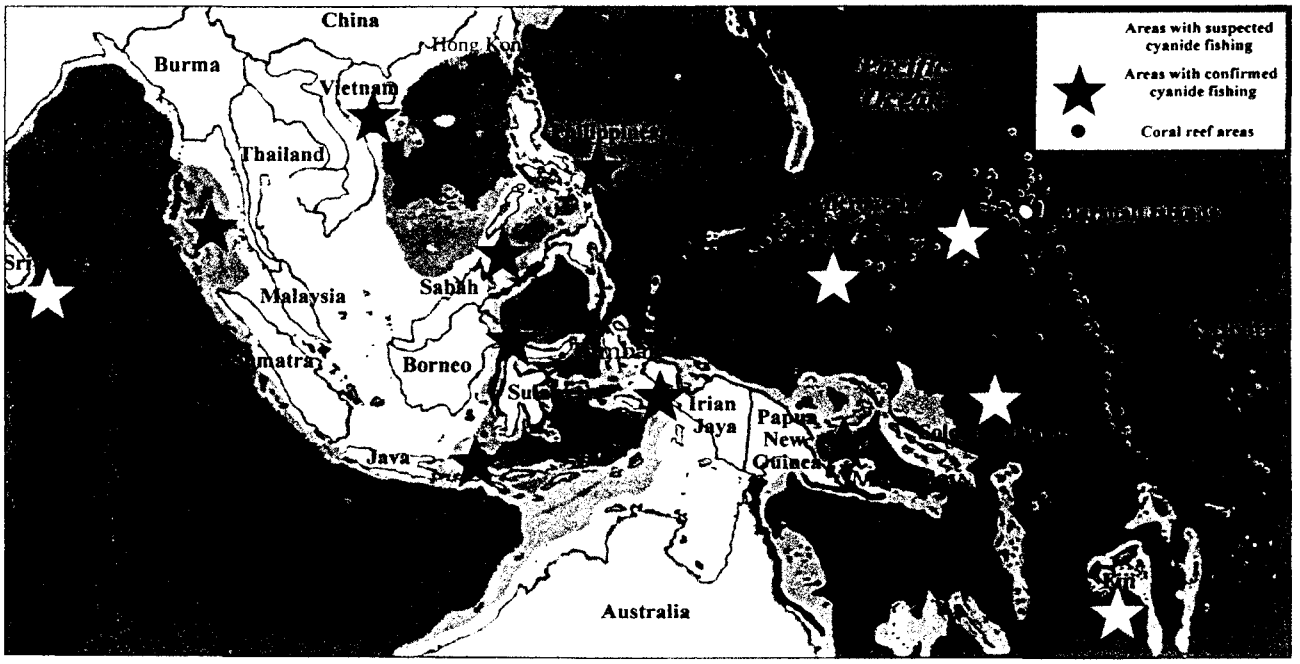
The napoleon wrasse is a prime target for cyanide fishermen.

Figure 1. Cyanide fishing in the Indo-Pacific



SOURCE: Charles Victor Barber and Vaughan R. Pratt

CYANIDE FISHING IN MILNE BAY, PAPUA NEW GUINEA

With some 12,000 square kilometers of coral reefs (an area nearly the size of Connecticut), Papua New Guinea is an important center of Earth's marine biodiversity. In the past few years, these rich reefs have attracted the attention of Hong Kong's live fish traders, who have systematically introduced cyanide fishing for the capture of napoleon wrasse and grouper species. In May 1998, a survey by investigators from the International Marinelife Alliance and Conservation International of Milne Bay Province, home to some of the country's most important reef areas, revealed the lengths to which some Hong Kong operators have gone to expand the scope of cyanide fishing.[1]

Since 1991, the government of Papua New Guinea has been assisting the provincial youth councils in developing business ventures in the fisheries sector to provide young people with jobs and income. A private consultant was hired to help identify potential overseas investors in the scheme, and as a result a Hong Kong firm called Charter Wide Investments (CWI) was invited to develop live reef fishery operations. After failing to establish operations in several other provinces (due in part to suspicions by local officials that CWI was using cyanide and other destructive methods), in 1995 CWI chose Milne Bay as its base of operations and established a partnership with D'Entrecasteaux Youth Marine Supplies (DYMS), a company incorporated by the local youth council. Together, they obtained a trial permit to conduct a live reef fishery venture and began operations in April 1997.

The project was supposed to provide employment and training for young workers in the area, with CWI furnishing the necessary supplies, offering instruction in hook-and-line live capture techniques, and marketing the catch in Hong Kong. DYMS's role was to represent and protect the interests of the fishermen in negotiations with both the government and CWI. It has not worked out that way, however.

In reality, CWI trained a core group of 40 fishermen to use cyanide to catch fish, ignored its responsibility to spread the economic benefits to the whole area, and specifically targeted napoleon wrasse—a species that is extremely difficult to catch with a hook and line.[2] The divers were forced to remain on CWI's ship for periods of at least 30 days and to work 12-hour days for minimal rations and very low pay. For its part, DYMS not only failed to protect the fishermen's interests but was profiting handsomely from the deal, according to the fishermen and other local observers.

Since September 1997, CWI has made three shipments of live fish to Hong Kong, officially totaling some 21 tons. Catch records submitted to the government have apparently been fabricated, however. For instance, the record for one shipment shows only one ton of napoleon wrasse, while the fishermen themselves say the shipment contained six tons of that highly valued species. Because the fishermen were free-diving rather than using compressed air, they were forced to use abnormally large amounts of cyanide, about 140 grams per dive.[3] Many of the fishermen fell ill right on the ship with symptoms similar to those of cyanide poisoning (though the company blamed the high rate of illness on malaria).

The use of cyanide was confirmed by the divers themselves as well as by the investigators' own observations, even though the operation managers tried to conceal it. (One manager brought out the hook-and-line gear he claimed they were using, but this amounted to a total of 4 or 5 hooks too small for groupers and two crude decompression needles. Meanwhile, the investigators came upon a sack of cyanide squirt bottles in the back of the operation's warehouse.) A local dive operator also related that he had come upon a whole seaborne operation (small boats and a mother ship, all sporting CWI's blue and red colors) that scattered upon his arrival, leaving a long trail of 200 to 400 smaller reef fish floating dead in the water. Following some of the boats, he witnessed them using squirt bottles on the reefs.

It is suspected that at least some local authorities have colluded with CWI. For example, one local fisheries official who was in charge of inspecting all of CWI's shipments was visibly nervous and reluctant to talk to the investigators, who were later told by locals that he had mysteriously come into some money in September 1997 (when CWI sent its first shipment of fish) and had been throwing lavish parties at his home.

CWI and DYMS's trial permit was recently canceled due to local dissatisfaction with the operation. Local communities are now expressing an interest in working with the International Marinelife Alliance and Conservation International to shift the focus from cyanide fishing to a sustainable live fish trade. But in view of Papua New Guinea's vast coral reefs, this episode is undoubtedly just the first skirmish in a long and difficult campaign.

1. F. Cruz and B. McCullough, "The Live Reef Fish Trade in Milne Bay Province, Papua New Guinea: Field Assessment Report" (unpublished report by the International Marinelife Alliance, 1998).

2. Napoleon wrasse can only be caught with a hook and line if a special technique and the appropriate bait are employed. Usually, two fishermen lie crosswise in a small boat looking into the water through goggles while the bait is lowered to the proper depth. When questioned by IMA field personnel, most fishermen were found to be ignorant of the particular bait needed to catch this highly valued species.

3. Divers using compressed air can take the time to chase fish into crevices and selectively apply cyanide to them. Free-diving divers with limited time under water are more likely to spread vast clouds of the poison as fast as possible.

coral formations and squirt the cyanide solution into the crevices where fish hide.[3] The cyanide stuns the fish, making them easier to capture. In some cases, however, the fishermen have to use crowbars to pry coral heads apart and retrieve the stunned fish.

Cyanide fishing can be very a lucrative business, at least for the vessel and holding-tank operators, exporters, and importers involved in the trade. Military, police, and other officials are also paid well for looking the other way. The divers, by contrast, are usually exploited by those who organize and supply the fishing operations. (For a description of the ways in which illegitimate business practices and official corruption enter into cyanide fishing, see the box above.)

This type of fishing exacts a heavy toll, however, both from those engaged in it and from the environment. For divers, the most immediate health threat is not from cyanide but from the fact that they spend long hours at considerable depths (often 15–25 meters) breathing through tubes attached to air compressors. As a result of the length of time they spend submerged, divers

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Squirting cyanide solution into a crevice in a coral reef.

often suffer from decompression sickness ("the bends") upon returning to the surface. Nor is the air they breathe underwater necessarily healthy: The compressors that supply it are often refitted paint compressors on which the intake and exhaust valves are close together, which causes the divers to breathe in large amounts of carbon monoxide. There have been no systematic studies of the effects of such practices on divers' health, however.[4]

The risks of eating fish caught with cyanide are also unknown. It is likely, however, that fish sold live pose little risk to human health because of the relatively rapid rate at which (it is thought) fish metabolize and excrete cyanide. Not all fish that are caught with cyanide are exported alive, however: Those that die in the process are often consumed locally. (Cyanide is also sometimes added to the bait used to catch fish with a hook and line.) Dead fish, of course, do not metabolize the cyanide, which tends to accumulate in the internal organs, especially the liver.[5] The risks of eating such fish have not been studied but may be significant (particularly in Asia where people eat—and sometimes prefer—the internal organs).

Cyanide fishing is also very destructive to the coral reef ecosystems in which it is practiced. Large percentages of the fish that are captured live die in transit due to their poison-weakened state, meaning that many more fish have to be taken than are actually needed.[6] In addition, cyanide kills coral and reef invertebrates along with many nontarget fish.[7] The extent to which exposure to cyanide injures or kills the organisms that make up coral reefs themselves has not been studied extensively and thus is not really known. A field test in the Philippines in 1980 showed that two exposures to cyanide three months apart can completely kill the exposed reef area.[8] Laboratory tests at the University of Guam in 1995 indicated that exposures as low as 1 part in 10 million could kill corals.[9] Experiments at the Great Barrier Reef in 1995 suggested "a deleterious effect of cyanide fishing on corals in the immediate vicinity." The researcher who conducted these experiments noted, however, that it is difficult to estimate the level of exposure to cyanide from fishing. The initial exposure is likely to be high (i.e., parts per thousand), but it probably declines to low levels (parts per billion) within hours or even seconds, depending on currents.[10]

In addition to these formal scientific findings, there is a good deal of anecdotal evidence about the effects of cyanide fishing on corals. Deleterious

effects were first reported in the Philippines during the 1980s. A more recent report from eastern Indonesia states that fishermen and divers "are adamant that the live fish business is responsible for empty reefs throughout the Philippines and Indonesia, and industry representatives give several examples of

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An illegally caught aquarium fish in the Philippines.

archipelagoes that are exhausted."[11] Other observers report that cyanide fishermen in those two countries "invariably asserted that cyanide causes extensive damage to corals." In addition, divers and dive-tour operators say that cyanide fishing has caused the "total destruction" of reefs—including the corals, other invertebrates, and fish.[12] In short, there is strong evidence that cyanide kills corals, but questions remain about the necessary level of exposure, the effects of repeated exposure, and the relative susceptibility of different kinds of coral.

Deadly in any marine environment, cyanide fishing is particularly tragic in the Indo-Pacific, which possesses some 70 percent of the planet's coral reefs and is the global center of biodiversity for corals, fish, mollusks, and reef invertebrates.[13] Cyanide fishing also threatens the livelihood of poor coastal people in the region, where dependence on fish protein is very high and fishing provides millions with income.[14]

The Philippines, which is the birthplace of cyanide fishing,[15] is also the only country with a program to eradicate the practice. Since the early 1990s, the Bureau of Fisheries and Aquatic Resources and the Philippine branch of the International Marinelife Alliance (IMA), a nongovernmental organization, have been developing and implementing a broadly based Destructive Fishing Reform Program. Experience with this program during the last five years shows that cyanide fishing can be reduced through a combination of the right policies and laws; beefed-up enforcement efforts; enhanced public awareness; testing of live fish exports; training of cyanide fishermen in alternative techniques; and the development of sustainable, community-based resource management and livelihood programs that transform local fishermen into frontline marine stewards.

The Live Reef Fish Trade

The live reef fish trade in Southeast Asia has an estimated annual retail value of $1.2 billion (U.S. dollars), $1 billion of which consists of exports of food fish (mostly to Hong Kong) and $200 million of which consists of exports of aquarium fish to Europe and North America.[16] Not all of these fish are caught with cyanide (Australia's live reef fishery, for example, is cyanide-free), but a very large percentage are. To understand the dynamics of this trade, it is necessary to be familiar with the various actors involved and the incentives that motivate their behavior.

First on the list are the cyanide fishermen themselves. The number of such fishermen operating in the Indo-Pacific region is not known. However, based on estimates for the Philippines (where there are about 4,000), the total number probably does not exceed 20,000. Thus, cyanide fishing is not a ubiquitous problem like slash-and-burn agriculture, which is practiced by millions of poor farmers. Nor is poverty the root cause of cyanide fishing, although many of those who engage in it are quite poor. On the contrary, cyanide fishermen are a fairly small and discrete group who are responding to very specific incentives: a new technology, a ready market for the product, lax government enforcement of anti-cyanide laws, and the lack of viable alternatives for making a living.

Next on the list are the exporters. The number of companies engaged in exporting live reef fish in the Indo-Pacific region is also unknown, but it

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appears to be expanding rapidly. In the early 1960s, for example, there were only three companies exporting aquarium fish from the Philippines and none exporting live food fish. By the 1990s, there were some 45 aquarium fish exporters in the country and 8 companies exporting live food fish. At least 10 companies have holding tanks for live food fish in Bali, Indonesia, a major transhipment point.[17] Conservative estimates of the annual volume of Asian trade in live food fish range from 20,000 to 25,000 metric tons (mostly from Indonesia), though the real total may be far greater.[18] Philippine government statistics show that as many as 6 million aquarium fish were exported from that country in 1996, and Indonesia is catching up quickly.[19]

Closely related to the exporters are the businesses that import live food and aquarium fish. These businesses, in fact, are in essentially the same position as exporters: Without pressure from the government to ensure that the fish they import were not caught with cyanide, they have little incentive to take action on the issue. As one large importer has argued, "We . . . importers do not participate in any catching of fish or its activities. We just finance the people by equipping them with boats and fishing gear. We just buy fish from them. The production side is left to them."[20]

The last actors in the live reef fish trade are the consumers of these fish. Experience shows that consumers can play an important role in pressuring the aquarium-fish industry to reduce imports of fish caught with cyanide. Indeed, bad publicity and the ensuing consumer pressure in the United States have recently led to efforts to certify imported aquarium fish as having been caught using sustainable methods.[21] Opposition to cyanide fishing is virtually nonexistent among the Chinese consumers of live food fish, however. As one Hong Kong observer has remarked, "being endangered actually seems to spur demand."[22]

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Sustainable fishing with nets in the Philippines.

In the face of powerful economic pressures, is there any hope of curtailing cyanide fishing? The answer is "yes," provided the right approach is taken. Experience in the Philippines and, more recently, Indonesia suggests that an effective anticyanide strategy must combine three elements. First, the governments of the source countries must reform their policies and strength-

en their institutions to effectively deal with the problem. Second, the governments of the importing countries must take steps that reinforce the measures taken by the source countries. Third, and most fundamentally, there must be strong partnerships with those on the front lines, that is, the fishing communities and fishermen in areas where cyanide fishing is practiced.

Policy Reform in Source Countries

There are a number of measures that the countries in which live reef fish are caught can take to curb the use of cyanide:

Establish cyanide detection test (CDT) laboratory facilities at all major collection and shipment points. IMA and the Philippine Bureau of Fisheries and Aquatic Resources have developed a simple test to determine the presence of cyanide in live-caught fish.[23] This test has been in use for more than six years in the Philippines, with six laboratories currently testing 6,000 samples annually. Testing is crucial to reducing cyanide fishing. Without it, authorities cannot determine whether fish have been caught with cyanide or obtain convincing evidence to prosecute violators. But to be successful, CDT labs must be backed up by a larger network of agencies and monitoring posts, as well as by staff trained in sampling prospective live fish shipments.

Establish adequate data gathering and monitoring systems. In many countries, fisheries data are highly aggregated, making it impossible to tell how many of a given species were brought to a particular collection point, the volume of exports in a given month or year, or who was involved in the harvesting and exporting. There will be no way to regulate cyanide use in the live-fish trade until such data are regularly collected.

In the Philippines, the data system is now structured so that the government can monitor the total number of aquarium and live food fish moving through domestic and international airports as well as major international seaports, along with the activities of individual exporters and other relevant information. The data are actually collected by IMA through its CDT and monitoring network and then provided to all relevant national and provincial government offices.

Establish a firmer legal framework to detect and prosecute cyanide fishing and trade in cyanide-caught fish, ultimately requiring mandatory testing and certification of all live reef fish exports. While fishing with cyanide and other poisons is illegal in virtually every country in Southeast Asia and the Pacific, a much firmer legal framework is needed to make these laws effective. Once a CDT laboratory and monitoring network are established, all exporters should be required to submit to random sampling and testing, inspection, and licensing by the government. Along the same lines, all shipments should require a certificate that shows the origin, volume, and species composition of the shipment and indicating that it has been subject to random CDT procedures and is cyanide-free.

A mandatory certification system (such as the one that will be established in the Philippines by the end of 1998, when draft regulations are finalized) would provide both positive and negative incentives for exporters. On the one hand, uncertified fish would become a liability. On the other hand, certified fish could obtain higher prices—an "environmental premium"—in markets where governments regulate imports and consumers prefer fish caught without cyanide.

Of course, enforcement procedures and penalties must be fairly applied and should focus on punishing the larger players in the trade (such as exporters and corrupt officials) rather than unduly persecuting the divers themselves. To that end, governments might consider enacting strong forfeiture provisions against large operators. These provisions should apply not only to those fish that test positive for cyanide but also to the boats and holding facilities used for cyanide fishing. Nonetheless, the divers should be informed that the use of cyanide is illegal and that repeat offenders will be punished harshly. This will only be perceived as just, however, when local fishermen see the big operators prosecuted first. Targeting the latter also reduces divers' incentive to take part in the trade.

Ban or restrict the export of especially vulnerable species, such as the napoleon wrasse. Blanket bans on the live reef fish trade are both unwise and unworkable and just drive the trade underground. When the Philippines attempted such a ban in parts of its Palawan province several years ago, for instance, fishermen continued to use cyanide but killed the fish after capture and sold them in the fresh fish market. In addition, these bans deprive coastal communities of one of their most lucrative sources of income. The goal of live reef fisheries policy should be threefold: to ensure that reef fish are caught without cyanide; to keep the harvest at a sustainable level; and to provide a fair return to local fishermen. It should not be to place reef fish completely off limits.

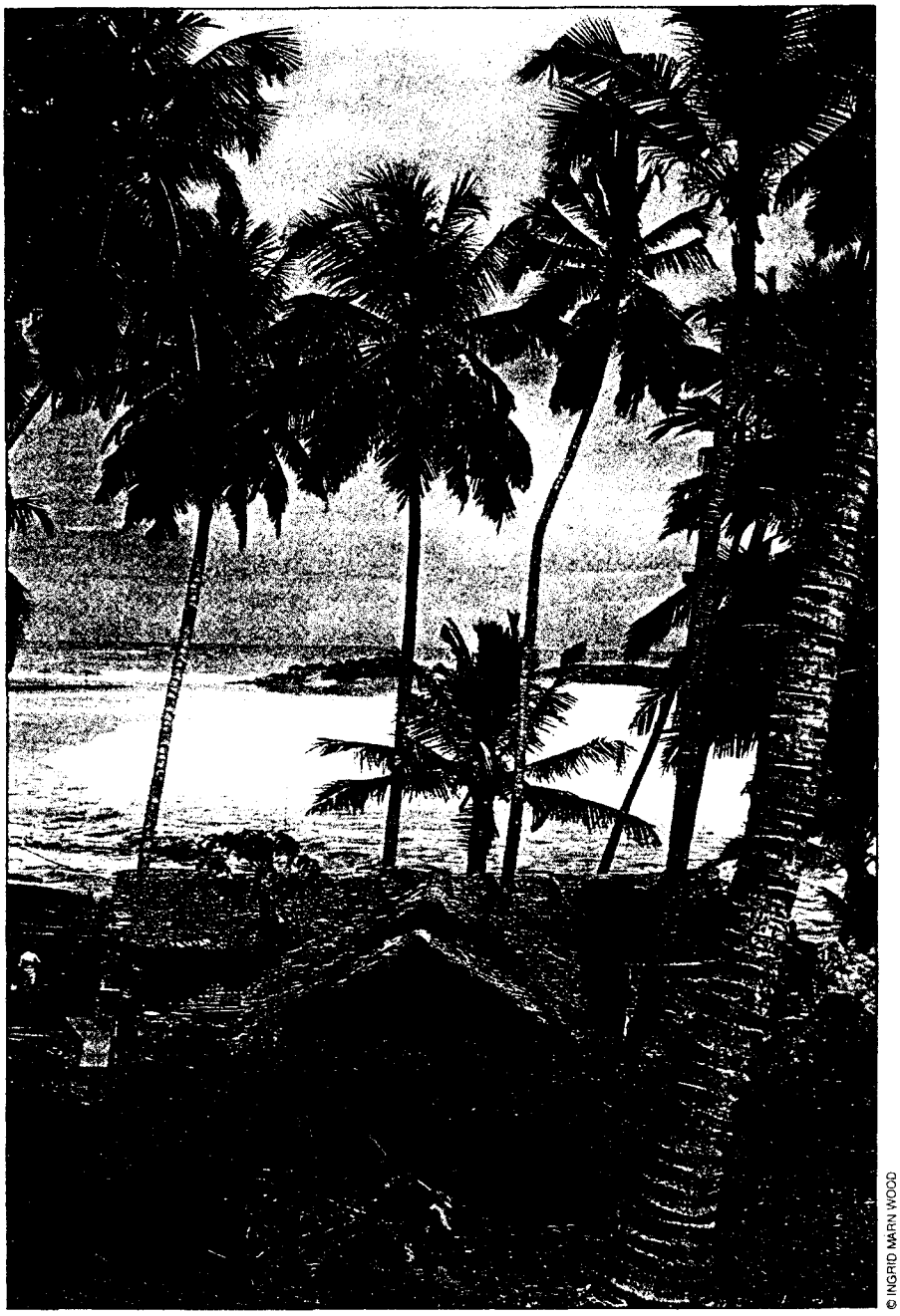
Even so, the pressures on particular species may become so great that governments will have to ban their capture altogether. This is currently the case with the napoleon wrasse, which takes a long time to reach sexual maturity, can be relatively easy to catch, and has the highest value of the live food fish species. Although a ban is unlikely to stop the trade in this species altogether, it should reduce the total volume of such trade.

Regulate the importation, distribution, and use of cyanide. Cyanide has many legitimate uses in industry, but in the Indo-Pacific region a considerable amount of it is diverted to live-fish collection. In most of the region's countries, the importation, distribution, and use of cyanide is virtually

unregulated. To remedy this problem, a Sodium Cyanide Act was introduced in the Philippine House of Representatives in late 1996 (it has yet to be passed, however).[24] Although this type of law will undoubtedly be difficult to enforce, it should increase the price of cyanide on the black market, thus making alternative techniques more attractive economically to those fishermen who are currently using cyanide in their operations.

Address corruption within governments. The ease with which government officials can be bribed works against all of the other measures that source countries can put in place to stop cyanide fishing. But with so much money at stake, corruption is a recurrent problem. It can only be eliminated when officials at the highest levels of government take a firm public stand against it and when corrupt officials are dealt with harshly. The heads of vulnerable agencies like fisheries, the navy, and customs must establish a firm policy that anyone convicted of involvement in cyanide fishing will be summarily fired and permanently barred from civil service or military positions. In addition, prosecutors should make it known that they will seek the maximum penalties available under the law in prosecuting corrupt officials. The media can help by exposing instances of corruption. Finally, an effective CDT lab and monitoring network, backed up by community-based monitoring, can provide governments with a great deal of information about potential corruption problems.

Mount public awareness campaigns in the media and schools. NGOs and government leaders should work systematically to build public awareness of the threat of cyanide fishing and the steps that must be taken to stop it. Press releases, symbolic public events, and the steady provision of information to journalists are all tools that can raise public awareness and strengthen other anticyanide fishing measures. In the schools, information about the value of marine resources and biodiversity, the effects of cyanide fishing, and the tools available to stop it should be integrated into the curriculum from the primary grades on. Cyanide fishing is a learned behavior that becomes a tradition over time. By teaching alternatives from an early age, countries can help to ensure that it does not become deeply rooted.



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A typical fishing village in the Philippines.

Policy Reform in Importing Countries

As in any other type of international trade, the countries that supply live

reef fish will need the cooperation of governments in the importing countries if their efforts to stem cyanide use are to be effective. At present, no importing country requires proof that imported fish were not caught using cyanide or penalizes firms that purchase such fish. Importing countries should take the following steps:

Monitor imports of live fish and provide data to exporting countries. Importing countries should establish data collection systems that record—by species—the number of live fish imported and their country of origin. These countries should then share that data with the appropriate government agencies in the exporting countries. In this way, exporting countries will be able to verify their own statistics and investigate discrepancies arising from unrecorded exports.

Phase in a legal requirement that all live reef fish imports be certified as cyanide-free. As soon as the source countries require certification for all exports, importing countries should reciprocate by requiring that all live-fish imports be so certified. Because Indonesia and other source countries do not currently have testing and certification systems, it is unrealistic for importing countries to immediately impose a ban on imports of uncertified fish. But importing countries can begin phasing in a prohibition on such imports while working with the exporting countries to develop testing and certification procedures, laws, and technical capacity. Importing countries will also need to work with groups such as the U.S. Marine Aquarium Council, a new industry-NGO organization to provide independent monitoring of the certification systems that governments set up.

Increase consumers' awareness of the impacts of cyanide fishing. As in other areas of environmental certification, it is crucial to build consumer awareness. When consumers themselves demand assurances that the fish they are buying have not been caught with cyanide, the pressures on exporters and governments to take action will mount rapidly.

Some live fish importers are already moving to ensure that the fish they buy have not been caught with cyanide. For instance, Brightfuture Industries, a Hong Kong firm, has publicly committed itself to being cyanide-free and has even trained fishermen to catch groupers using hook-and-line techniques. Brightfuture is now organizing an association of live fish importers in Hong Kong and is working to promote anticyanide and other sustainability policies within the local industry (see the box on page 32 for a description of one of its activities).

Working with Fishing Communities

Even with the best policies in place, there is just no substitute for working directly with the fishermen and their families. If they are left out of the equation, it will simply not be possible to solve the problem of cyanide fishing. Here again, there are a number of measures that can be taken.

The first is to train fishermen in alternative fishing techniques. When fishermen are presented with effective, cyanide-free methods of catching food and aquarium fish—and given greater awareness of the legal, health, and ecological risks of cyanide fishing—many choose to switch to those methods. In the Philippines, for instance, IMA has trained more than 2,000 cyanide fishermen in more ecologically benign techniques. A typical training program involves 25 to 30 fishermen and can last up to a month. The content of the program varies depending on whether the fishermen are catching aquarium fish or live food fish. In both cases, however, the first part involves classroom instruction on the basics of reef ecology, alternative techniques for capturing live fish, management of the catch, and other core topics.

In the case of aquarium fish, the second part of the training program (which can take two to three weeks) involves in-water exercises to teach the fishermen how to use fine-mesh barrier nets along with basic diving safety. Once these fishermen have learned how to catch a core number of species, they are taught to use different types of nets so that they will be able to catch a wide enough variety to compete effectively in the market. This also reduces the pressure on individual species. In the case of live food fish, fishermen are taught hook-and-line techniques for catching groupers and, most importantly, simple ways to decompress the fish's air bladders to ensure post-harvest survival and health.[25] Because different species of groupers favor different types of bait, bait preparation is a key part of the training. (Because these fishermen do not have to dive, lessons in diving safety are not offered.)

After the formal training period ends, IMA trainers stay with the community for up to a month to monitor the catch. Fish samples are also collected for testing at IMA labs to ensure that cyanide use has in fact ended. Other activities, such as organizing local fishing associations and cooperatives and devising means to add value to the catch take more time and involve periodic follow-up over months or even years.

The second measure that can be taken to curb cyanide fishing is to enhance the income fishermen receive from the live-fish trade and other sources. When fishermen get more money for cyanide-free fish, they are extremely enthusiastic about switching to cyanide-free techniques. Typically, cyanide fishermen receive only a small percentage of the value of their catch, with the lion's share going to middlemen. By helping fishermen to acquire post-harvest equipment and know-how and assisting them in developing their own marketing cooperatives and outlets, governments and NGOs can boost the fishermen's own share of the profits from fishing.

Few fishing communities, however,

ESTABLISHING A SUSTAINABLE LIVE REEF FISHERY IN THE CENTRAL PACIFIC: THE CASE OF KIRIBATI

The island nation of Kiribati (pronounced "Kiribas") stretches 3,218 km along the equator in the central Pacific Ocean. With a land area of only 823 square kilometers and a population of only 80,000, the country's exclusive economic zone covers some 3.5 million square kilometers of ocean, an area nearly nine times the size of California. Kiribati's three island groups (the Gilbert, Line, and Phoenix Islands) contain 29 coral atolls, and the country's vast reefs are among the most pristine on the planet. Its economy is based on copra, seaweed, and fishing, with the licensing of foreign tuna boats being an important source of income. The government, however, is the country's largest employer.

In 1997, Patrick Chan, director of a Hong Kong-based live fish importing firm called Brightfuture Industries, surveyed Kiribati's potential as a source of groupers and napoleon wrasse. He discovered that the species were plentiful and that the local people did not eat them—indeed, their only use at that time was as pig food. Brightfuture is committed to sustainable, cyanide-free fishing, and it has taught some local fishermen the hook-and-line method of capturing fish live as well as the proper techniques for storing them in floating cages to await pick-up. In late 1997, Brightfuture's *Fortuna Star* called in Kiribati and picked up some five tons of live reef food fish.

Traditional, local village councils are an important part of Kiribati's governance system, and they exert considerable control over the use of reef resources. Both the local councils in the initial collection areas and government fisheries authorities have warmly welcomed Brightfuture as a potentially valuable source of employment and income for local communities.

In May 1998, the *Fortuna Star* made a second trip and picked up some seven tons of live fish, this time inviting an investigator from the International Marinelife Alliance to accompany the ship and document the operation.[1] The investigation confirmed that Brightfuture was indeed establishing a cyanide-free live reef fishery and that it was paying local fishermen good prices for the catch compared with those paid in countries such as the Philippines and Indonesia. While surveys to determine sustainable harvest levels still need to be done, it appears that this operation is a sustainable one that provides local communities with a new high-value, low-volume fishery. It is a hopeful sign that Brightfuture, which is a major player in an industry often viewed as central to the cyanide-fishing problem, has taken the initiative to promote cyanide-free and sustainable fishing on this important Pacific reef frontier.

The investigation also discovered, however, that several Chinese and Indonesian fishermen have begun live-fish operations in the northern Gilbert Islands and that local officials are very concerned about the reported use of "hookah" diving compressors and "chemicals." Far to the east, around Christmas Island in the Line Island group (only three hours by air from Honolulu), eight groups are reported to be collecting aquarium fish for shipment to Hawaii. Some collectors and exporters in the region have expressed the suspicion that chemicals—probably cyanide—are being used by at least some of these collectors.

The government has expressed interest in establishing cyanide detection labs both in Tarawa (the capital, which is in the Gilberts) and on Christmas Island and in establishing a more comprehensive policy on the live reef fish industry in general. Over the next few years, the International Marinelife Alliance and the World Resources Institute will be working with the government, Brightfuture, and local village councils to ensure that the considerable potential for a sustainable live reef fish trade in Kiribati is not threatened by rogue operators bringing cyanide and other destructive practices to these remote and outstanding reefs.

1. G. P. Reyes, "Kiribati: A Report on the Recent Visit to the Central Pacific Islands of Kiribati" (unpublished report by the International Marinelife Alliance, 1998).

subsist wholly from the live-fish trade. On the contrary, they usually pursue a "portfolio" strategy that includes selling fresh and dried fish in addition to live fish, along with engaging in agriculture, wage labor, and other gainful activities. An effective livelihood enhancement strategy needs to target all of these activities and introduce new ones where the opportunity exists. The introduction of simple technologies can often add significant value to the products that communities are already harvesting and selling. Examples include spicing fish and producing oyster sauce from raw oysters.

Another important measure is promoting community-based management of local fisheries and coral reefs. Important as training and income enhancement are, partnerships with fishing communities must go beyond these activities. The sustainable management of coastal areas requires complete cooperation between government agencies and the local people who earn their living from the sea—an arrangement often called co-management. Destructive activities such as cyanide fishing, blast fishing, coral mining, and mangrove destruction can only be curbed when the communities on the front line become central players in conservation efforts and benefit directly from the sustainable management of coastal resources. This will require policy shifts on the part of most governments, which have traditionally treated coastal zones and fisheries as subject to state power alone.

In some areas of eastern Indonesia and the western Pacific, customary systems of marine tenure and management provide a sound institutional basis for community-based efforts. In Palau, for example, a traditional tenure system has been effective in limiting overfishing and, in the view of one researcher, is "probably the most valuable fisheries management measure ever devised."[26] Where such systems exist, governments should recognize and support them, providing technical and financial assistance to traditional communities so that they can more easily adapt to rapid economic and technological changes.

As it happens, most coastal communities in Southeast Asia no longer have functioning customary systems for managing and conserving coastal resources. Rather, they are heterogeneous mixes of immigrants and natives

CYANIDE FISHING AND REFORM IN SULAWESI, INDONESIA

In 1996, concerned about rumors that live fish operators from the Philippines were moving into Indonesia's North Sulawesi province, the International Marinelife Alliance (IMA) conducted an investigation in the area.[1] At the outset, this investigation was a bit of a cloak-and-dagger operation: Concealing the fact that he was from IMA, the investigator made a point of befriending the Filipino boss and his employees in Manado, who were glad to have a countryman with whom to pass the time over a few beers one night.

The Filipinos, it turned out, were running a widespread cyanide fishing operation stretching from Manado on Sulawesi's northern tip all the way to Ujung Pandang in the far south of the large island. Working with a local businessman, they were capturing volumes of groupers and napoleon wrasse large enough to justify chartering aircraft to transport the catch to Manila for reshipment to Hong Kong. Other operators in the area were specializing in cyanide-caught aquarium fish, shipping their catch through Bali and Jakarta. Most disturbingly, the Filipinos had been systematically introducing the cyanide fishing technique to new areas of North Sulawesi province and to part of adjacent Central Sulawesi province. The Filipino exporter who had shared beers and trade secrets with the investigator eventually found out that IMA was on his trail and returned to the Philippines. But the damage had already been done: Indonesians have proven quite adept at cyanide fishing—and fully capable of spreading the technique without Filipino assistance.

IMA felt that it had to act but was uncertain as to how. New to Indonesia, the organization felt strongly that it could not work with the fishing communities there without a local ally and clear support from the fishermen themselves. Discussions with a Manado dive operator who was concerned about the destruction of the province's reefs (which are world famous in diving circles) led to a strategy, however. This person, it turned out, was a leader of Primkoveri, the provincial cooperative of military veterans, and Primkoveri became IMA's key local partner.

One of the areas in which IMA had investigated the live reef fishery (in this case, for aquarium fish) was a village called Tumbak whose 257 families (nearly 1,200 people) had become increasingly involved in the cyanide-based fish trade. In early 1997, for instance, the buyer who held the local monopoly on the trade reported that he was shipping 6,000 to 8,000 aquarium fish from Tumbak every week.[2] With some help from Primkoveri, IMA began a dialogue with the Tumbak fishermen to assess their interest in learning the barrier net method of collecting aquarium fish[3] and in receiving assistance in marketing their catch. The initial response was favorable, with a number of the fishermen expressing the desire to learn alternatives to the cyanide method.

In July 1997, an IMA training team that included two Indonesians recruited in Manado began a formal training program for 50 fishermen. The first few days were difficult both because of the language barrier and because the fishermen lacked the proper equipment. Soon, however, the fishermen realized that they could catch as many or more fish—and have fewer of them die in the process—with a barrier net, so they readily embraced the new technology. After three weeks of training and their first shipment, the fishermen were weaned away from cyanide.

Since that time, IMA has helped the fishermen to organize an association through which they have established links to buyers in Europe. No longer dependent on one middleman, they are able to obtain better prices for their fish. And with IMA guidance, they are now selling some 35 species whereas before they only sold 5. Reduced mortality in the capture and post-harvest process, lack of by-catch (nontarget fish killed by the cyanide), and a wider variety of target species (implying less pressure per species) indicate that a clearly unsustainable fishery has been transformed into a far less destructive one.

New groups of fishermen from Tumbak and adjacent villages were trained in early 1998, and similar programs are being established in other parts of the province and the neighboring province of Central Sulawesi. Several international aid agencies have expressed interest in supporting the program, and the Indonesian branch of IMA has been established to coordinate that effort.

1. For more details, see C. V. Barber and F. Cruz, "Turning the Poison Tide: The International Marinelife Alliance's Cyanide Fishing Reform Pilot Program in Indonesia," Live Reef Fish Information Bulletin Number 4 (Noumea, New Caledonia: Secretariat of the Pacific Community, 1998), 1.

2. R. B. Pollnac, C. Rotinsulu, and A. Soemodinoto, *Rapid Assessment of Coastal Management Issues on the Coast of Minahasa*, Draft technical report (Coastal Resources Management Project-Indonesia, 1997), 43–45.

3. The barrier net method of capturing live aquarium fish involves setting up a transparent net around the perimeter of the target coral area. The collector then scares the fish with sound or movement, so that they instinctively dart back in the direction of their coral refuge. The net, however, denies them access to the crevices in the coral and gives the collector enough time to harvest them with scoop nets and specially designed buckets with fine-mesh zippered net tops. With this method, unwanted fish are released and the reef is left virtually undamaged.

that lost such systems long ago. This does not mean that viable community management systems cannot be created, however. The Philippines is a good case in point: Although its customary management systems have vanished, it has the most numerous and the most active community-based coastal resources management initiatives in all of Southeast Asia. A recent survey covering the period 1984 to 1994 revealed that there were 104 sites where such systems were being implemented, and it noted that the actual number was probably higher.[27]

The final measure that can be taken to curb cyanide fishing is to increase the capacity of local communities to monitor fishing practices and enforce anticyanide regulations. Local fishermen are on the water far more regularly than government fisheries officers and know their areas better. With minimal training—which NGOs are often best equipped to provide—these groups can serve as an early warning network, letting officials know when cyanide fishing operations appear in their area. In the Philippines, for instance, members of local fishermen's organizations and cooperatives have been deputized as fish wardens to patrol their fishing grounds. Although local community groups cannot be expected to confront well-organized—and often well-armed—cyanide fish-

ing vessels, they can perform important norm-setting and self-policing activities within their community. (See the box on page 33 for a case in which IMA successfully worked with a local community to suppress the practice of cyanide fishing.)

Closing Remarks

Cyanide fishing is not the only threat to the coral reefs and other coastal ecosystems of the Indo-Pacific region. Others include the rapid conversion of coastal habitats such as mangrove swamps for aquaculture or the production of charcoal; overfishing due to excess fleet capacity stemming from government subsidies; dynamite fishing; haphazard tourism development; pollution by factories and mines, along with contamination by urban wastes, fertilizers, and pesticides; and sedimentation related to deforestation. But the training and community-organization strategies essential to stopping cyanide fishing should provide an important catalyst for communities to address these threats as well.

The difficulty of putting an end to cyanide fishing should not be underestimated. It is important to note, however, that people have long caught and sold live fish without using cyanide and that they still do in places such as Australia, the Caribbean, and Hawaii. Nothing is intrinsically wrong with a cyanide-free live fish trade as long as it is practiced sustainably and protects the coral reef ecosystems that provide habitat for the fish. But cyanide fishing is fast becoming a deadly tradition in many countries of the Indo-Pacific. The challenge is to swiftly eradicate that tradition and ensure that the greatest coral reefs on the planet survive into the 21st century.

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NOTES

1. Hong Kong Agriculture and Fisheries Department, *Live Marine Fish Imports, 1997* (Hong Kong, 1998).

2. Cyanide compounds include cyanide salts such as sodium cyanide or potassium cyanide (either solid or in solution) and the gas hydrogen cyanide. When mixed with seawater, the chemical is mostly present as cyanide ions. Cyanide is one of the most rapidly acting of all poisons, and even small concentrations of it are extremely hazardous. Entering organisms by inhalation, absorption through the skin, or ingestion, it causes suffocation by blocking oxygen from metabolic pathways. Owing to its widespread use in industrial processes, cyanide is available throughout the world. Although some countries have imposed fairly strict controls on its distribution, in others—including almost all of those in Southeast Asia—it is readily available in pellet form. See National Occupational Health and Safety Commission, *Cyanide Poisoning* (Canberra: Australian Government Publishing Service, 1989).

3. Some divers get air through "hookahs" in their mouths that are attached to air compressors on support boats. Others, however, "free dive," staying down only as long as the air in their lungs holds out.

4. C. V. Barber and V. R. Pratt, *Sullied Seas: Strategies for Combating Cyanide Fishing in Southeast Asia and Beyond* (Manila: World Resources Institute and International Marinelife Alliance, 1997), 7–8.

5. R. E. Johannes and M. Riepen, *Environmental, Economic, and Social Implications of the Live Reef Fish Trade in Asia and the Western Pacific* (Bonnet Hill, Australia: R. E. Johannes Pty; and Wellington, New Zealand: Fisheries Development Associates, 1995), 21.

6. See P. Rubec, "The Need for Conservation and Management of Philippine Coral Reefs," *Environmental Biology of Fishes* 23, nos. 1–2 (1988): 141; Johannes and Riepen, note 5 above; and F. Cruz, "Survey and Area Assessment of the Manado Live Reef Fish Collectors, Local Shippers, and Exporters" (unpublished report by the International Marinelife Alliance, 1996).

7. See P. Rubec and V. R. Pratt, "Scientific Data concerning the Effects of Cyanide on Marine Fish," *Freshwater and Marine Aquarium* 7, no. 5 (1984): 4; P. Rubec, "The Effects of Sodium Cyanide on Coral Reefs and Marine Fish in the Philippines," *Marine Fish Monthly* 2, nos. 2–3 (1987); and R. J. Jones and A. L. Steven, "Effects of Cyanide on Corals in Relation to Cyanide Fishing on Reefs," *Australian Journal of Marine and Freshwater Research*, no. 48 (1997): 517.

8. Rubec, note 7 above.

9. Johannes and Riepen, note 5 above, page 25 (reporting a personal communication from Robert Richmond of the University of Guam).

10. R. R. Jones, "Effects of Cyanide on Coral," Live Reef Fish Information Bulletin Number 3 (Noumea, New Caledonia: Secretariat of the Pacific Community, 1997).

11. M. V. Erdmann and L. Pet-Soede, "How Fresh Is Too Fresh?: The Live Reef Food Fish Trade in Eastern Indonesia," *Naga*, January 1996, 7.

12. Johannes and Riepen, note 5 above, pages 24–25.

13. D. Bryant, L. Burke, J. McManus, and M. Spalding, *Reefs at Risk: A Map-Based Indicator of Threats to the World's Coral Reefs* (Washington, D.C.: World Resources Institute, 1998); International Coral Reef Initiative, "East Asian Regional Report on the Issues and Activities Associated with Coral Reefs and Related Ecosystems" (report presented to the 1995 International Coral Reef Initiative workshop, Dumaguete City, the Philippines); and Rubec, note 6 above.

14. L. M. Chou, "Marine Environmental Issues in Southeast Asia: State and Development," in A. Sasekumar, N. Marshall, and D. J. MacIntosh, eds., *Ecology and Conservation of Southeast Asia Marine and Freshwater Environments Including Wetlands* (Kluwer Academic Publishers, 1994), 139.

15. Cyanide was first used to capture fish for aquariums in the early 1960s. Since the 1970s, it has been used to capture food fish for the Hong Kong market as well.

16. The figure for food fish is an estimate by the authors based on data in Johannes and Riepen, note 5 above. That for aquarium fish is from "The Marine Aquarium Trade: Part of the Problem and Part of the Solution," *International Year of the Reef*, Reporters' tip sheet for week 11, 1997.

17. Johannes and Riepen, note 5 above.

18. Ibid., page 15.

19. International Marinelife Alliance and Bureau of Fisheries and Aquatic Resources, "Briefing Paper on the Live Reef Fish Industry in the Philippines and the Strategies Being Implemented to Improve and Monitor the Trade" (report submitted to the presidential cabinet meeting, Manila, 21 January 1997); and H. Cesar, *Economic Analysis of Indonesian Coral Reefs* (Washington, D.C.: World Bank, 1996).

20. Ricky Lau, managing director of Fisherton Holdings, Ltd., statement made on ITN News, Hong Kong, 8 April 1996. At the time, Fisherton Holdings was Hong Kong's largest importer of live reef fish.

21. The Marine Aquarium Council (MAC) was established in the United States in late 1997 as an independent governing council to set standards, oversee environmental certification, and promote conservation education in the aquarium fish trade. (The council does not do certification itself; rather, it accredits certifying organizations that apply the standards it has developed.) MAC's board includes representatives of environmental organizations as well as aquarium fish collectors, exporters, importers, retailers, and public aquarium managers. Pilot certification activities are planned for Hawaii and the Philippines in late 1998.

22. Johannes and Riepen, note 5 above, page 13.

23. In this test, sample fish are first examined for damage from hooks, nets, or spears, as well as for any visible internal abnormalities. The lab technicians then test for the presence of cyanide. Because cyanide is rapidly absorbed by internal organs such as the brain, the liver, and the intestines, these tissues are removed for testing whenever they are large enough to provide a useful specimen (when they are not, as is the case with small aquarium fish, the entire body is used as the specimen). The sample is then weighed, blended into a solution, and subjected to an extraction and distillation process. A cyanide ion-selective electrode with a silver membrane is then inserted into the distilled solution, causing silver ions to replace any dissolved cyanide ions. Such displacement either raises or lowers the pH of the solution (depending on the kind of cyanide present), thereby providing an indication of the quantity of cyanide in it.

24. This bill would require that all imports of cyanide be authorized by the government in advance and that cyanide sales be "strictly controlled." As part of the control measures, sellers and end users would need authorization from the Department of Environment and Natural Resources to distribute, purchase, or use cyanide compounds and would have to file weekly reports on such activities. Both sellers and end users would also be subject to spot checks. The penalties stipulated by the bill are stiff, with prison terms for unauthorized possession or importation of cyanide ranging from 6 to 12 years and fines starting at $10,000.

25. When groupers are brought up rapidly from the depths of the ocean, the compressed air in their air bladders expands. If this pressure is not relieved, the fish are likely to die. Relieving it is easily accomplished, however, by inserting a hypodermic needle behind the gills.

26. R. E. Johannes, *Words of the Lagoon: Fishing and Marine Lore in the Palau District of Indonesia* (Berkeley, Calif.: University of California Press, 1981), 64.

27. R. S. Pomeroy amd M. B. Carlos, "Community-Based Coastal Resource Management in the Philippines: A Review and Evaluation of Programs and Projects, 1984–1994," *Marine Policy* 21, no. 5 (1997): 445.