SULLIED SEAS

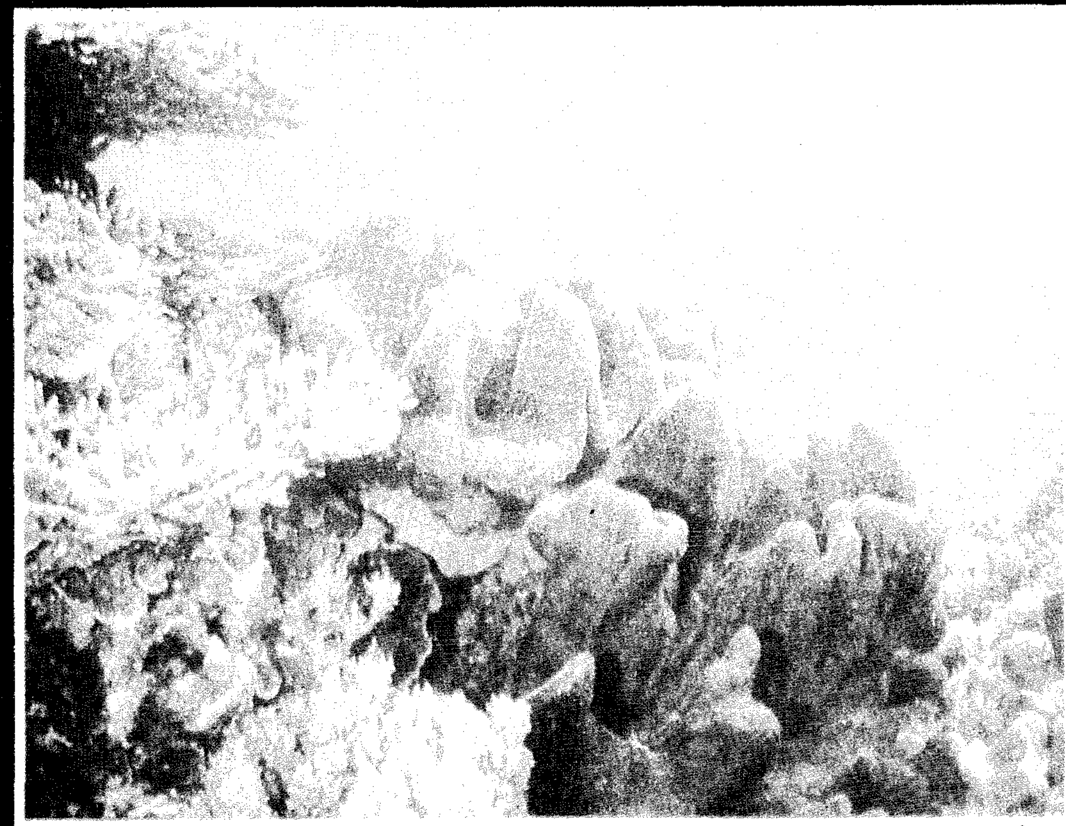
Strategies for Combating Cyanide Fishing in Southeast Asia and Beyond

CHARLES VICTOR BARBER
VAUGHAN R. PRATT

World Resources Institute

International Marinelife Alliance

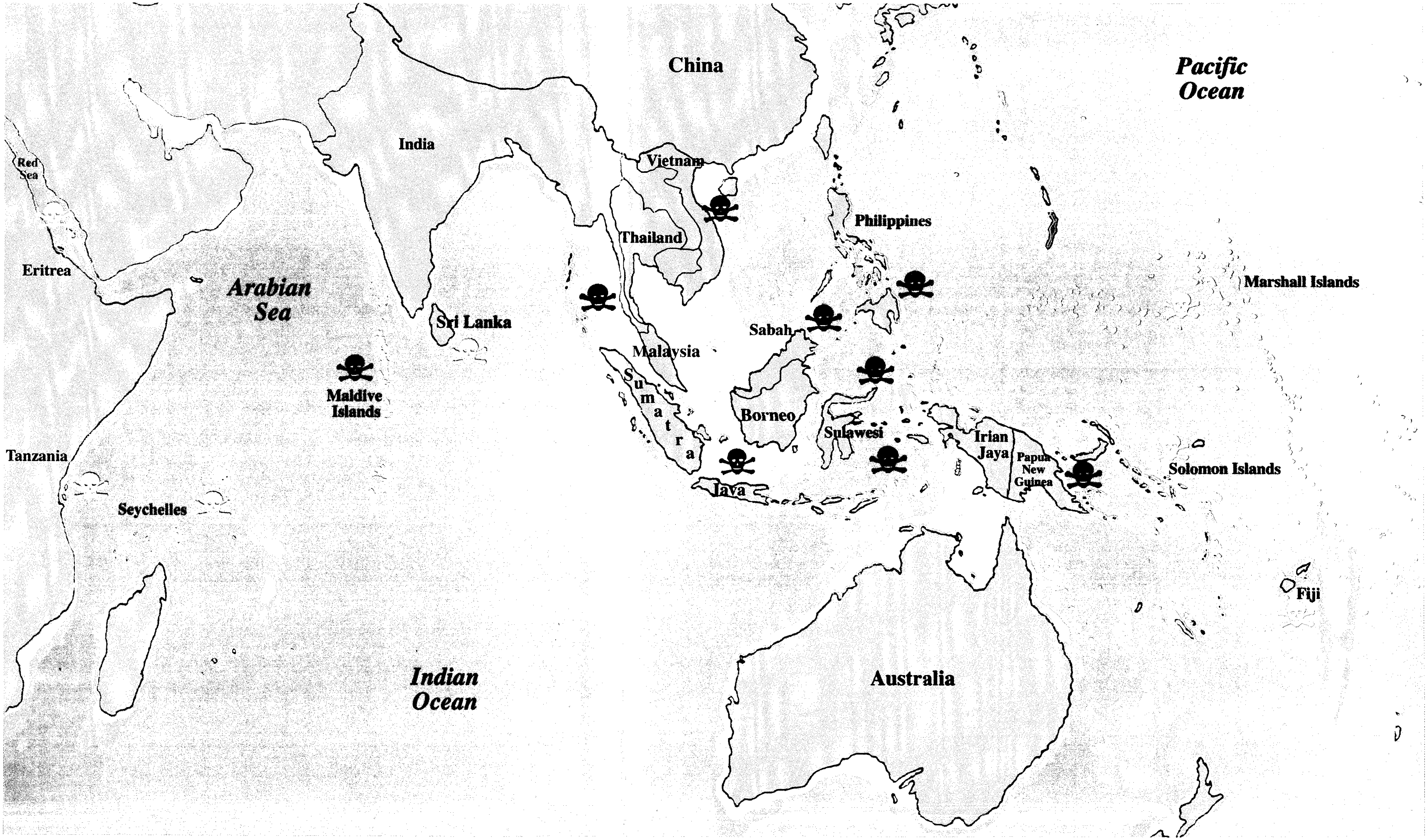
Reefs at Risk



Cyanide-fishing turns productive reefs into ....

an aquatic graveyard.

THE GROWING THREAT OF CYANIDE FISHING IN THE INDO - PACIFIC REGION



LEGEND Coral reef areas. Areas with confirmed cyanide - fishing activities. Areas where cyanide - fishing is suspected.

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The **International Marinelife Alliance (IMA)** is a non-profit, non-government marine conservation organization which was founded in 1985 to help conserve marine biodiversity, protect marine environments and promote the sustainable use of marine resources for the benefit of local people. The organization advocates judicious utilization of marine resources and the conservation of coral reefs in underdeveloped countries.

The **IMA** condemns destructive fishing practices, advocates environmental defense, popularizes alternative livelihood for surplus fisherfolk, promotes "clean" harvesting technology, nurtures environmental activism, propagates environmental causes, supports environmental education, adheres to the principles of sustainable development, and safeguards marine biodiversity.

The **IMA** is the primary force behind ongoing initiatives in the Philippines to elevate the predominantly extractive orientation of Philippine fisheries into the realm of sustainable management. The focus on the Philippines is dictated by the chilling realization that the latter's coral reef ecosystems, one of the most diverse in the world, are severely threatened by a deadly mix of human induced stresses which pollution, siltation, over-harvesting and destructive fishing practices.

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Charles Victor Barber
Vaughan R. Pratt

Foreword

Throughout human history, people have seen the oceans both as a vast and mysterious realm filled with danger and as an inexhaustible food source. Although we still know relatively little about the marine environment, we have learned that the oceans' resources are limited and that humans are the most dangerous creatures abroad on the sea. Fearsome predators like the great white shark have been hunted to near extinction, and overfishing has sharply decreased the populations of previously "common" food species like the cod and tuna. The crush of human numbers and economic activity threaten coastal habitats such as mangroves and coral reefs worldwide.

Nowhere are threats to the marine environment and the consequences of marine degradation more severe or alarming than in Southeast Asia. A region of high population densities and rapidly-growing economies, it is also the global center of marine biodiversity. Millions of Southeast Asian people, many of them very poor, depend on the sea for food and livelihood. The forces pressing in on Southeast Asia's marine biological wealth are similar to those found throughout the world and include overfishing and use of destructive fishing gear, land-based pollution and soil runoff, coral mining, and haphazard coastal development.

In addition Southeast Asia's coral reefs and marine life face a threat that was, until the past few years, unique. Since the 1960s, more than a million kilograms of deadly sodium cyanide has been squirted onto coral reefs in the Philippines to stun and capture ornamental aquarium fish. More recently a growing demand for larger reef food fish has vastly increased the incidence and spread of cyanide fishing. Chinese consumers in Hong Kong and other major Asian cities greatly value certain reef fish when they are plucked live from a tank, cooked, and served minutes later; the consumers pay up to $300 per plate for some species. The combined demand for aquarium and live food fish has spread cyanide fishing throughout Indonesia and into neighboring countries such as Papua New Guinea, Vietnam, the Maldives, and Fiji. In the past year, officials in countries as far-flung as Eritrea and Tanzania have voiced suspicions that their fast-growing live fish export industries may also be using cyanide.

Sullied Seas details the extent of the cyanide fishing threat and proposes steps that affected countries, donors, nongovernmental organizations and the live fish industry can take to counter it. Written by WRI Senior Associate Charles Victor Barber and Vaughan Robert Pratt, co-founder and head of the International Marinelife Alliance-Philippines (IMA), the report discusses what is known about the impacts of cyanide fishing on both reefs and human health, explains the techniques and technologies involved, and looks at the economics of the live fish trade. The authors describe one attempt to halt the practice, the five-year old Philippines' Cyanide Fishing Reform Program (CFRP), looking at the progress the program has made as well as the considerable challenges it faces. *Sullied Seas* concludes with a set of practical recommendations for steps other countries should take to overcome the growing cyanide fishing problem. Complemented by descriptive color photographs and explanatory maps, the report makes an important contribution to the conservation of Southeast Asia's unparalleled marine heritage.

The report's authors are uniquely qualified to tell the story of cyanide fishing and the CFRP. WRI's Charles Barber has worked on natural resources policy issues in Southeast Asia for more than a decade and has lived in the Philippines, focussing his efforts on marine issues since early 1994. Vaughan Pratt heads IMA, the organization that first brought the cyanide-fishing issue to the world's attention in the 1980s, developed the CFRP in collaboration with the government of the Philippines, and currently operates the CFRP's Cyanide Detection Test laboratory network under contract with the Philippine Bureau of Fisheries and Aquatic Resources.

We would like to thank the Biodiversity Conservation Network and the Ministry for Economic Cooperation and Development of the Federal Republic of Germany for their financial support for the research and analysis reflected in *Sullied Seas*. We hope that this report will assist the people of Southeast Asia to continue their progress in conserving their unique and valuable marine environment.

Jonathan Lash
President
World Resources Institute

I

A Poison Tide on the Reef

- At risk: the coral reefs of Southeast Asia
- The impacts of cyanide on fish and coral reefs
- The impact of cyanide on human health
- Why cyanide fishing is a unique threat

On August 7, 1996, the *Morning Sun*,[1] a ship registered in Guangzhou (Canton), docked at Hong Kong with a cargo of Indonesian fish. Unremarkable in the bustle of one of the world's busiest ports, the *Morning Sun*, loaded with 20 tons of live fish,[2] was a key link in a chain of poison and profits that is bringing destruction to the coral reefs of Southeast Asia.

The fish onboard the *Morning Sun* were almost certainly caught by applying hundreds of kilograms (kg) of sodium cyanide,[3] the most lethal broad-spectrum poison known to science, across vast areas of coral reefs in an area so rich in biological diversity that it may justifiably be called the "Amazon of the oceans." The cyanide was undetectable in the fish by the time they arrived in Hong Kong because the fish had been held in coastal cages for some time before beginning their journey.[4]

The *Morning Sun*'s catch was just a drop in the bucket. Some 13,000 tons of live food fish were imported into Hong Kong from Australia, Indonesia, Malaysia, the Philippines, the Maldives, Taiwan, and Thailand by air and sea freight in 1995, according to estimates by the Hong Kong Agriculture and Fisheries Department.[5] With the exception of those fish from Australia, where cyanide is not used, most are believed to have been caught using the poison.

Once unloaded, the *Morning Sun*'s fish were moved to a warren of holding tanks in the city and soon ended their journey in one of the colony's many restaurants catering to the booming demand for live fish. Picked from a restaurant's display tank—or that of a specialized shop next door—steamed, and served minutes later, one fish of the most favored species, the napoleon wrasse (*Cheilinus undulatus*, also known as the humphead or maori wrasse), sells for as much as $350. Based on a per-kilogram wholesale price of

$50, the shipment was worth $1 million wholesale [6] and several times that when sold in restaurants. A conservative estimate of the wholesale value of the Hong Kong live food fish trade is about $450 million, with a retail sales value that may top $1 billion.[7]

Cyanide fishing is also the method of choice for capturing Southeast Asia's unmatched diversity of ornamental fishes for the aquarium fish trade, which has a global retail value of approximately $200 million.[8] Sales of aquarium hobby hardware and supplies—such as tanks, filters and fish food—probably add another $300 million in annual retail sales for a total retail value of $500 million.[9] Some 85 percent of aquarium fish are captured on the reefs of Indonesia and the Philippines; the remaining 15 percent come from the Caribbean, the Red Sea, Hawaii, and the Indian Ocean. The United States imports more than 60 percent of the marine aquarium fish collected worldwide; the rest go to Europe, Australia, and East Asia.[10]

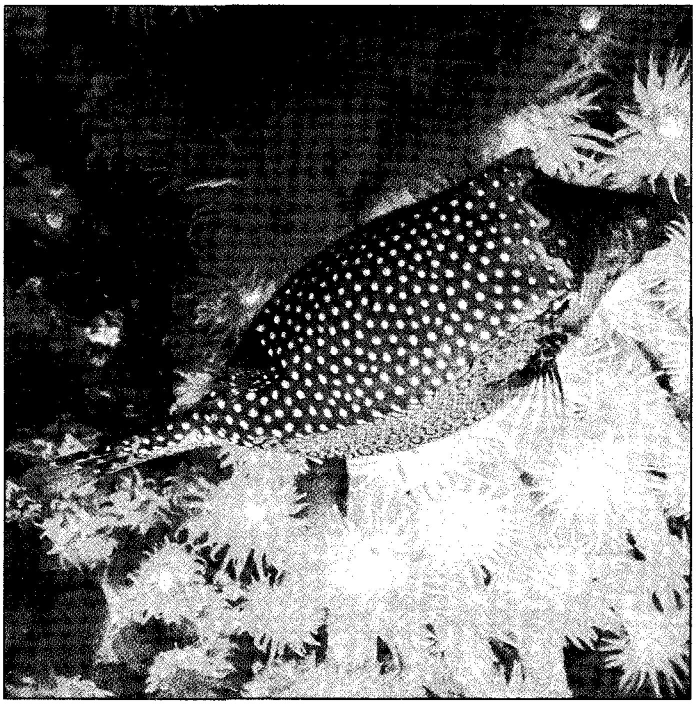
Far from Hong Kong's restaurants and the pet stores of Europe and North America, fishermen in Southeast Asia, the Indian Ocean, and the Pacific dive into the sea with "hookah" tubes in their mouths—attached to air compressors on small boats—and makeshift squirt-bottles in their hands. These fishermen squirt deadly cyanide ion and hydrocyanic acid[11] into coral formations, thereby stunning and collecting their prey. Sometimes a crowbar is necessary to pry apart the coral heads and reach the stunned fish that hide in crevices.[12] The rewards are high, with some cyanide divers making more than university professors in their countries, but so are the risks. Untrained in diving safety, many fishermen fall prey to decompression sickness ("the bends").

Contributing to this chain of poison are a variety of intermediaries—vessel and holding-tank facility owners, and fish exporters and importers—as well as civilian, police, and military officials who look the other way for a cut of the profits. In the words of one Philippine official: "As a certified multimillion-dollar industry, the live fish trade has found impudent defenders, behind-the-scenes apologists, and unscrupulous supporters. As the ocean is being raped and devastated in silence, the criminals are laughing merrily on their way to the bank."[13]

The use of cyanide to catch live fish for the aquarium trade, primarily in the Philippines, has been documented and condemned since the early 1980s.[14] More recently, the rapid spread of cyanide fishing throughout Southeast Asia and adjoining waters[15] has attracted growing attention from the media[16] and international environmental groups such as the World Wide Fund for Nature (WWF) and The Nature Conservancy (TNC).[17] The topic was introduced by the government of Hong Kong into the agenda of the Asia Pacific Economic Cooperation (APEC) initiative during 1996[18] and has received considerable attention from the multinational International Coral Reef Initiative.[19]

Despite this growing concern, cyanide fishing is spreading unchecked throughout Southeast Asia's seas and increasingly into the Pacific and Indian oceans. Cyanide fishing is technically illegal across most of the region, and some countries have recently taken additional actions—such as Indonesia's 1995 restrictions on the export of napoleon wrasse.[20] But only the Philippines has an action program aimed at eliminating cyanide fishing.

Action to date has been inadequate. To stop cyanide fishing, it is time to move from expressions of concern to effective policy and action. This report sets out an initial plan of action for combating cyanide fishing in Southeast Asia and elsewhere, based on the experience of the Philippines' Cyanide fishing Reform Program (CFRP) during the past five years. Combining technical and scientific approaches with policy reforms, stepped up enforcement, and community-based strategies, the CFRP is the most developed program of its kind. Although imperfect—cyanide fishing is still a great problem in the Philippines—the CFRP provides important lessons for other countries where cyanide-fishing is expanding and for the many governments, non-governmental organizations (NGOs), and international assistance agencies worldwide that have recently become concerned about the issue.



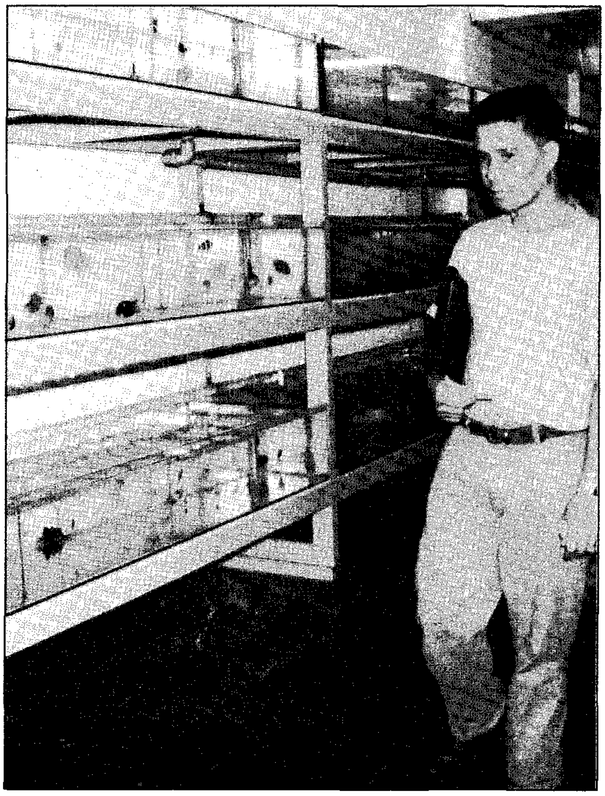
Spotted Boxfish (Ostracion melegris) commonly captured and exported from the Philippines

At Risk: The Coral Reefs of Southeast Asia [21]

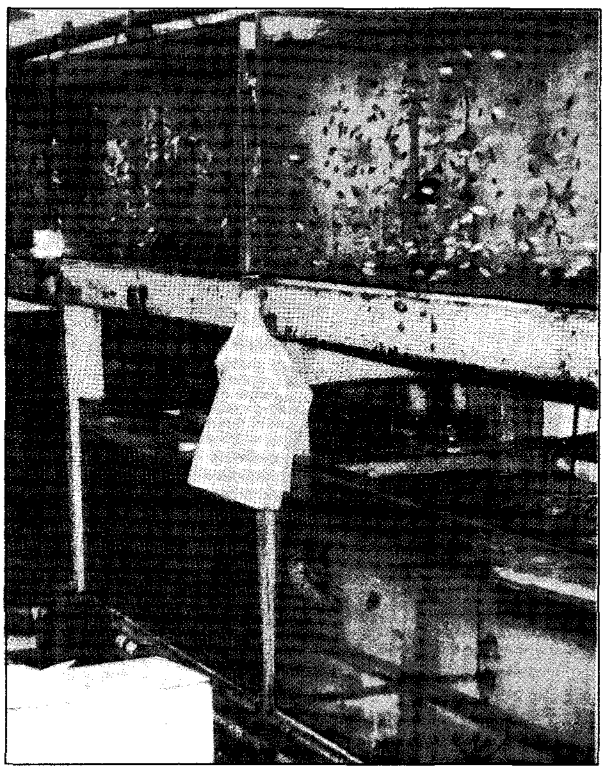
The coral reefs, sea grass beds, and mangroves of Southeast Asia's seas and coasts support some of the most diverse marine flora and fauna on Earth. Some 30 percent of the world's coral reefs are found in Southeast Asia—the largest share of any single region. Indeed, Southeast Asia is considered the global center of coral diversity, which peaks in eastern Indonesia, the Philippines, and the Spratly Islands, home to 70 genera and 400 species of corals.[22] The region is also the global center for diversity of marine fish with over 2,000 species of shore fish living in the shallow waters of the Philippines alone.[23] Southeast Asian reefs are also the planet's center of diversity for marine invertebrates, including molluscs and crustaceans.[24] In the Spratly Islands the total number of species to be found at all depths (to 1800 meters) certainly ranges into the tens of thousands.[25]

These rich marine resources are crucially important to the livelihoods of Southeast Asian peoples and nations. Dependence on fish for animal protein is extremely high throughout the region[26]—one estimate puts it at 65 percent for the Philippines, Malaysia, and Indonesia[27]—and the figure nears 100 percent in many poor coastal villages. In the Philippines, fish supply 70 percent of animal protein and 30 percent of total protein.[28] Fishing industries, large and small, provide food and cash income for millions.

Most marine biodiversity is concentrated in coastal and near-shore areas, making these areas correspondingly important in economic terms. Almost 90 percent of the fisheries resources in the region come from the shallow continental shelf and coral reefs in coastal zones.[29] A wide range of species important for commercial and subsistence uses are dependent on coral reefs, mangroves, and sea grass beds, which serve as breeding and nursery grounds for fish and other aquatic species.[30] A study on the coral reef at Sumilon Island in the Philippines recorded an annual fish catch of nearly 37 met-



Ornamental fish retail shop, Manila, Philippines



Ornamental fish export facility, Manila, Philippines

ric tons per square kilometer (km^2).[31] According to one estimate for Indonesia, the average net annual income from coral reef fisheries that operate from reefs in good condition at maximum sustainable yield levels of effort is \$12,000 per km^2.[32] In many Southeast Asian countries, diving and beach-based tourism, both of which depend on healthy coastal and marine ecosystems, are big business.[33] Moreover, coral reefs protect coasts and beaches by providing a natural barrier against harsh waves and surf.

One study[34] estimates that the net present losses to society resulting from destruction of one km^2 of coral reef over 25 years—aggregating fisheries, tourism, and coastal protection—values may be as high as \$1.16 million for areas with tourism potential and substantial coastal infrastructure.[35] Although precise estimates of monetary and nonmonetary losses are difficult to determine, it is abundantly clear that the destruction of coral reefs poses a considerable threat to human welfare and the environment in Southeast Asia.

The Impacts of Cyanide on Fish and Coral Reefs

The deadly impacts of cyanide on fish have been extensively studied.[36] When sodium cyanide is dissolved in water, it forms hydrocyanic acid (HCN). Concentrations of HCN exceeding 0.1 milligram (mg) per liter have been found to kill sensitive fish species and lower HCN concentrations have debilitating, sub-lethal effects. Some species, however, seem capable of surviving much higher levels of HCN exposure for several days. HCN enters the fish's bloodstream through the gills and intestine and is rapidly distributed to other body tissues. The poison interferes with the fish's ability to metabolize oxygen and causes death via depression of the central nervous system, which is most sensitive to oxygen deprivation (hypoxia).

Fish that survive HCN exposure gradually metabolize the poison into the less toxic thiocyanate, which is excreted through the urinary tract.[37] Surviving fish that are not taken by divers face decreased chances of survival in the short-term due to predation in their weakened state or HCN-induced "sudden death syndrome." In the longer-term they suffer impaired growth, reproduction and disease resistance.[38] An estimated 80 percent of cyanide-collected aquarium fish die in the chain from collector to aquarium hobbyist.[39] No reliable quantitative estimates of mortality rates of live-caught food fish exist, but Johannes and Riepen[40] conclude that mortality is quite high, especially for fish caught by less-experienced operators.[41] Cruz's observations of dead groupers in the live grouper fishery in Manado, Indonesia, confirm this.[42]

Much of the evidence concerning the impacts of cyanide on reef invertebrates is anecdotal. This is not surprising, since so little is known about the vast diversity of Indo-Pacific invertebrates in general—new species are discovered literally every day.[43] Aquarium fish collectors and divers claim, however, that invertebrates are more suscep-

Box 1.1
The Nature and Uses of Cyanide

Cyanide compounds include cyanide salts, such as sodium cyanide or potassium cyanide, which can be either solids or in solutions, and the gas hydrogen cyanide (HCN), also known as hydrocyanic acid gas. Cyanide salts are used in gold and other metal extraction, electroplating, and metal cleaning. Hydrogen cyanide is occasionally used in the fumigation of ships. More notoriously, it was used by the Nazis in gas chambers during the Holocaust (and known as Prussic Acid), and has been employed by some U.S. states for executing convicted criminals.

Hydrogen cyanide gas and its simple salts are among the most rapidly acting of all poisons. Even small concentrations are extremely hazardous. Cyanide gas can be produced when cyanide solids or liquids are mixed with the moisture in air, steam, or acid fumes. The gas is highly flammable.

Cyanide compounds act very rapidly and may enter the body by gas inhalation, skin absorption, or ingestion. Cyanide poisoning essentially causes suffocation of the organism affected because cyanide stops the use of oxygen in metabolic pathways. At some dosage levels, cyanide may also affect the central nervous system, slow the heart, or stop electrical activity in the brain.

Cyanide is widely available throughout the world because of its extensive use in industrial processes. Although some countries impose fairly strict controls on its distribution, in other countries—including most of Southeast Asia—the poison is sold freely without monitoring controls.

Source: NOHSC, 1989.

tible to cyanide than fish.[44] Sea anemones exported from the Philippines, for example, are said by aquarium traders to be of poor quality as a result of the use of cyanide in catching species such as the clownfish, which associates closely with anemones.[45] Some invertebrates appear highly susceptible to cyanide poisoning, although others seem to be relatively resistant.[46]

The extent to which exposure to cyanide injures or kills the organisms that make up coral reefs themselves has not been studied extensively and is not well understood. Field experiments on coral heads near Cebu island were conducted by the Philippines Bureau of Fisheries and Aquatic Resources (BFAR) in 1980.[47] Coral heads in two quadrats were sprayed with cyanide in April and again in August and two control quadrats were marked. Although the sprayed corals showed rapid signs of distress,[48] they appeared to recover several days after each exposure. But by November 1980, three months after the second exposure, all corals in the test cyanide quadrats were dead, but those in the control quadrats were still alive, except for 25 percent of the branching corals in one control quadrat that had been grazed by the coral-eating crown of thorns starfish (*Acanthaster sp.*). This initial study indicated that cyanide does indeed kill corals.[49]

Recent unpublished research at the University of Guam confirms these findings. In these experiments, corals exposed to cyanide (4 parts per thousand) for 10 minutes began to bleach within four hours, and nine out of ten specimens died within four days. At 0.1 parts per thousand for 30 minutes, the corals bleached within three to four days and experienced tissue loss after nine days.[50] Even at exposures as low as 1 part in 10 million, corals began dying after three weeks.[51]

A study conducted on Australia's Great Barrier Reef in 1995 by Dr. Ross Jones of the University of Sydney strengthened the evidence that cyanide damages corals.[52] Small fragments of the hard coral *Pocillopora damicornis* were exposed to a range of cyanide concentrations for different exposure times. Corals died following the highest doses and lost varying amounts of their symbiotic algae (*zoothanthellae*) at lower doses. Coral respiration was also inhibited by 10-90 percent, depending on the level of cyanide exposure. Jones noted that it is difficult to accurately estimate the level of exposure that corals experience during cyanide fishing. Initial exposure is likely to be high (parts per thousand) but rapidly dilute to low levels (parts per billion) in periods of time ranging from seconds to hours, depending on currents. Calculating various rates of net exposure, however, Jones concluded that "the results of this study suggest a deleterious effect of cyanide fishing on corals in the immediate vicinity."

Anecdotal evidence about the effects of cyanide fishing on corals is plentiful, and was reported in the Philippines during the 1980s.[53] A more recent account from eastern Indonesia reports 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 archipelagos that are exhausted."[54] Johannes and Riepen[55] report that cyanide fishermen in those two countries "invariably asserted that cyanide causes extensive damage to corals." In addition, divers and dive-tour operators reported that cyanide fishing has caused "total destruction" of reefs—corals, other invertebrates, and fish—noting that reef structures remained intact, which would not be the case if dynamite or storms were responsible.[56]

In short, there is strong evidence that cyanide kills corals, but many questions remain about the level of toxic exposure, the effects of repeated exposure, and the relative susceptibility of different kinds of corals. A recent field study in the Philippines that attempted to model the relative impacts of dynamite, cyanide, and anchor damage on live corals, concluded that "the estimated mortality from cyanide ranged from 0.01percent to 8 percent per year," an inconclusive finding. Researchers emphasize "the need for studies to determine the actual rates of mortality of corals in the field exposed to cyanide during fishing operations."[57]

Despite incomplete data on the toxicological effects of cyanide, the process of cyanide fishing itself indisputably wreaks havoc on coral reefs. Fish sprayed with cyanide frequently flee to the interior of coral structures. To capture them, the cyanide fishermen pry and hammer the reefs apart. The rubble left behind is similar to the destruction caused by dynamite fishing, but is compounded by the direct impact of the poison.

The Impacts of Cyanide Fishing on Human Health

The health risks of eating fish caught with cyanide have not been studied and are not known. It is likely, however, that fish caught with cyanide and sold live pose little human health risk because of the relatively rapid rate at which cyanide is thought to be metabolized and excreted by still-living fish, although the precise rate of metabolization has not been accurately determined.[58]

But not all fish caught with cyanide are exported live. The mortality rate in the period between capture and export is quite high, and the fish that die in the process of cyanide-fishing are often consumed locally. Cyanide is also sometimes used in bait to catch pelagic fish with hook-and-line gear.[59] Dead fish do not metabolize cyanide, which concentrates much more in the internal organs, especially the liver, than in the flesh. The risks of eating fish killed intentionally or unintentionally with cyanide have not been studied but may be significant. Coastal peoples in Asia, unlike westerners, eat and sometimes prefer the internal organs of fish—especially the liver. A case reported in the Philippine press illustrates the potential risks. On the island of Cebu, Eddie Nodalo was cleaning a swordfish for dinner in early September 1993. As he worked he threw the entrails to the family's five hungry cats. Within 30 minutes, all five cats were dead. The fish was tested at a government laboratory and found to be contaminated with cyanide.[60]

Cyanide poses risks to human health through other types of accidental exposure. Cyanide and cyanide-contaminated containers are often left laying around the houses of cyanide fishermen. Occasional deaths are reported when fish brought home in cyanide storage bags are eaten, or when fish caught with cyanide-laced bait are consumed.[61] On the Philippine island of Palawan in 1995, for example, a cyanide fisherman left a plastic bag of the poison on a table during a party. Two children ate some of it and very nearly died.[62]

Although not related to the toxic properties of cyanide, improper use and maintenance of diving equipment poses additional health threats to cyanide fishermen. The increased pressure on the body during diving causes nitrogen to be absorbed into the body's tissues. As a diver surfaces, the excess nitrogen begins to be eliminated. If the absorbed nitrogen is above a certain level, it clumps together in relatively large bubbles, causing decompression sickness, commonly called "the bends." The risk is particularly high when divers repeatedly dive without adequate intervals on the surface. Symptoms are varied and can range from minor discomfort to temporary or permanent paralysis to rapid death.[63]

The danger of decompression sickness and ways to avoid it have been studied extensively. Every recreational diver uses dive tables (and more recently, computers) to establish safe depth and time limits. Cyanide fishermen, however, are often ignorant of diving physiology, and their employers do not bother to enlighten them or do not understand the problem themselves. As a result there is an epidemic of decompression sickness in virtually every community where cyanide fishing is practiced. One study makes a "conservative" estimate that the mortality rate for Indonesian cyanide divers is 1 percent per year.[64] Higher rates have been reported in some areas: on Marinduque Island, Philippines, 30 of 200 cyanide fishermen developed serious cases of the bends (typically paralysis) in 1993, and 10 of them died. Residents of Barang Lompor Island in South Sulawesi, Indonesia, reported that 10 of their divers had died in the past several years. In eastern Indonesia "nearly 100 percent of the divers interviewed have suffered at least minor symptoms of decompression sickness. Severe paralysis and death are not uncommon."[65]

Even less data are available about injuries sustained from breathing contaminated air from old, poorly operated and maintained compressors, although observers report that such injuries are common. In the Philippines, cyanide divers often use refitted paint-spraying compressors with air intakes next to exhaust vents, so divers are breathing a mixture of air and engine exhaust while submerged.[66] In the words of one researcher in Sulawesi, Indonesia, "I personally thought that I was going to die when testing one of these—the inlet for the compressor is literally right next to the (engine) exhaust, yet no one here thinks the air tastes bad."[67] These observations mirror findings in the Philippines some 15 years earlier.[68]

Even when warned about the risks of cyanide fishing, divers often argue either that their poverty leaves them no choice or that the cold or evil sea spirits are to blame. In Sulawesi, the fishermen just accept the bends and bad air "as the hazard for a big-money job."[69] Because most coastal communities where cyanide fishing is prevalent are quite poor, epidemiological studies are nonexistent, and the true extent of the considerable health problems faced by cyanide fishermen is unknown.[70]

Why Cyanide Fishing Is a Unique Threat

Cyanide fishing is not the only threat to the coral reefs and other coastal ecosystems of Southeast Asia. Other threats include rapid conversion of coastal habitats such as mangroves for aquaculture, charcoal, and building materials;[71] overfishing due to government-subsidized fleet over-capacity;[72] dynamite fishing;[73] haphazard coastal tourism development;[74] runoff from industrial pollution, mining, urban wastes, and fertilizers and pesticides; and sedimentation arising from deforestation.[75]

Nevertheless, four unique characteristics of cyanide fishing provide hope that it can be stopped or at least significantly reduced:

- Cyanide fishing is concentrated in Southeast Asia and is often focused on isolated reefs far from the effects of coastal habitat conversion and sedimentation. As a result, the problem is relatively localized and a discrete target for control efforts.

- First discovered in the late 1950s, cyanide is a relatively recent fishing technique and has only come into widespread use in the past three decades in the Philippines, much more recently in other countries. Outside of the Philippines, therefore, the practice is not yet deeply embedded in local cultures and economies.

- Cyanide fishing targets a very specific and "high-end" market—live food and aquarium fish—with some food species selling for as much as $180 per kg and some aquarium species fetching $350 per individual.[76] The consumers and their suppliers are therefore an identifiable and fairly limited group.

- There is a clear and not-too-complicated set of actions to address the problem if governments, the live fish industry, scientists, NGOs and fishing communities can be persuaded and assisted to take action.

Although the difficulties in stopping cyanide fishing should not be underestimated, it is important to note that people have long captured and sold live fish without using cyanide, and they still do in many places such as the Caribbean and Hawaii, where live aquarium fish have been collected with fine-mesh nets for decades. Nothing is intrinsically wrong with a cyanide-free live fish trade as long as it is practiced at sustainable levels, and protects the coral reef ecosystem that provides fish habitat. But cyanide fishing is fast becoming a deadly tradition in the Philippines, handed down from father to son. It will soon be just as firmly established in Indonesia and other countries of the region. Our challenge is to eradicate the growing cyanide tradition and replace it with a cyanide-free fishing tradition. The Philippines has taken some important initial steps in this direction. Other countries in the region need to take similar steps, keeping in mind the lessons learned from the Philippine experience.

II

Cyanide Fishing and the Live Fish Trade: An Overview

- The roots of cyanide fishing: the Philippine aquarium fish trade
- The live food fish trade
- Economics of the live fish trade
- Aquaculture and the live food fish trade
- The techniques and technology of cyanide fishing
- The political economy of cyanide fishing

The Roots of Cyanide Fishing: The Philippine Aquarium Fish Trade

In 1957, a Filipino entrepreneur named Earl Kennedy began exporting aquarium fish caught on coral reefs, thereby starting a major export industry. By the mid-1980s, the Philippines had become the source of 75 to 80 percent of tropical marine aquarium fish sold worldwide. At about the same time Kennedy was starting up his new business, a U.S. researcher described the impacts of low concentrations of sodium cyanide on fish in a U.S. Fish and Wildlife Service report: cyanide was fast acting in stunning fish, but those that survived the initial exposure, if transferred to clean water, revived with no apparent ill effect.[77] Philippine aquarium fish collectors heard about this soon thereafter, and decided to try it out.[78]

In 1962, Kennedy noticed a sharp and sudden increase in the volume of fish he was receiving from a small island several hours to the south of Manila. These fish were often in shock when he received them, and he eventually discovered that the reason for this was the use of cyanide to catch them. In Kennedy's view, the subsequent boom in the Philippines' marine aquarium fish trade during the 1960s resulted mainly from the rapidly spreading use of the poison.[79]

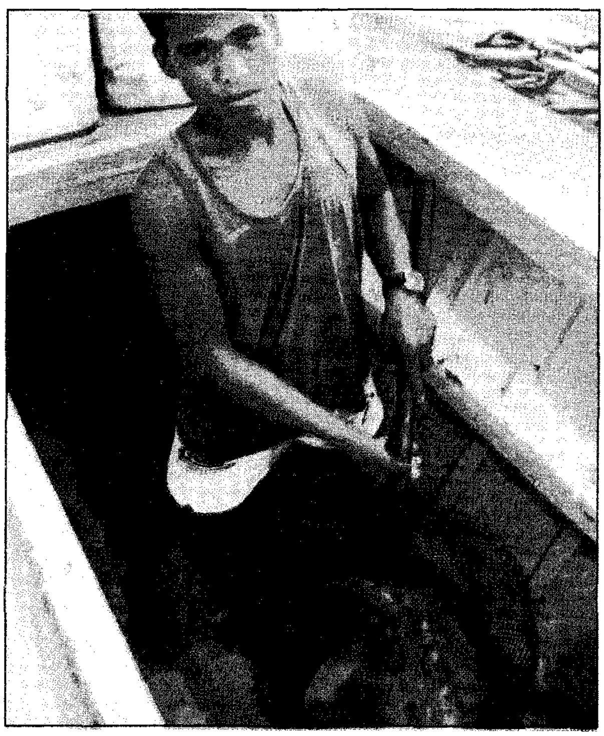
In the 1960s, there were only three aquarium fish exporters in the Philippines. By the 1980s, 35 companies engaged in fierce competition, and exports reached 2 million kg in 1980.[80] Export volume began to decline thereafter, although total export value continued to rise until 1984 as a result of increasing prices. The trade slumped in the mid-1980s in part because of anti-cyanide publicity generated by the International Marinelife Alliance (IMA),[81] but high levels of fish mortality experienced by importers and aquarium owners during that period was probably the key factor in slowing demand for Philippine aquarium fish.[82] The 1991 establishment of cyanide testing laboratories and enforcement procedures also served to dampen the trade. Overall, three decades of cyanide use and other destructive fishing practices have debilitated most Philippine reefs, precipitating a sharp decline in the availability of desired aquarium species. Declining stocks in the Philippines, however, have led to the opening of other source areas, particularly Indonesia, where there may be more than 4,000 aquarium fish collectors currently operating.[83]

Despite declining wild stocks, aquarium fish still comprise nearly half of the live fish trade volume in the Philippines.[84] But in recent years it has been the trade in live food fish that has fanned the spread of cyanide fishing in the Philippines and elsewhere. In Indonesia, for example, while the aquarium fish trade may be worth some $32 million annually, "it seems that the live grouper trade is at the moment much more important in economic terms (and) appears to be at least three times as big as the aquarium fish trade, and probably even much more."[85]

The Live Food Fish Trade[86]

Keeping fish alive until they are cooked has been a popular Chinese custom for centuries, but until recently only locally caught or farmed freshwater and marine species were used for this culinary specialty. As Hong Kong's wealth increased in the 1960s, so did the demand for live fish, and marine species from more distant waters began to appear on the local market. Consumers favor wild-caught fish over farmed ones and wild fish command a market premium. At first, the locally-available red grouper (*Epinephelus akaara*) was the species of choice, but stocks of this species were severely depleted by the early 1970s. As Hong Kong fishermen ventured further afield to reefs in the South China Sea, new species that they brought home alive grew in popularity. These included the napoleon wrasse (*Cheilinus undulatus*), spotted coral trout (*Plectropomus leopardus*) and various other grouper species, and rock lobsters. As demand for live food fish soared, fishermen scoured more distant reefs such as those of the Spratly and Paracel islands. These areas were soon over-exploited as well.

The first documented use of cyanide to catch grouper species and napoleon wrasse for the Hong Kong market was in the Philippine province of Palawan in the early 1970s. Robinson reported to the government in 1986 that a thriving cyanide-based trade in these species had been under way in the waters of Palawan province for some 15 years.[87] The operators, all Philippine nationals, were utilizing large boats with live-well holding systems capable of collecting up to 5 tons of fish per trip. Robinson noted that at least



Live grouper fisherman showing his daily catch, Coron, Palawan, Philippines.

Box 2.1
The Spread of Cyanide Fishing: From the Philippines to Sulawesi, Indonesia

In early 1995, investigators from the International Marinelife Alliance-Philippines (IMA) surveyed the extent to which cyanide fishing had become established in the Indonesian province of North Sulawesi, an area close to the southern Philippines. They discovered that four companies had set up cyanide-fishing operations in 1994, prior to which the practice was virtually unknown. The largest of the companies, P.T. Luckindo Makmur Bahagia (LMB), turned out to be jointly owned by Tecson "Toto" Cheng of the Manila-based Sea Dragon firm, one of the largest exporters of cyanide-caught groupers and wrasses in the Philippines, and was employing 16 cyanide divers. Three other smaller firms were also involved in the trade. Rock lobsters, groupers, and napoleon wrasses are the target species. Both cyanide divers and local fishermen confirmed that cyanide is the only locally-known method for capturing live fish. Mortality rates were observed to be high, although dead lobsters and fish could still be sold, for a lower price.

These firms, based in Manado, the provincial capital, operated in a decentralized manner, with cyanide divers in localities around the province keeping their live catch in cages, from which pickups were made for delivery to the holding facilities in Manado, the provincial capital. The catch was then shipped out by air to exporters in Surabaya, Bali, or Jakarta, who then flew the fish to Hong Kong.

The three smaller firms shipped their live catch to Bali and Jakarta (presumably for transhipment to Hong Kong), while LMB was shipping directly to Manila, using FEAC Hawker Sedely planes chartered from Manila and each capable of carrying a cargo load of ten tons. Because export of napoleon wrasse from Indonesia is restricted, the wrasses (which made up a considerable proportion of the catch and are the highest-value of the species exported) were mislabelled as groupers. In addition, the IMA researchers heard reports of large "mother-ships", which each operate a number of outboard- and diving compressor-equipped small boats, returning to Hong Kong when their holding tanks are full.

Cyanide fishing is technically illegal in Indonesia under the Basic Fisheries Law of 1985 and its implementing regulations, but the law has never been enforced in North Sulawesi, according to local divers and fishermen, who say that no one to their knowledge has ever been apprehended for its use. The openness with which cyanide fishers and exporters discussed the issue seems to bear out this conclusion.

Interviewed about the legality of cyanide use in Indonesia, Mr. Cheng of LMB commented that "it only takes money to solve the problem of legality." Presumably the same holds true for the misidentification and export of napoleon wrasse.

And there is plenty of money in the trade in Manado. Groupers of the most coveted sizes were sold by the local operators to exporters in Bali, for example, for as much as $55 apiece while napoleon wrasse were sold for more than twice as much. Divers typically realize about 20-25 percent of the selling price.

With those kind of profits to be made, it is not surprising that local fishermen take to the destructive new technology. But it is wrong to assume that fishermen in North Sulawesi are taking up cyanide fishing because they are forced into it by poverty. Rather, cyanide fishing techniques and technology have been systematically introduced by foreign operators seeking new sources of live fish to replace the ones they have destroyed in the Philippines, and local fishers are taking advantage of the windfall profits, in ignorance of the long-term impacts of cyanide fishing on their resource base.

And the spread of cyanide fishing in Sulawesi continues. The Filipino cyanide divers in Manado told the IMA team that they had been introducing cyanide fishing techniques into new areas of the province and the adjacent province of Central Sulawesi. By early 1997, the Filipino divers had gone home and the operations were wholly in Indonesian hands. Because Manado is an important dive-tourism destination, most operators had moved to more remote locations, with many relocating to Central Sulawesi province.

Source: Cruz, 1995; 1996.

INDONESIA
SABAH
Medan
Padang
SUMATRA
BORNEO
Balikpapan
SULAWESI
Manado
Ternate
Sorong
Fakfak
Ambon
IRIAN
JAYA
Telukbetung
Jakarta
JAVA
Surabaya
Aru Is.
Dili
Legend
Live Food Fish Collection Sites
Aquarium Fish Collection Sites
International Airports

one-third of aquarium fish exporters were also dealing in food fish species. By the mid-1980s the trade was so profitable that the industry began shipping the most valuable live fish by air, even though shippers had to pay the freight for about three liters of seawater for each kg of fish.

Groupers are easily overfished no matter what methods are used. Because many groupers and other target species for the live food fish trade are often slow-growing and long-lived, they are vulnerable to anything but low levels of fishing pressure. They also often aggregate to spawn at well-defined times and places, making them easy targets for overfishing.[88] The growing use of cyanide significantly increases groupers' existing vulnerability to over-exploitation.

As fishermen depleted stocks of target food fish species in the Philippines, the industry opened new areas in neighboring countries. In 1984, one Hong Kong company opened operations in Palau, the nearest Pacific island group; by 1989 numerous companies were moving into Indonesia, and by 1992 several firms were operating in Papua New Guinea. In 1993, several companies began operating in the waters of Australia's Great Barrier Reef. In 1994, two companies set up shop in the Solomon Islands, with licenses reportedly granted without the knowledge of the Fisheries Department. Hong Kong fishing firms no longer have a monopoly on this lucrative, expanding food fish trade. Companies from Taiwan, Singapore, Malaysia, and China are all now operating in the region as well.

In the past few years, cyanide-fishing has been reported from Cambodia, the Maldives, Sabah (Malaysia), Thailand, and Vietnam. Emerging live fish industries in the Red Sea (Eritrea) and Tanzania are also suspected of possible cyanide use. Expansion has been particularly dramatic in Indonesia, where recent estimates show the country supplying more than 50 percent of the 20,000-25,000 metric-ton volume of the live food fish trade in the region—one report puts the total for Indonesia alone as high as 20,000 metric tons.[89]

Economics of the Live Fish Trade

Production: Conservative estimates of the annual volume of fish traded in Southeast Asia for the live food fish market range between 20,000 and 25,000 metric tons, more than half of which comes directly from the wild; much of the remainder comes from aquaculture operations that rely on the capture of wild juveniles.[90] The total volume of harvested wild fish is certainly far greater, however, for several reasons:

- An unknown but probably significant percentage of cyanide-caught fish die before they reach the market.
- Domestic consumption in countries with significant overseas Chinese populations is growing as urban centers in major reef countries—such as Jakarta, Medan, Surabaya, Manila, and Cebu—grow in size and affluence.
- It is a big ocean, and monitoring and record-keeping in most source countries are sporadic and ineffective. Indonesia, for example, keeps no official records for the live fish trade,[91] and Hong Kong just began to keep records in June 1996.[92]
- Many vessels operate clandestinely or under protection of corrupt officials and do not report their catches at all. Between 1986 and 1993, one Philippine coast guard station monitored 1,671 intrusions by Taiwanese vessels, some of which were reportedly

engaged in cyanide fishing. Hong Kong, Singaporean, Korean, and Japanese boats, some using cyanide, are also reported to be poaching in the nation's seas. In April 1995, several Chinese boats using cyanide were apprehended in a part of the Spratly Islands claimed by the Philippines.[93]

Operating with few restrictions, the live food fish trade follows a classic boom and bust cycle. Although the Philippines still exported about 2.1 million kg of live food fish and a similar volume of aquarium fish in 1996, this figure was down from an aggregate figure of nearly 7 million kg in 1995.[94] Bigger players in the international trade appear to view the Philippines as "fished out" and to have moved to other countries such as Indonesia—which is currently the source of as much as 75 percent of the international trade—and more recently to the reefs of Papua New Guinea, the Solomon Islands, and the Maldives. Depletion of target species is so rapid, though, that even some areas of newly exploited Indonesia appear to be exhausted already.

The value of the live food fish catch is very high. In 1996, several particularly large giant groupers (*Epinephelus lanceolatus*) sold in Hong Kong for nearly $11,000 each.[95] Live napoleon wrasse and highfin grouper—the most favored species—command wholesale prices of $60 to more than $90 per kg. Coral trout fetch $40-60 per kg wholesale and several other grouper species fetch $20-40 per kg. Retail prices are higher still. In restaurants, an optimally sized napoleon wrasse sells for up to $182 per kg; that species' lips—considered a particular delicacy—were selling in mid-1995 in some Hong Kong restaurants for as much as $225 *per plate*. One 40-kg napoleon wrasse may sell for as much as $5,000, $425 for the lips alone.[96] At those prices, the 8 tons of napoleon wrasse aboard the *Morning Sun*, described in Chapter One, would be worth $1 million.

If one conservatively assumes that the average wholesale price for all live food species caught on Southeast Asia's coral reefs is $40 per kg and that 15,000 metric tons are caught wild each year, the wholesale aggregate value of the food fish trade amounts to at least $600 million annually, and its retail value reaches more than $1 billion.[97] The aquarium fish trade adds an annual retail value of around $170 million.[98] Therefore, we estimate that the Southeast Asian live fish industry has an annual retail value of at least $1.2 billion.

Demand: Consumer demand for live food fish continues to rise. Most live reef fish are imported into Hong Kong, but the wealthy Chinese elites of Southeast Asia's "tiger" economies such as Indonesia, Thailand, Malaysia, and the Philippines demand their own "status fish" to complement more conventional symbols of success. "Along with a Rolex and BMW, one can signal that one has 'arrived' by eating very highly priced fish in public."[99]

China's booming economy has created additional demand for luxury live fish in recent years, although data on Chinese imports and consumption remain sketchy. Because China levies high import duties on fisheries products, a growing volume of live reef fish are routed to China through Hong Kong. In the 1980s, Hong Kong consumed all of the live fish it imported. By 1992, however, 25 percent of Hong Kong's live fish imports were re-exported to China, and currently more than one-third (5,000 tons annually or about 5-6 million premium-sized fish) of these fish are consumed in China. In addition, it is likely that large additional volumes are moving into China unrecorded. If China's current high rate of economic growth continues, consumer demand for imported live reef fish is expected to soar. Indeed, many Hong Kong live fish restauranteurs are expanding into southern China.

Unfortunately, consumers of live reef fish show little concern for the environmental impacts of the live fish trade. According to one Hong Kong observer, when Indonesia announced restrictions on the export of napoleon wrasse, consumers sought them all the harder. "Being endangered actually seems to spur demand." The importers for their part disavow responsibility for the methods by which the fish are caught: "We the Hong Kong 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."[100]

Data do not exist to accurately determine what percentage of the fish in the live food fish trade are caught using cyanide. All evidence indicates, however, that the percentage is very high, with the exception of operations in Australian waters, where oversight is tight and cyanide is not used.

Even in the Philippines, where specialized laboratories are run for the government by the International Marinelife Alliance-Philippines (IMA) to conduct random tests on catches, and an anti-cyanide policy has been in place for a number of years, 739 out of

Box 2.2
Live Fish Export Statistics: How Many Fish?

The Philippines is currently the only country exporting live fish that keeps relatively complete records of the volume of exports. These figures are calculated and presented in terms of their *gross weight*—which includes the weight of the fish, water, and packing material. The actual percentage of gross weight comprising fish—*net weight*—varies between aquarium and food fish.

Aquarium fish are each shipped in a separate plastic bag, and the packing density is quite low. Thus, net weight is only about 3 percent of gross weight for aquarium fish. With food fish such as groupers, however, which fetch a much lower price per unit of weight, the high costs of air shipment have forced shippers to devise techniques allowing for much higher packing densities—primarily enriching the water with oxygen—and the net weight for food fish exports comprises about 40 percent of the gross weight.

Thus, while the Philippines exported roughly the same gross weight of aquarium and food fish in 1996, the net weight for aquarium fish was only about 7.5 percent of that for food fish. When, however, one looks at the number of individual aquarium and food fish exported, assuming that aquarium fish average 10 grams and food fish average about 1 kg, equivalent gross export weights means that 6.25 times more individual aquarium fish are exported than individual food fish.

Philippine Live Fish Exports, January-November 1996

	Gross weight of exports	net weight of exports	Average fish size	Number of individual fish exported
Aquarium	2,100,000 kg	63,000 kg	10 grams	6,300,000
Food	2,100,000 kg	840,000 kg	1 kilogram	840,000

Source: IMA and BFAR, 1997

3,950 samples (19 percent) still tested positive for cyanide in 1996, and the actual percentage of fish caught with cyanide is likely much higher: More than 90 percent of live fish vessels boarded at sea by enforcement authorities are found to be using cyanide.[101]

In countries without an anti-cyanide program, use of the poison is thought to be even more widespread. A recent study estimated that a stunning 320-640 tons of cyanide is used for fishing in Indonesia annually.[102] An informal survey sent out in 1996 by the World Wide Fund for Nature Indonesia Programme confirmed that cyanide fishing is widespread: 14 responses from around the country[103] suggested that the live reef fish trade is booming in all reef-rich areas of the country and in all cases is carried out almost exclusively with cyanide.[104] IMA's recent work in north Sulawesi suggests that virtually all the live food fish caught there are obtained with cyanide.[105]

Aquaculture and the Live Food Fish Trade[106]

Could fish farms provide an alternative to cyanide-fishing? About one-third of the export volume of live groupers in the Asian region comes from fish farms.[107] Almost all farm-raised groupers are raised from wild-caught juveniles (fingerlings). Grouper fingerlings are collected seasonally in countries throughout the region and sold to fish farmers who raise them to maturity in cages. Demand from fish farmers far outstrips fingerling supply, and grouper fingerling populations have already been depleted in some collection areas. Grouper aquaculture based on collection of wild fingerlings does not decrease pressure on wild stocks. To the contrary, it increases the pressure and is therefore unsustainable.[108]

Pressure on fingerling populations

Box 2.3
Estimated Annual Import of Live Food Fish into Hong Kong, 1996

Species	Tons	%
Leopard Coral Trout	5023	39%
Tiger Grouper	1853	14%
Spotted Coral Trout	1575	12%
Flower Cod	1197	9%
Green Grouper	495	4%
Hump-head Wrasse	367	3%
High-finned Grouper	191	2%
Green Wrasse	158	1%
Coral Trout	133	1%
Other Species	1926	15%
TOTAL	**12918**	**100%**

Source: Leung, 1996.

could be avoided if groupers could be raised from the egg. About ten species of grouper have been raised successfully from the egg over the past decade, mostly in Taiwan, but only two species have been successfully raised on a commercial scale and even in those cases the survival rate between hatching and the three-centimeter fingerling stage is only 1 to 10 percent. With adequate funding for research and development, commercially viable grouper-hatchery aquaculture will likely succeed, although not for some years to come. Currently, though, there is little practical information about the culture of the most valuable species, notably the napoleon wrasse. Indeed, little is known about the basic biology of this species, which is not farmed in large quantities due to difficulties in obtaining wild fingerlings.[109]

Another obstacle to substituting farm-raised groupers for wild ones is the widely reported preference of consumers in Hong Kong and other importing centers for the flavor of wild-caught live fish. In 1996, the U.S.-based Nature Conservancy conducted a blind "taste test" in which 100 leading gourmets were brought together for a series of fish taste comparison tests at three separate dinners in Shanghai, Hong Kong, and Taipei. Wild-caught malabar grouper (*Epinephelus malabaricus*) was blind-tested against farm-raised malabar grouper from two different hatcheries, and also against wild-caught coral trout (*Plectropomus leopardus*). Participants at the outset voiced their preference for wild-caught fish and claimed that they could tell the difference between wild-caught and farm-raised specimens. But the majority in all three test locations actually preferred the farmed malabar grouper over the wild-caught fish of the same species. On the other hand, the wild-caught coral trout ranked higher than either the wild-caught or farm-raised malabar grouper in all three tests. Unfortunately, coral trout—like the napoleon wrasse—is one of the species in highest demand and cannot at present be raised successfully in hatcheries.[110]

If technologies to breed the whole range of live food fish species at a commercially attractive cost level are developed, they will undoubtedly relieve pressure on wild stocks of some live food fish species. But aquaculture will not necessarily eliminate incentives for cyanide fishing, and the two should not be confused. The fact that a wealthy fish farmer is producing groupers by aquaculture will have no effect on the income of a poor cyanide fisherman. Experience with intensive brackish-water aquaculture in Southeast Asia indicates that the profits from intensive fish farming are captured by a small wealthy elite and are not widely shared in the surrounding community.[111]

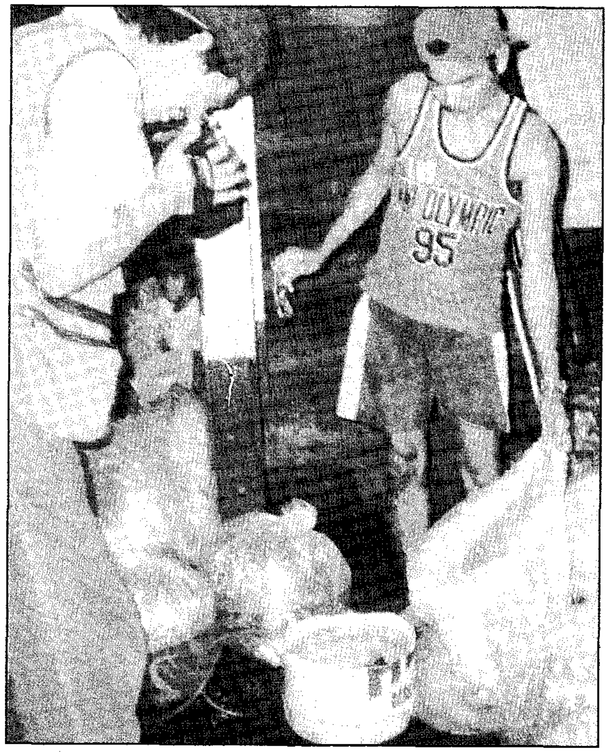
The Techniques and Technology of Cyanide Fishing

The basic technology of cyanide fishing includes a supply of cyanide (usually in tablet form), a squirt bottle with which to apply the poison, a collection net to hold captured fish, and an underwater breathing apparatus of some kind. In the early stages of cyanide fishing in a particular area, target species can be obtained in shallow waters and breathing apparatus is not so necessary. But divers soon need to go deeper as surface stocks are depleted, and most cyanide fishing is done with compressed air provided by a "hookah" apparatus in which breathing tubes run from a compressor on a small boat to the divers below.

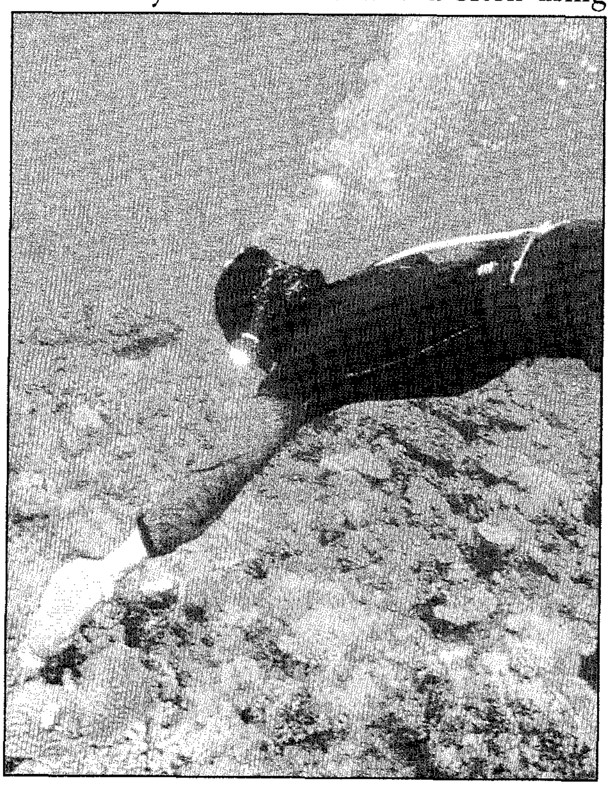
A typical cyanide diver will place approximately 100 grams of cyanide in the squirt bottle. One filling with water yields enough poison to catch about three commercial-size food fish. Catching aquarium fish requires greater amounts of cyanide than catching food fish.[112] Cyanide is relatively cheap (about four to six dollars per kg) and easy to obtain throughout the region from drugstores, Chinese traders' shops, and local industries such as electroplating shops. Often, fish-cage or boat owners supply the poison to divers on credit.[113] In the Philippines' Lingayan Gulf, divers noted that a special permit is required to purchase cyanide but that the exporters encouraged use of the poison and supplied it to them.[114] Some exporters describe the poison to prospective cyanide divers as "magic powder" or "medicine."[115]

Between 1991 and 1995, 29 million kg of cyanide was legally imported into the Philippines, 7 million kg in 1995 alone.[116] Obtaining the poison for illegal purposes is not very difficult.

Cyanide-fishing in the field is carried out in two types of operations. The first involves individuals or small groups working with locally modified boats and often using



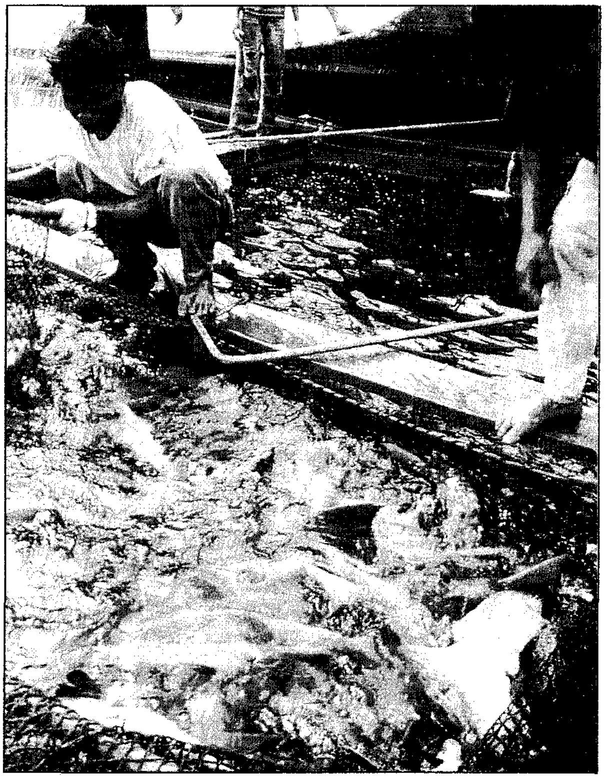
IMA Fisheries Officer inspecting ornamental fish shipment from the province of Romblon, Philippines.



Philippine fishermen squirting cyanide on reefs to capture ornamental fish.

equipment and cyanide loaned by middlemen. They tend to fish closer to ports and populated areas and use very basic diving equipment. In the second type of operation, well-organized teams of divers with better equipment (wetsuits, fins, breathing regulators) work off large live fish transport vessels (LFTVs) equipped with holding tanks sufficient for one to two tons or more of live fish. These large vessels can range much further than the small boats and are the ones targeting the more remote reefs of eastern Indonesia and the western Pacific. First reported in the Philippines in the early 1980s by Robinson (1986), these larger vessels apparently do not operate in Philippine waters any more but are widely used in eastern Indonesia.

Both types of operators typically deposit the catch at central collection points where the fish are stored in cages. The fish are then



Live food fish holding cages in Indonesia.

transferred to even larger transport vessels — such as the *Morning Sun* described in Chapter One—or flown out by air cargo plane.

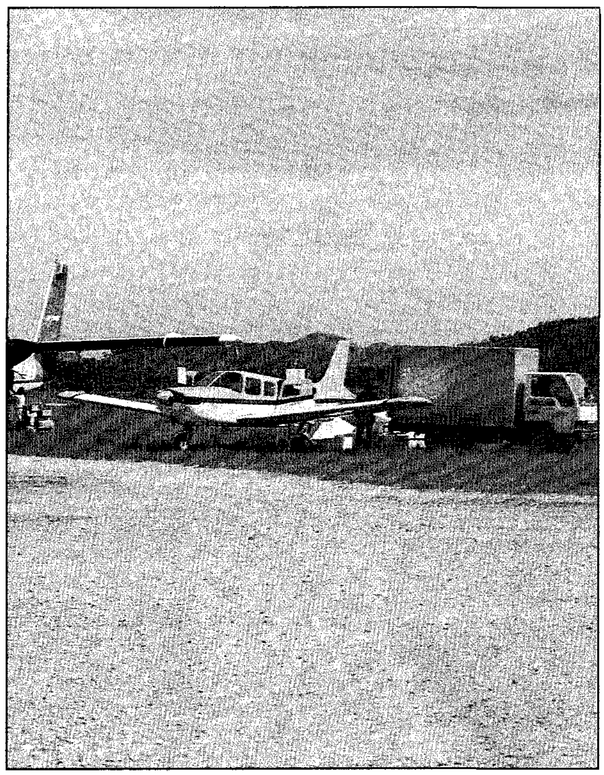
Air shipment typically takes place in several stages. Fish brought into the collection center at Coron in the Philippines' Palawan province are flown first to Manila in styrofoam coolers and then are transferred to holding tanks near the airport to recover from the stress of the journey. Several days later, the fish are flown out to Hong Kong. Bali serves as an important air transhipment point for fish from eastern Indonesia, with 10 air cargo firms involved in the trade there in 1995.[117]

There are few reliable data on the relative amounts of fish being transported by air and sea. One study notes a general trend toward air shipments,[118] while others report that LFTVs carry a great deal of the catch from eastern Indonesia.[119]

The Political Economy of Cyanide Fishing

The cyanide-based live fish trade in Southeast Asia is similar to the trade in illegal drugs. It is technically illegal, large amounts of money are at stake, the system is abetted by corrupt civilian and military officials, and it takes advantage of poor rural workers for whom the profits from the trade are irresistible. Market delivery routes are circuitous and varied and take advantage of the difficulties inherent in policing vast areas of the ocean and porous ports and borders.

The wealthy consumers of the product like narcotics addicts have little knowledge about or concern for the damage that their habit wreaks on individuals, national economies, or the marine ecosystem. It is, in short, a political economy of greed, poverty, corruption, and unrelenting consumer demand, and



Live groupers being shipped by chartered plane from Coron, Northern Palawan to Manila.

the difficulties in stopping it should not be underestimated. Like the illegal drug business, it is unlikely that cyanide-fishing can ever be totally stamped out as long as the demand continues, entrepreneurs stand ready to fill that demand, and fishermen are willing to provide the labor and take the risks.

Nevertheless, there is also a significant difference between the drug and cyanide-caught fish trades. With live fish, it is not the product that is detrimental but the technology used to obtain it. There are few advocates for stamping out the live fish trade in the way that most governments vow to eradicate the trade in illicit drugs. The need, rather, is to eliminate the destructive collecting techniques, ensure that harvesting remains at sustainable levels, and ensure that the fisherman receive a fair return for their effort.

Experience during the past five years in the Philippines shows that cyanide fishing can be reduced through a combination of the right policies and laws, beefed-up enforcement efforts, enhanced public awareness, cyanide testing of live fish exports, and development of sustainable community-based resource management and livelihood alternatives that transform local fishermen into the front line of marine stewards and protectors. Despite some flaws, the Philippines' approach contains valuable lessons for other countries of the region as they struggle to confront the rising tide of poison engulfing their coral reefs.

III

Combating Cyanide Fishing in the Philippines

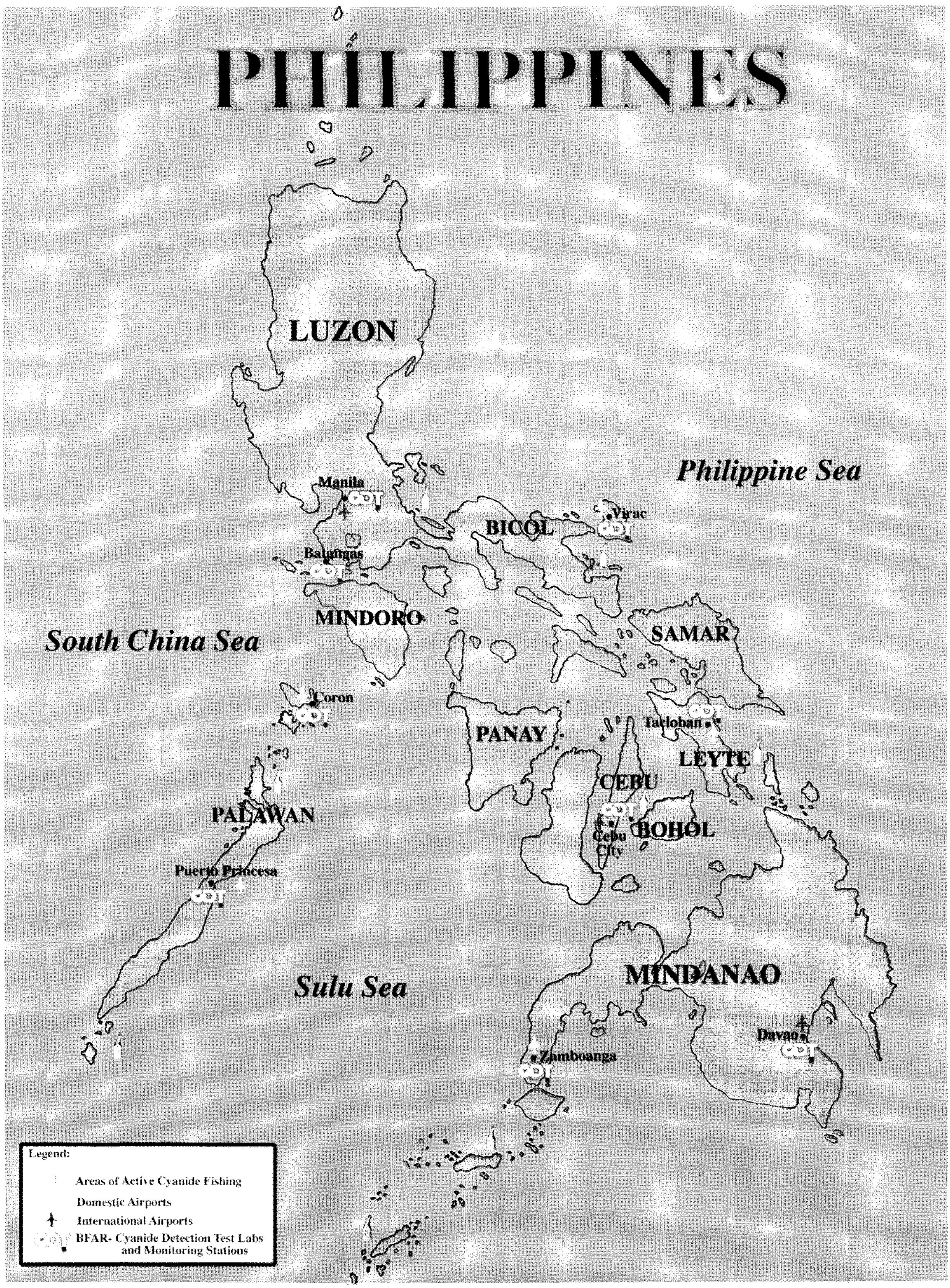
- Status and importance of Philippine marine resources
- Cyanide fishing and the Philippines live fish trade in the 1990s
- Anti-cyanide policies, 1975-1990
- The Cyanide Fishing Reform Program

Status and Importance of Philippine Marine Resources

The nearshore waters and reefs of the Philippines are among the biologically richest on the planet, with 381 coral species, 1,831 fish species and 538 mollusk species known to science. Many undescribed reef species, especially among the invertebrates, are thought to exist as well.[120] The Philippines has experienced catastrophic destruction of its coastal resources during the past several decades. A recent biodiversity country study concluded that with only 5 percent of the country's reefs considered to be in excellent condition, 30-50 percent of its seagrass beds lost in the past 50 years, and about 80 percent of its mangroves destroyed in the past 75 years, it is even "difficult to define an undisturbed ecosystem or habitat that could serve as a standard against which to measure degree of disturbance and rates of change."[121]

Immediate causes of this disaster include runoff impacts of widespread deforestation, mining, and industrial agriculture; over-exploitation of fish stocks by an over-capitalized commercial fleet; the widespread use of cyanide and other destructive fishing gears and techniques (such as small-mesh nets and explosives); haphazard coastal tourism development; and the migration to the coast of great numbers of farmers uprooted by deforestation, land degradation, natural disasters, and the loss of access to land to commercial interests.[122]

The results of marine degradation are felt most acutely in the country's coastal communities, virtually all of which rely to some degree on the sea for their livelihoods. Some 59 percent of the country's population—and ten of its largest cities—lie in the coastal zone.[123] More than 1 million people are directly employed in the fisheries sector, 68


PHILIPPINES
LUZON
Philippine Sea
Manila
Virac
BICOL
Batangas
MINDORO
SAMAR
South China Sea
Coron
Tacloban
PANAY
LEYTE
CEBU
PALAWAN
BOHOL
Cebu City
Puerto Princesa
MINDANAO
Sulu Sea
Davao
Zamboanga
Legend:
Areas of Active Cyanide Fishing
Domestic Airports
International Airports
BFAR- Cyanide Detection Test Labs and Monitoring Stations

percent of them working in small-scale fisheries. Fish is a key staple food, with annual consumption estimated at nearly 40 kg, one of the highest rates in the world. Fish provide the country's people with about 70 percent of their animal protein intake and 30 percent of total protein intake.[124]

Fishing communities are among the poorest in the country. Many poorer fisherfolk use the traditional paddled *banca* (canoe) and fish with a simple hook and line. In addition to managing the household, women generally process and sell the catch, and go out gleaning with their children on reefs and mangroves. Such families, with an average of 6 children, are likely to live in a thatch hut, or in a makeshift lean-to in more urban areas. Running water is rare, and electricity is found only in homes nearer to urban centers. Most fishing families are usually in debt to a local moneylender on whom they must also rely for services the local government does not supply (such as fish catch refrigeration).[125]

The livelihood of poorer fishing families has deteriorated during the past few decades. Fish catches are at one-fifth their post-World War II levels; the fish are smaller and of poorer quality; and the fishermen have to travel much further to get them, increasing their costs and limiting time available for other jobs. Migration to the coasts by landless peasants has swelled populations and increased competition for employment outside the fisheries sector. Industrialization and land conversion in some areas have displaced fishing families, sometimes by force. At the same time, poorer fishermen must compete with growing fleets of highly capitalized foreign or elite-owned fishing vessels.[126] In such dire straits, it is not surprising that many fishermen have succumbed to the lure of the relatively big money to be made in cyanide fishing, despite the dangers that the practice poses to their health and to the source of their livelihood the reef.

Cyanide Fishing and the Philippines Live Fish Trade in the 1990s

The Philippines was the birthplace of cyanide fishing, initially for the aquarium trade in the 1960s and increasingly for the live food fish trade in the 1980s. By the early 1990s, the trade was well established, dominating some local economies and reaching to virtually all of the richest reefs in the country.

Certain factors have predisposed the Philippines to the cyanide fishing industry. First, the use of cyanide has become a tradition in many communities, handed down from generation to generation. Second, the poverty of many coastal areas—exacerbated by declining fish stocks and a lack of alternative livelihood opportunities—makes the quick cash from cyanide fishing irresistible to many fishermen. Third, the Philippines lies close to Hong Kong, the main market for live food fish. Fourth, the insurgencies of the past several decades (communist and Muslim separatist), repression and economic mismanagement during the Marcos era (ending in 1986), and a long-standing tradition of local political strongmen that verges in some areas on warlordism have left a legacy of weak and corrupt government institutions. These institutions, particularly at the local level, are often dominated or controlled by predatory business interests such as cyanide fishing enterprises.[127] As Magno concludes, the root of the state's "intrinsic incapacity" to "pursue its 'constitutional' mandate to provide a healthy ecology for its citizenry is the fact that its institutions are captive to private interests."[128]

Against this background, an army of at least 4,000 hard core cyanide divers squirt at least 65 tons of cyanide—and possibly much more[129]—onto vast areas of Philippine coral reef every year.[130] Some 7,000 tons of cyanide per year are imported legally into the country by 20 companies, ostensibly all for use in gold and silver mining, electroplating, and other industries. Although the cyanide-fishing frontier has moved on to neighboring countries, the Philippines still exported 2.1 million kg (gross weight) of food fish to Hong Kong during the first eleven months of 1996, with a wholesale value of approximately $33.6 million. In that same period, about the same gross volume of aquarium fish, with a wholesale value of about $31.5 million, was exported to Europe and the United States.[131] These figures represent a decrease from 1995 of 46 percent for food fish and 27 percent for aquarium fish.[132]

Declining stocks of target species are surely one reason for this reduction: as already noted, many members of the live fish industry consider the Philippines to be "fished out" and have focused their energies on Indonesia and other "new frontiers." But the steps taken by the government during the past five years or so to regulate the live fish trade and suppress the use of cyanide are also an important part of the explanation.

Anti-Cyanide Policies, 1975-1990

Cyanide fishing has been illegal in the Philippines for more than two decades. Presidential Decree 704 of 1975 (PD 704), the basic law governing fisheries, clearly prohibits cyanide fishing, possession of cyanide on boats, and selling of cyanide-caught fish, and prescribes heavy penalties.

The Local Government Code of 1991, which gives considerable power over local fisheries to municipalities, directs municipal governments to enact ordinances prohibiting cyanide fishing within municipal waters (those up to 15 km from shore) and grants municipal governments the authority to prosecute violations under the applicable laws.[133]

Despite this strong legal basis for stopping cyanide fishing, enforcement has until recently been sporadic. As a result, cyanide fishing has grown exponentially during the two decades since it was clearly outlawed. A number of factors are to blame.

Characteristics of the live fish trade: As already noted, many fishing communities are extremely poor; cyanide fishing offers profitable incomes; cyanide-fishing technology is easy to obtain; demand for live fish has continuously increased; and the Philippines is close to the major markets in Hong Kong and southern China.

Characteristics and capacities of the Philippine state: During the reign of Ferdinand Marcos, "crony capitalism" and corruption flourished.[134] Many in government, from local police to high Manila officials, could be easily bribed to look the other way or to drop a case. These problems diminished after Marcos's fall but they have not disappeared, especially at provincial and local levels. As Broad and Cavanagh explain:

> The Philippine government...is a mixed bag. Some officials are corrupt and beholden to the plunderers of natural resources. Others—particularly local officials—are often simply poor and hence easily susceptible to bribery. Still other government employees are genuinely honest and sincerely strive to do their bureaucratic job as best they can. Given that mix, governments face severe limits on their ability to halt resource destruction.[135]

Even when officials are honest and dedicated to stopping cyanide-fishing, the state's capacity to monitor fishing grounds and transportation routes is extremely limited. The 1996 enforcement budget of the Bureau of Fisheries and Aquatic Resources (BFAR) was a mere $250,500, and illegal fishing ranks only ninth in the Navy's order of priorities. Provincial Coast Guard stations are grossly undermanned and underequipped.

Box 3.1
Basic Provisions Banning Cyanide Fishing in the Philippines

It shall be unlawful for any person to catch, take or gather or cause to be caught, taken or gathered fish or fishery/aquatic products in Philippine waters with the use of....obnoxious or poisonous substance.... [Although there is an exception for duly approved research, educational, or scientific purposes.]

It shall, likewise, be unlawful for any person knowingly to possess, deal in, sell, or in any manner dispose of, for profit, any fish or fishery/aquatic products which have been illegally caught or gathered.

The discovery of...obnoxious or poisonous substance...in any fishing boat or in the possession of a fisherman shall constitute a presumption that the same [was] used for fishing in violation of this Decree, and the discovery in any fishing boat of fight caught or killed by the use of....obnoxious or poisonous substances....shall constitute a presumption that the owner, operator, or fisherman was fishing with the use of....obnoxious or poisonous substances...

[I]llegal fishing shall be punished....by imprisonment from eight (8) to ten (10) years, if obnoxious or poisonous substances are used: Provided, that if the use of such substances results in 1) physical injury to any person, the penalty shall be imprisonment from ten (10) to twelve (12) years or 2) in the loss of human life, then the penalty shall be imprisonment from twenty (20) years to life, or death.

[Dealing in illegally-caught fish or fishery/aquatic products].... shall be punished by....imprisonment from five (5) to ten (10) years.

Source: Articles 33 and 38, Presidential Decree No. 704 Revising and Consolidating All Laws and Decrees Affecting Fishing and Fisheries, Republic of the Philippines (1975).

The Inside Story, a popular television program, revealed in 1995 that the Coast Guard station in the province of Batangas, less than 80 km from Manila, had no government-issued motorized boat for patrol operations. The same is true for dozens of other districts. As a result, BFAR has had to use its own scarce resources for purchase of motorized *bancas* to provide local authorities with a minimal level of mobility at sea.

Export promotion policies: Although cyanide fishing is clearly illegal, state policy also aggressively promotes expansion of fisheries exports. PD 704 states, for example, that the government shall "encourage and promote the exportation of fish and fishery/aquatic products..." Given the high value of the live fish trade, this provision creates a potential political obstacle to firm action against live fish exporters if they are not conclusively proven to have been using cyanide.

Ambivalent policies regarding community-based natural resources management: Local communities will only conserve and protect resources if they have appropriate incentives to do so—such as property and management rights over reefs and fisheries—and Philippine policies are the most supportive of community-based resource management in Southeast Asia.[136] But at the same time, the Constitution of 1987, continuing a tradition stretching back to the Spanish colonial period, places all natural resources, including fisheries, under state ownership.[137] Because the state lacks even the most rudimentary capacities to manage and regulate private access to its vast territorial seas (27,000 km^2 of which are coral reefs), the nation's coral reefs have become a *de factó* "open access" resource. Local communities therefore have had little legal or economic incentive to conserve reef areas because they have no right to exclude others from or to appropriate the benefits of their local reefs.

Lack of a reliable method for determining the presence of cyanide in live fish: It was only in 1991 that a reliable procedure for testing live-caught fish for the presence of cyanide in their tissues was introduced in the Philippines as part of the Cyanide Fishing Reform Program, discussed below. Previously it was necessary to either catch cyanide fishermen in the act or discover cyanide tablets on board fishing boats, both actions requiring patrolling capacity that does not exist in the Philippines. Without this new testing procedure, there was no way to determine if fish had been caught with cyanide once they were in holding tanks or further along the trade route.

The Cyanide Fishing Reform Program

Beginning in 1985, a campaign by the International Marinelife Alliance (IMA) exposed the widespread misuse of cyanide in the Philippines and its role in supplying the growing demand for aquarium fish in North America.[138] Mincing few words, IMA exposed the ecological costs of the aquarium hobby and accused major industry players of turning a blind eye to—if not openly abetting the destruction of the Philippines' marine resources. IMA's strategy was to appeal to members of the pet industry, show them that they were ultimately losing out from the use of cyanide (because of bad publicity and high fish mortality) and, ultimately, galvanize them into a potent lobby group to reform the live fish trade.

In 1986, coinciding with the fall of the Marcos regime and the new administration of President Corazon Aquino, IMA-Philippines registered as a new Philippine NGO and launched a parallel initiative to bring the cyanide fishing problem into the mainstream of Philippine national consciousness. This public awareness campaign helped win the support of the Aquino administration. During the next six years, IMA and the Bureau of Fisheries and Aquatic Resources (BFAR, within the Department of Agriculture) cooperated to achieve the following results:

- Use of fine-mesh nets for aquarium fish collecting was legalized, thus providing fishermen a true alternative to cyanide;
- A pool of trainers to teach fishermen the cyanide-free live-fishing tradition was organized;
- Net-skills training programs were conducted;
- Alternative livelihood programs for cyanide fishermen and their families were created; and,
- A computerized test for detecting the presence of cyanide in fish tissues and organs was developed by IMA and the Bureau of Fisheries Aquatic Resources

(BFAR) and adopted by the government as an enforcement tool against cyanide-fishing.

Since the 1992 election of president Fidel Ramos, these steps have come together in the Cyanide Fishing Reform Program (CFRP), a partnership between IMA and BFAR. BFAR has adopted the CFRP as its master plan for combating cyanide fishing and provides funding for the laboratory, research, and inspection services carried out by IMA. All agencies sitting on the Presidential Committee on Anti-Illegal Fishing and Marine Conservation have endorsed the CFRP.

Since 1992, the CFRP has resulted in the following activities and outcomes:

Creating the Cyanide Detection Test (CDT) laboratory network: The first CDT lab was established near the Manila airport in 1992, and there are now five fully functional labs in operation at major live fish collection and shipment points throughout the country.[139] There are also CDT liaison and monitoring posts at three other major live fish trade transhipment points.[140] The IMA-managed labs conduct inspection, random sampling, testing and monitoring activities under a grant of authority from BFAR.

Since 1992, the CDT labs have tested more than 6,000 samples of marine products from more than 100 different species. The testing has resulted in the filing of more than 55 court cases for cyanide fishing in five provinces, and gained the support of all major law enforcement agencies. The labs also double as testing centers for dynamited and formalin-laced fish.[141]

The capacity of the CDT network is rapidly expanding: 3,920 of the 6,000+ samples tested since the network was established were tested during 1996, and the geographic reach of the labs was broadened with the 1996 opening of the three monitoring stations. Samples tested in 1996 came from 15 provinces located throughout the country, representing thousands of tons of live fish shipments randomly sampled and tested.

The labs are also involved in research on the effects of cyanide on fish and have entered into a cooperative agreement with scientists at the University of Hong Kong who are interested in determining aging data and breeding cycles of groupers through tests on their gonads and otoliths (ear bones).[142] Results of this research will be useful in identifying the appropriate periods to declare closed seasons for grouper fishing to protect the breeding cycle.

Finally, CDT lab staff conduct workshops on monitoring, inspection, and sampling of live reef fish for fish wardens and local government officials. The purpose is to improve the quality of samples collected during inspections and to familiarize officials with the testing procedures, thereby improving efficiency.

Establishing Monitoring, Inspection, and Sampling (MIS) teams: Working closely with the CDT lab network, MIS teams carry out sampling activities and monitor the national live reef fish trade, collecting data at all major transhipment centers throughout the country. The statistical records they produce are the only ones available in the Philippines; and they allow BFAR to get an idea of the size and composition of the live fish trade. This monitoring network provides the government with the eyes, ears, and data it needs to effectively regulate the trade, and it complements the testing work done by the CDT labs.

Strengthening the legal basis for regulating the live fish trade: In consultation with IMA, BFAR developed a Fisheries Administrative Order that comprehensively regulates the export of live reef fish from the Philippines.[143] Under this order, to be issued at the end of 1997, all prospective exporters must be inspected by and registered with BFAR prior to seeking export permits. The company must keep records of the number

Box 3.2
The Cyanide Detection Test

The Cyanide Detection Test (CDT) being used in the Philippines was developed in 1991 by IMA, BFAR, and a private analytical-testing laboratory in the United States. While testing procedures for determining the presence of cyanide in water and other solutions were well established, no reliable procedure existed at the time for determining the presence and level of cyanide in animal tissue. To overcome this problem, the CDT procedure combines an accepted procedure of the American Society for Testing of Materials with Standard Methods for the Examination of Water and Wastewater.

Fish samples are first identified and examined externally (for damage from hooks, nets, or spears) and internally (for stomach contents and any visible abnormalities). Because cyanide is rapidly absorbed in the internal organs (such as the brain, liver, and intestines), these tissues are removed from larger fish for testing, while the whole specimen is used with smaller aquarium fish. The sample is then weighed, blended, and digested in a strong acid solution in the presence of a catalyst in a one-hour reflux distillation. Other reagents, such as sulphamic acid and lead carbonate, are added to eliminate nitrate/nitrite and sulfide interferences, respectively. If cyanide is present in the sample, it is liberated as hydrogen cyanide and absorbed into a sodium hydroxide solution.

The second part of the procedure uses Ion-Selective Electrode (ISE) with cyanide-specific probe to detect the presence of cyanide in the absorber solution. If cyanide ions (CN-) are present, numeric readout is reflected by the meter. The cyanide concentration present in the fish tissues are reported in parts per million.

Equipment necessary to establish a CDT laboratory managed by IMA costs approximately $75,000. Each laboratory is run by a licensed chemist, two laboratory technicians, a fisheries biologist, and two or three fisheries officers as well as administrative managers for records and operations and a utility person. The labs are each capable of running at least 30 tests per day. Each test takes approximately 2 hours, including preparation of the sample, distillation, and reading of the results.

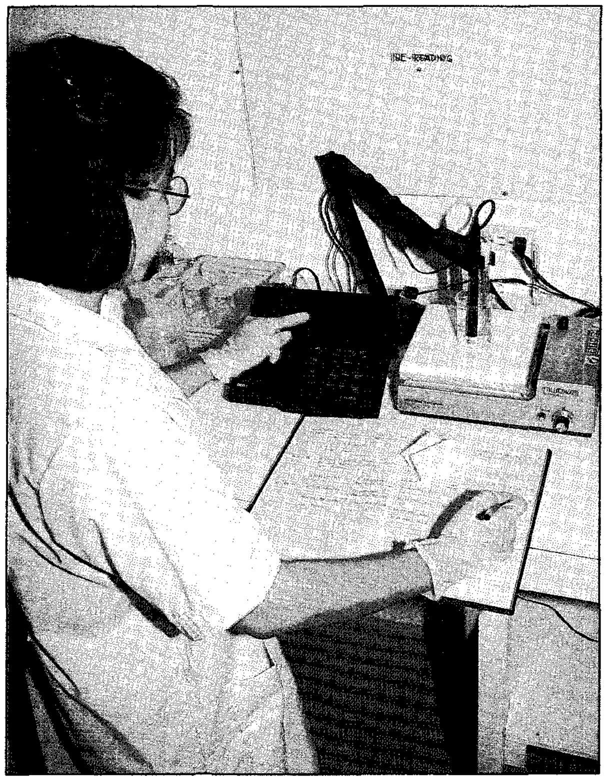
Source: IMA, 1995.

and species of fish they seek to export, and all shipments awaiting export must be randomly tested for cyanide by one of the CDT labs and declared cyanide free by BFAR. A minimum of 1 per 50 food fish and 5 per 100 aquarium fish must be collected for testing. Shipments found to be contaminated are subject to immediate confiscation, and repeat offenders are subject to losing their export licenses and to existing criminal penalties for the use of cyanide.

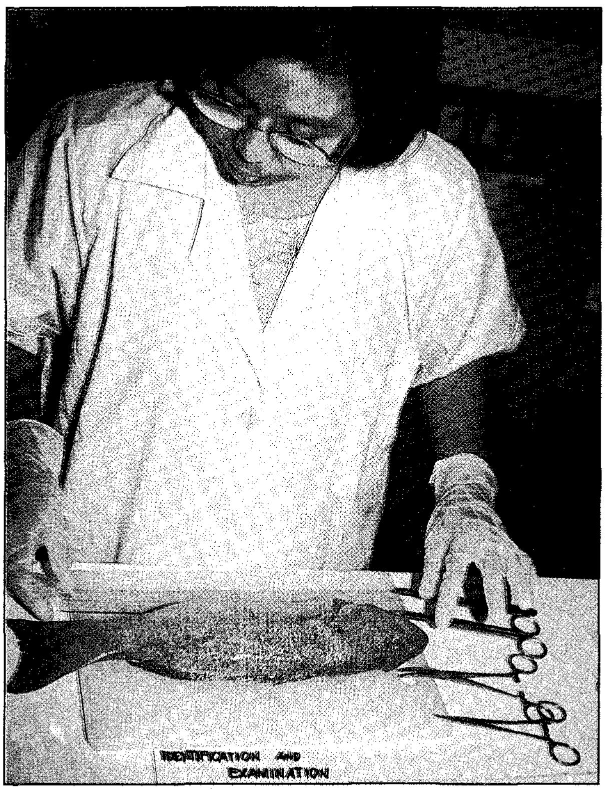
The new order makes all live reef fish exports subject to mandatory CDT testing under clear and systematic procedures.

Unscrupulous exporters will still be able to evade the system by illegally shipping fish directly to Hong Kong from remote areas, thereby bypassing ports and collection centers, but stepped-up collaboration with the Hong Kong authorities, noted below, should diminish such abuses.

In 1996, a draft "Sodium Cyanide Act"[144] that would strictly regulate the import and use of cyanide was also introduced in the Philippine House of Representatives. The draft bill requires all cyanide imports to be authorized in advance by the government and requires the poison's sale to be "strictly controlled." Control elements include requirements for traders and end-users to seek authorization from the Department of Environment and Natural Resources (DENR) to purchase, distribute, or use cyanide and to file weekly reports on the sale or use of the substance. Both traders and buyers would be subject to spot checks by the government. Penalties under the act are stiff, with prison terms for unauthorized possession or importation of cyanide ranging from six to 12 years and fines set at a minimum of $10,000.



CDT chemist analyzes distillate reading using the Ion Selective Electrode (ISE) method.



CDT lab technician examines and identifies fish submitted for cyanide testing.

While this draft law would undoubtedly be difficult to enforce, it should have the effect of driving up the price of cyanide on the black market, thus making nondestructive techniques of live fish capture more economically attractive to fishermen currently using cyanide.

Stepping up enforcement and prosecution: The CFRP has resulted in an increase of cases brought to court against companies trafficking in cyanide-caught fish. During 1996, 23 court cases were filed based on CDT tests, and there are currently a total of 50 cases pending in courts throughout the country. Although few people are actually serving prison time for their involvement in cyanide fishing (12 in 1996), the threat of confiscation may be nearly as potent.

A case from Palawan illustrates why. Concerned about cyanide fishing, in 1993 the Palawan provincial government enacted a five-year ban on live fish exports from the province. In June of 1994, a local middleman supplying live groupers to the Palawan-based Seaworld Commercial Trading Company sought a special exemption to deal in and export groupers to Hong Kong from the province's governor. The governor acceded, on the condition that the fish be tested by the Palawan CDT. When CDT staff and a government officer collected samples, they tested positive for cyanide. The middleman demanded a second test, to be carried out in the presence of his representative. The new test was also positive, and the live groupers in the middleman's fish cages—40 tons, with an estimated value of $4 million—were held by the government for months, until the charges were dropped on a legal technicality. But by this time most of the fish had died, and both the middleman and the exporter lost a great deal of money, the middleman almost going out of business as a result.

Training Fishermen in Cyanide-Free Fishing Technologies and Value-Added Sustainable Production Activities: The central element of the CFRP is training and education for the fishermen currently using cyanide. When fishermen are presented with effective cyanide free technologies for capturing live food and aquarium fish—and given greater awareness about the legal, health, and ecological risks of cyanide fishing—many choose to convert to cyanide free techniques. In addition, when fishing communities are helped to add value to other kinds of local production, such as fresh and dried fish and nonfisheries activities, their incentives for engaging in cyanide fishing are reduced.

BFAR-CDT and local fishery agents conduct joint inspection of reef fish being shipped out of Puerto Princesa City, Palawan - where a ban on the commerce in live reef fish is being strictly enforced.

A typical one-week local training program targets 20-30 fishermen who are currently using cyanide to catch either live food or aquarium fish and have developed an interest, albeit through IMA awareness activities or their own their own experiences, in learning cyanide-free techniques. Initially, three-day on land "classroom" sessions provide lectures and discussions concerning the arguments in favor of cyanide-free fishing, cyanide-free technologies, post-harvest management of catches, cooperative marketing and other strategies for adding fisheries production value, and safe diving techniques.

These sessions are specialized to address specific types of live fish capture. Fishermen who primarily collect aquarium species are trained in the use of fine-mesh barrier nets.[145] Fishermen for whom food fish are the target species are trained in hook-and-line techniques for capturing groupers and, importantly, simple techniques for decompressing the air bladders of captured fish to ensure their post-harvest survival and health. Because particular grouper species favor distinctive bait sizes and shapes, bait preparation is a key part of the hook-and-line training as well.

Following the "classroom" sessions, the fishermen and trainers carry out four days of in-water training in either net or hook-and-line techniques. The intensive one-week training is followed by a three-week follow-up period of monitoring by the trainers to ensure that trainees have mastered fishing techniques and proper post-harvest care. Other activities, such as organizing local fishing associations and cooperatives and developing value-added livelihood activities, take more time and involve periodic follow-up participation by the trainers over months or years.

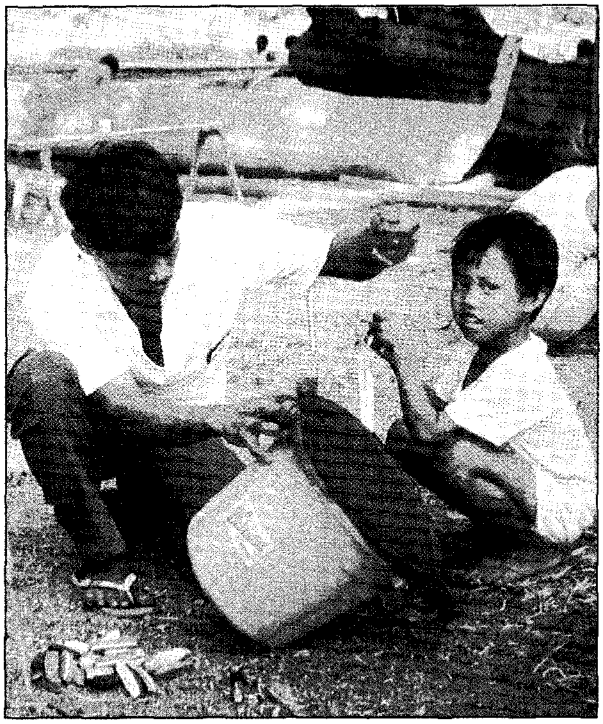
Using this basic model, IMA has trained over 2,000 fishermen in more than 10 provinces during the past decade. Staff have focused strong training efforts on Palawan province, a major cyanide-fishing center. In 1997, IMA expanded training programs to many new areas and now operates such programs in five major cyanide-using regions. IMA has also initiated the first Indonesian training program, in North Sulawesi province, in collaboration with a local organization. In addition to IMA's work, the Haribon Foundation, a Philippine NGO, has conducted a number of similar training programs for aquarium fish collectors.

Beyond training in cyanide-free fishing techniques, IMA works with communities to promote a variety of livelihood enhancement activities. Introduction of simple technologies can often add significant value to products that communities are already harvesting and selling. In communities where the capture and sale of tiny dried fish (*dilis*) is a common activity, for example, teaching simple techniques to spice the fish can raise their value by 40 percent. Where raw oysters are collected, teaching oyster sauce production methods adds considerable value to that product. In some communities, training programs promote nonfishery activities, such as soap making, tailoring, and handicrafts production. In short, the training program seeks to assist a larger socio-economic transformation of poor fishing communities towards a better standard of living based on sustainable resource use and capturing a larger share of the local profits for local benefit.

CFRP training will succeed only if both the central government and local governments units (which have considerable new authority over coastal areas under the 1991 Local Government Code) are fully mobilized in the effort, something which has only begun to happen.[146] Funding for CFRP training programs is also inadequate. IMA, for example, could train many more fishermen than it does if additional CFRP training funds were available.

Sustaining and expanding this on-the-ground training, month after month and year after year, is the key to stopping cyanide fishing. Unfortunately, the same governments, international aid agencies, foundations, and international NGOs that have expressed concern about cyanide fishing have not yet put their full weight behind such training programs. Ideally, these powerful entities would mobilize funding for a widely expanded training program in the Philippines and the establishment of similar programs in neighboring countries.

Promoting reform of live food fish import policy in Hong Kong: Because consumer demand in Hong Kong is driving the demand for live food fish, actions by the Hong Kong government need to complement CFRP activities in the Philippines (and other live food fish source countries.) Recently, local Hong Kong groups and individuals concerned about the impacts of cyanide fishing have been working with the Hong Kong government to raise its level of concern about the issue. With their help, the government has developed better data collection and monitoring procedures for imports of live fish and has committed to an action program to tackle cyanide fishing on the import and consumption side of the problem. Potential elements of the plan include a review and strengthening of relevant laws, establishment of a tracking system for all local vessels capturing live fish in the Philippines and Indonesia and all foreign vessels importing live fish into Hong Kong; improving the system for classifying fish imports; raising public and government official awareness; raising the cyanide fishing issue regionally in the Asia-Pacific Economic Cooperation (APEC) process, and working with governments of source countries to facilitate information exchange and the coordination of control measures.[147] A proposal to substantially increase the penalties for unauthorized cyanide possession is also under consideration.[148]



Entire family gets involved in making nets and other gears necessary to engage in the barrier net collection method.

IMA community development specialist interacts with cyanide fishermen to build goodwill and win their trust.

Box 3.3
Toward a Cyanide-Free Fishing Tradition on Canipo Island

Canipo Island is located in the Calamianes group of islands in the north of Palawan province. The area has been a traditional fishing ground for live grouper collection, especially the high-priced spotted coral trout (*Plectropomus leopardus*). For years, hundreds of fishermen used sodium cyanide to collect groupers. In 1993, however, a local businessman engaged in live grouper collection started a cooperative called Kawil Amianam — Filipino for hook-and-line collecting. The group used the traditional hook-and-line but also developed a method for decompressing the air bladders of the captured fish with the use of sharp plastic lollipop sticks.

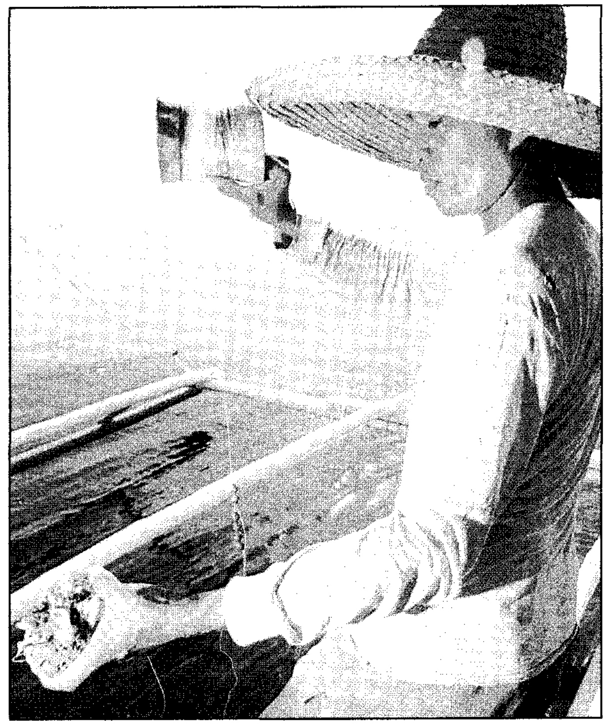
More than 400 fishermen in the area have since soon joined Kawil. Common reasons cited include: the credibility of the Cyanide fishing Reform Program (which was introduced in the area in 1994); pressure from their peers who have already joined the group; and, Kawil Amianan's success in destroying the myth that groupers cannot be caught live with hook-and-line. In 1994, the Kawil fishermen began having samples of their catch tested by the CDT lab in Manila, with assistance from the CDT liaison office in Coron. Fish sampled by the liaison office were sent to Manila by air and tested. The results (in the form of a certification that the tested fish was either cyanide-positive or cyanide-free) were returned to the Kawil members within 36 hours, so as not to unduly interfere with shipping of the catch.

In 1995, IMA started working with Kawil to train more fishermen in the area and to assist in modifying the bladder-decompression technique. Improvement comes in the form of replacing the sharpened plastic lollipop sticks with less stressful large-gauge hypodermic needles. The Kawil hook-and-line and decompression technique is also being popularized in other areas of the country via training programs. Sampling and testing of Kawil's catch has continued for the past two years, and the test results indicate that virtually all members of the group are satisfied with the hook-and-line method and have not reverted to cyanide use.

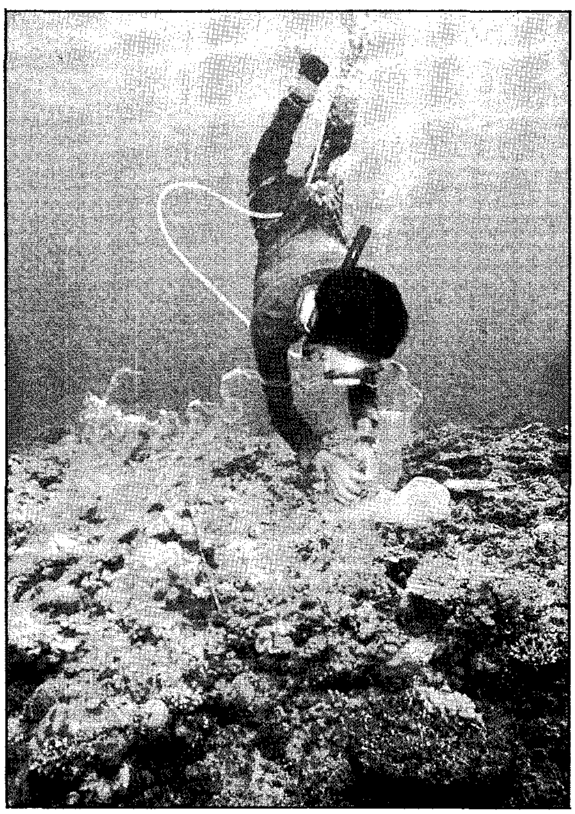
Major reasons for the success of the cyanide reform effort in the Canipo area can be attributed to: 1) dedication and persuasiveness of the Kawil Amianan leadership; 2) the fact that fishermen receive a higher price for cyanide-free groupers; 3) the presence of CDT sampling and monitoring personnel in the area; and, 4) the no-nonsense effort of the cooperative's leadership to police its ranks.

Promoting anti-cyanide policies and practices for the aquarium fish industry in the United States and Europe: Just as consumer demand in Hong Kong drives the live food fish trade, demand in the United States and Europe drives the market for aquarium fish. Since the early 1980s, IMA has worked to raise awareness about the use of cyanide among U.S. aquarium fish importers and consumers and has continued to do so through mass media, on the Internet, and at numerous international meetings. Since that time, many U.S. and European conservation groups and fish importers have also begun to publicize the issue. A decade of rising public awareness about cyanide fishing has paid off. Currently, a Marine Aquarium Fish Council that will set environmental certification standards is being organized in the United States.[149] In Europe, the Ornamental Fish Industry (UK), Ltd., a trade association representing more than 400 businesses in the industry, has issued a strong statement condemning the use of cyanide to collect coral reef fish and welcoming "any initiative to bring this deplorable practice to a halt."[150]

Continuous promotion of public and official awareness: CFRP has worked to ensure that cyanide fishing remains firmly in the public eye and on official agendas. The Philippine press regularly runs articles on the



Fishing for live groupers using the hook-and-line decompression technique. Canipo Island, Northern Palawan, Philippines.



Fisherman using barrier net to collect ornamental fish.

dangers of cyanide fishing and CFRP activities. In 1996, Hong Kong newspapers and television also began to cover the issue. International attention to the problem and the CFRP came in 1996 from *Time*, *The Economist*, CNN, and Australian television.[151]

Awareness work with the school system is also an important part of CFRP, which strives to educate and mentor a new generation of environmental activists by offering materials on marine issues that can be easily integrated into school curricula. Working with teachers and school administrators, IMA provides written materials and "hands-on" teaching aids, such as collections of coral and other marine life samples.

The Philippines' Cyanide Fishing Reform Program has secured some notable successes in its first five years. Awareness of the impacts of cyanide fishing is much higher than it used to be. Stronger laws are being developed, and existing laws are more strictly

Simple tools for live food fish collection: fishing line; decompression needle; decompression chamber; and, rocks to weigh down the bait and line.

enforced. The capacity to monitor the live fish trade has improved, and the CDT laboratory and monitoring network now functions in all major live fish trade centers. The thousands of samples provided by CDT labs to Hong Kong researchers have expanded the scientific data on the aging and breeding seasons of key fish species. Cooperation with Hong Kong authorities has increased, and Hong Kong government officials asked IMA staff to provide advice during 1996. At the same time, both the CFRP and a wide range of other community-based coastal resource management initiatives are under way to provide tangible technological and economic alternatives for cyanide fishermen.

Nevertheless, cyanide fishing has by no means been eradicated in the Philippines. To increase its effectiveness, the CFRP needs to tackle the following challenges: answering basic research questions; strengthening monitoring and testing procedures and capacities; augmenting enforcement capacities and penalties; and establishing community-based coastal resources management (CBCRM) initiatives and policies. These challenges, common to the Philippines and other countries where cyanide fishing is a problem, are examined in greater detail in the final section, which presents recommendations for reducing cyanide fishing across Southeast Asia and beyond.

BOX 3.4
Promoting Sustainable Aquarium Fisheries: The Marine Aquarium Fish Council

In 1996, a number of U.S. conservation organizations and aquarium trade groups met to develop the Marine Aquarium Fish Council (MAFC), a body that would serve as an industry-independent governing council to establish standards and oversee environmental certification of aquarium fish imports and sales in the United States.

The proposed MAFC would establish standards for certifying aquarium fish with reference to collection methods, suitable and nonrecommended species, size limits, holding and transportation methods, and other standards of practice. Costs would be borne by a percentage of the sales price, although grant funding would have to cover startup costs to develop and test applicable certification procedures. Actual certification would be carried out by certification institutions accredited by the MAFC and adhering to the MAFC standards, not by the MAFC itself.

The MAFC would require that collectors, traders and retailers adhere to all standards continuously and would identify appropriate enforcement mechanisms, including the monitoring of the chain of custody from reef to retailer. The council would work closely with the American MarineLife Dealers Association to reach more retailers and consumers.

In the Philippines, MAFC will need to collaborate with the CFRP, especially the new regulation coming into force in late 1997, which will mandate cyanide detection tests for all live fish exports. By extending the reach of the Philippines' regulations to aquarium fish traders and consumers in the United States, MAFC could potentially contribute to the sustainability of live reef fisheries.

Source: WWF-US, 1996

IV

Recommendations to Combat Cyanide Fishing in Asia & the Pacific

As other countries in the Asia-Pacific region and beyond gear up to do battle with the tide of cyanide fishing spreading across their reefs, recent experience in the Philippines with the Cyanide Fishing Reform Program suggests some basic steps that other countries should take, adapted to their own situations.

- **Conduct a survey on the extent of cyanide fishing and trade within the country.**

The first step in combating cyanide fishing is to get policymakers and the public to understand the problem. Both governments and NGOs need to gather and disseminate basic information on the extent and the impacts of the cyanide fishing problem. Government fisheries and environmental agencies can easily request that their local and regional offices report their knowledge of the extent and nature of the live reef-fish trade in their areas. National NGOs can do the same by requesting similar information from their local coastal area NGO partners. Bringing this information together and disseminating it via workshops, press briefings, and other means puts the issue on the public and policy agenda and builds pressure for positive action.

- **Establish cyanide detection test (CDT) laboratory facilities at all major live-fish collection and transhipment points.**

An effective CDT testing network is key for a strong effort to reduce cyanide fishing. Without testing, we cannot determine whether fish have been caught with cyanide or obtain convincing evidence to prosecute violators. The testing techniques developed by IMA have proven useful in the Philippines, and IMA is willing to work with other countries interested in adapting the Philippine system to their own requirements. Experience and future technological innovation will certainly improve the accuracy and efficiency of testing procedures.

CDT labs can only be effective, however, if they are supported with appropriate laws, as discussed below. In addition, the agency managing CDT labs must be trusted to be fair, efficient, and incorruptible by all sides—fish collectors and exporters as well as environmental protection advocates and marine resource policymakers and managers.

To be successful, CDT labs must also be backed up by a larger network of agencies and monitoring posts, and staff trained in sampling prospective live fish shipments and rapid sample transport. Such a network requires directives on participating in sampling and monitoring from central agencies to their local offices and training in correct sampling and shipping-to-lab procedures.

Speed is essential if CDT testing is to gain the support of legitimate exporters, who do not want their business unduly delayed by red tape. To that end, CDT labs need to follow the Philippines' model and function seven days a week, returning test results to the exporter (with a cyanide-free certificate if the tests are negative) within 24-36 hours.

Small island nations may find it difficult to set up their own CDT lab and may not need to do so. The smaller volume of samples they need to test may not justify establishing a separate lab, and costs may be too high. Such countries could contract with the CFRP facilities in the Philippines to conduct tests for them, as they might contract with a foreign police forensics lab for specialized criminal investigation needs. Island nations that are grouped closely together, such as those of the southwestern Pacific, might consider establishing a single regional CDT lab.

These decisions will depend on a country's needs. If a government merely suspects cyanide use in its live fishery and wants to obtain proof, contracting with the Philippine labs may be the sensible option. If these initial tests and other investigations determine that cyanide fishing is indeed a significant problem, then the country may wish to establish its own laboratory facility or collaborate with neighboring countries to do so.

Although testing is not a panacea, it is the best technical tool currently available to identify cyanide-tainted fish and provide hard evidence with which to prosecute violators. Countries that are serious about stopping cyanide fishing must be serious about developing their capacities to systematically test live fish intended for export.

- **Establish a national system of data gathering and monitoring that provides useful data for regulating the live fish trade.**

To monitor and regulate the live fish trade, governments need accurate and appropriate data. Many national systems for collecting fisheries and export statistics do not adequately disaggregate data, making it impossible to tell, for example, how many napoleon wrasses were collected in a particular location, exported in a given month or year, or who did the collecting and exporting. There is no way to regulate cyanide use in the live fish trade until better data are regularly available.

Under the CFRP, the Philippines now collects live fish data in ways that allow the government to keep a watch over exporters, total numbers of particular fish species moving through domestic and international airports and major international seaports, and other relevant information. IMA, the government's NGO partner, collects the data through its CDT and monitoring network and provides it 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.**

Although fishing with cyanide and other poisons is banned in virtually every country in Southeast Asia and the Pacific, a much firmer legal framework is needed to make these bans effective. Once a CDT laboratory and monitoring network is established, all prospective exporters should be required to submit to random sampling and testing, inspection, and government licensing. All shipments should require a certificate showing the origin, volume, and species composition of the shipment, and certifying that the shipment has been subject to random CDT procedures and is cyanide-free.

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; these procedures should not unduly persecute the cyanide divers themselves. Governments might consider enacting strong forfeiture provisions to prosecute large operators. With this approach, violators would lose not only the fish that test positive for cyanide but also any equipment, such as boats and holding facilities, proven to have been used for cyanide fishing.

Nonetheless, local cyanide divers should be educated that what they are doing, for whatever reasons, is illegal, and that repeat offenders will be punished harshly. This action will only be perceived as just, however, when local fishermen see the big operators prosecuted first. Targeting the big cyanide fishing interests also reduces the level of incentives for local divers to join in the trade.

- **Ban or restrict the export of especially vulnerable species, such as the napoleon wrasse (*Cheilinus undulatus*).**

A blanket ban on the live reef-fish trade would be both unwise and unworkable and would just drive the trade underground. A ban would also deprive local communities of one of the most lucrative sources of income to be found in the coastal zone. The cyanide-free capture of live fish at sustainable levels, with a fair return to local fishermen, should be the objective of live fishery policy.[152]

That said, the pressures on particular species may become so great that governments may want to ban altogether their capture and export. In the case of the napoleon wrasse, highest-valued of the live food fish species, over-exploitation may soon reach critical levels, warranting a complete ban. A ban is unlikely to stop the napoleon wrasse trade altogether, but it may reduce the trade's total volume.

In the Philippines, napoleon wrasse exports are banned in the province of Palawan. In 1995, Indonesia banned export of napoleon wrasse smaller than one kg and larger than 3 kg. Because Indonesia lacks a comprehensive CFRP and because its regulations are flawed (see endnote 20), the restrictions have been ineffective. The import of eight tons of Indonesian napoleon wrasse (most weighing over 3 kg) into Hong Kong on the *Morning Sun*, discussed in Chapter One, illustrates the ineffectiveness of the effort.

- **Strengthen community-based management of local fisheries and reefs.**

Sustainable coastal management requires the participation and support of the local communities that directly earn their living from the sea. Slowing cyanide fishing, blast fishing, coral mining, mangrove destruction, and many other sources of coastal degradation can only be done when the communities on the front line become central players in protection efforts and beneficiaries of sustainable management.

In some areas of eastern Indonesia and the western Pacific, long-standing customary systems of marine tenure and management provide a sound institutional basis for community-based efforts. Governments should recognize and support these customary systems and provide technical and financial inputs to assist traditional communities in adapting to rapid economic and technological changes.

Unfortunately, most coastal communities in Southeast Asia do not possess functioning customary systems for managing and conserving coastal resources. Many are comprised of a heterogeneous mix of immigrants and natives who lost such systems long ago. This loss does not mean that viable community management systems cannot be nurtured. The Philippines, where customary coastal management systems have vanished, has the most extensive and active community-based coastal resources management (CBCRM) initiatives in Southeast Asia.[153]

A successful CBCRM program requires government commitment in policy and law, collaboration with like-minded donors and NGOs, and a "learning process" of drawing on the ideas and innovations of local communities to establish, refine, institutionalize, and measure the accomplishments of CBCRM initiatives.

Development of alternative livelihood opportunities for coastal communities is a central part of the CBCRM approach. In the cyanide fishing context, such development generally involves training in cyanide free, sustainable techniques for capturing and marketing high-value live fish species. The program should also broadly examine other nonfishing alternatives, such as agricultural intensification, and the generation of industrial employment. Few fishing communities make their living solely from fishing but rather have a "portfolio" approach combining fishing, farming, and wage labor.

- **Build the capacity of local communities to serve as front-line agents in anti-cyanide monitoring and enforcement.**

Building on training, community organization, and livelihood enhancement initiatives, an effective cyanide fishing reform program needs to enlist local communities in the specific tasks of monitoring and enforcement. Local fishermen are on the water far more regularly and know their areas better than government fisheries officers. 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 operators appear in an area. In the Philippines, members of local fishermen's organizations and cooperatives have been deputized as "fish wardens" to patrol and monitor their fishing grounds.

Although local community groups cannot be expected to directly confront well-organized—and often well-armed—cyanide fishing vessels, they can perform important norm-setting and self-policing activities within the community. After all, a "community" does not decide to renounce cyanide. More often, one group of individuals within a community may make that decision, while others continue using cyanide. Peer pressure is thus important in spreading the cyanide-free tradition throughout the community.

Hingco and Rivera (1991) describe the role of peer pressure in a Philippine village where IMA-initiated net training for aquarium fish collection in the late-1980s:

> The use of cyanide is accepted in the community although users are often objects of antagonism. Together with the blast fishermen, they are blamed for the dwindling catch....The degree of antagonism was intensified when IMA entered the community. Its members are former cyanide users who now look down on

"unconvinced" fishermen because the latter refuse to resort to using nets. The antagonism between these groups has gone to the extent of name-calling. Cyanide users are branded as *tarantado* or *luko-luko* (fools). At times they are called "sodium boys" or "cyanide addicts." They are seldom invited to participate in community activities and are rarely consulted in the decisionmaking process in the *barangay* (village). In one instance, the *barangay* celebrated its *fiesta* without their participation.

- **Address corruption within vulnerable government units, such as fisheries, the navy, customs, and police forces.**

With so much money at stake in the cyanide-based live fish trade, corruption of officials in key government regulating agencies is a recurrent problem. Governments can only eliminate corruption if officials at the highest levels take firm public stands against it, and corrupt officials are dealt with harshly under the law. Agency heads must establish firm policies that those convicted of involvement in cyanide fishing will be summarily fired and permanently barred from civil service or military positions. National police agencies and prosecutors can make it known publicly that they will seek the maximum penalties available under the law to prosecute corrupt officials.

The media can help by exposing instances of corruption related to cyanide fishing in the press. Even in societies where the press is restricted, firm government policy statements against cyanide-related corruption should give the press a freer hand in reporting abuses.

Finally, an effective CDT lab and monitoring network, backed up by community-based monitoring, can provide government 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 about 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.

In the schools, information on the values of marine resources and biodiversity, the effects of cyanide fishing, and the tools available to stop it should be integrated into curricula from primary school onward. Cyanide fishing is a learned behavior that becomes a tradition over time. By teaching the cyanide-free tradition in the school system, countries can help to ensure that children are fully aware of the alternatives to cyanide fishing and their positive consequences.

Divers are also potential allies in raising awareness and gathering information. In the Philippines in 1994, IMA initiated a voluntary Status of Coral Reefs (SCORE) survey, using a simple questionnaire on reef conditions that divers were asked to complete and return by mail. By mid-1996, 200 of the 4,000 survey forms distributed by IMA had been completed and returned, providing the first new primary data on the condition of Philippine coral reefs since a survey done in 1983.[154]

- **Answer basic research questions.**

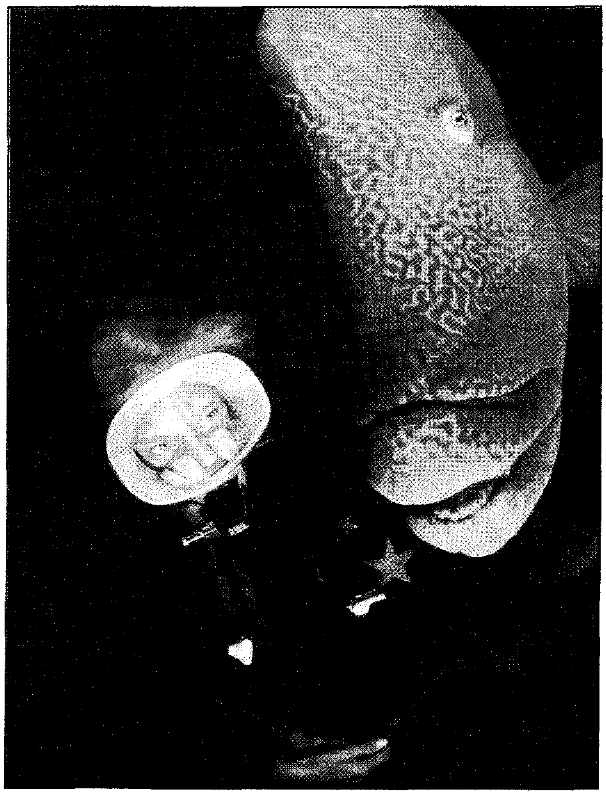
A great deal of basic research is needed before key scientific questions can be answered and appropriate management and control initiatives can be initiated. The current University of Hong Kong study on grouper spawning and aggregation cycles should produce data that will allow fisheries managers to establish effective closed seasons for grouper spawning sites during breeding periods. A more complex research agenda lies ahead for grouper and wrasse aquaculture, which still relies on unsustainable collection of fingerlings from the wild. Perhaps most important, evidence on the impacts of cyanide on corals and other invertebrate species is inadequate. Without firmer scientific authentication of these impacts, it is difficult to convincingly respond to cyanide fishing apologists and skeptics. Finally, human health data on the number and extent of diver injuries from decompression sickness are urgently needed.

- **Devise innovative funding mechanisms to support cyanide fishing reform programs, such as "blue taxes."**

Regulation of the live reef-fish trade should be self-financing. Given the trade's high profit levels, it is not unreasonable for governments to levy a tax on live fish exports that is indexed to the various species and their market value. These revenues can be earmarked for the various elements of a national cyanide fishing reform program, including labs, enforcement, community training, and livelihood enhancement. If an efficient monitoring and data collection system is in place, and all exporters are required to register with and report to the regulating agency, the information needed to levy such a tax will already be available.

In the Philippines, data are collected on the species and gross weight of fish exported by each firm. A taxation system could levy a fixed assessment per species kilogram on each firm exporting, for example, coral groupers. Tax assessment could occur at the time a cyanide-free export permit is issued, and tax collection could occur in conjunction with the export licensing system particular to the country.

Live fish exporters should contribute to the financing of cyanide fishing reform programs because the problem is brought about by the existence of their industry. The dive tourism industry, a significant income earner in countries such as Indonesia, the Maldives, Palau, Papua New Guinea, and the Philippines, also benefits directly from programs to reduce the use of cyanide. Because healthy reefs and abundant reef fish populations are the dive industry's stock in trade, it would not be unreasonable to levy a modest tax on dive operators to support efforts to reduce the threat of cyanide-caused reef destruction. Diver education that explains the cyanide problem and how the dive tax supports reef protection could help gain diver and dive industry support.



Diver enjoys the magnificent beauty of a Napoleon wrasse, Indonesia.

- **Prohibit all live fish imports not accompanied by cyanide-free certification, monitor live fish trade, and share resulting information with exporting countries.**

Efforts to stop cyanide fishing must target the demand side as well as the supply side. Governments of major importing countries and their live fish industries need to play an active role in preventing the trade in cyanide-caught fish, and governments exporting countries should encourage them to do so. Although the Hong Kong Government has taken some steps to regulate its live fish imports, it has not issued an outright ban on the import of live fish not certified to be cyanide-free by the governments of source countries. A complete ban on the import of noncertified fish should be the ultimate goal of all importing countries, once source countries develop certification systems. The proposed U.S. Marine Aquarium Fish Council is a potential model for this kind of import regulation.

Importing governments also need to improve their systems and capacities for monitoring of and data collection on live fish imports, as well as set up procedures to systematically share this information with source countries. Source countries should make a point of requesting importing countries to collect and share this information and should follow Hong Kong's lead in raising the cyanide fishing issue in the Asia-Pacific Economic Cooperation process, perhaps using that forum to establish multilateral information-sharing and notification agreements.

- **Influence appropriate international agencies to provide funding for cyanide fishing reform programs.**

International development assistance for marine management and conservation has increased through the 1990s despite a general downward trend in development aid. Developing country governments should ensure that international aid agencies recognize the seriousness of the cyanide fishing issue as well as ensure that marine sector aid programs include support for development of effective cyanide fishing reform programs. For their part, international aid agencies should include cyanide fishing reform in their marine sector aid strategies and provide technical and financial assistance to governments and NGOs that demonstrate a commitment to attacking the destructive cyanide fishing problem.

Endnotes

1. *"Morning Sun"* is a fictitious name.
2. The *Morning Sun's* cargo consisted of 12 metric tons of various grouper species and eight tons of napoleon wrasse (*Cheilinus undulatus*), also known as the humphead or maori wrasse.
3. Cesar (1997) estimates that it takes 10-20 grams of cyanide per grouper. If one conservatively estimates the size of each fish at 1 kg, the amount would be 200-400 kg for 20 tons of fish. But because not all cyanide that is sprayed results in a catch, and some fish die in transit from the capture site to Hong Kong, the actual amount of cyanide used to capture the 20 tons of fish on the *Morning Sun* was more likely in the range of 600-1,000 kg.
4. Cyanide is metabolized fairly quickly out of fish that remain alive after being stunned for capture. After several weeks in cages and tanks of clean water, the cyanide is difficult to detect with the testing methods currently available.
5. Leung, 1996.
6. All amounts in this report are in U.S. dollars unless otherwise specified.
7. Nearly 13,000 tons of live food fish were imported into Hong Kong in 1996. Taking an average per-kilo price of \$35, the wholesale value of the food-fish trade in Hong Kong alone is therefore about \$450 million.
8. There are no definitive figures on the volume and value of the global trade in marine aquarium fish (Meyers, 1997). Davenport (1997), however, estimates that the global trade is in the range of 60-100 tons, or about 10-15 million fish averaging about seven grams apiece. Based on the wholesale value of imports declared to Customs and the tax authorities in the United Kingdom—\$1.3 million for 1994—the wholesale import value of the global trade would be between \$39 million and \$65 million. Adding the value of live coral and invertebrates, and allowing for markups by the time the fish actually reach the hands of the aquarium hobbyist, the global retail value of the trade is likely to be at least \$200 million. This accords with the \$200 million estimate for the retail trade made by the International Year of the Reef (1997).
9. Meyers (1997) estimates that there are slightly fewer than one million individual aquarium hobbyists in the United States alone, and an undetermined additional number of business establishments with aquariums. The United States imports approximately two-thirds of the global trade in marine aquarium fish (International Year of the Reef, 1997). If one assumes that imports are in rough proportion to the number of marine aquarium hobbyists, then there are about 1.5 million such lobbyists worldwide. If they each spend only \$200 per year on hardware, fish food, and other accessories, then the aggregate annual retail sales value of these items would be about \$300 million.
10. International Year of the Reef, 1997.
11. Sodium or potassium cyanide, typically sold in solid pellets, becomes hydrocyanic acid when mixed with fresh water. In seawater, most of the cyanide is present as cyanide ion.
12. Rubec, 1987.
13. Alvarez, A. A., *The Chronicle*, December 4, 1994.
14. Robinson, 1983a, 1983b, 1984a, 1984b; Rubec and Pratt, 1984; Robinson, 1986; Rubec, 1987; McAllister, 1988.
15. Johannes and Riepen, 1995.
16. Hogarth, 1997; Spaeth, 1996; *The Economist*, 1996.

17. The Nature Conservancy supported a cyanide-fishing study by Johannes and Riepen (1995). Since then it has conducted a series of awareness-raising exhibits and workshops on the issue in Indonesia. The World Wide Fund for Nature (WWF) in 1996 launched a southeast regional effort to combat cyanide fishing (WWF, 1996).

18. Government of Hong Kong, 1996. At publication time (November 1997), under the auspices of the APEC Marine Resources Conservation Working Group, the Hong Kong Agriculture and Fisheries Department, The University of Hong Kong, State Oceanic the Administration of the People s Republic of China and the Taiwan Environmental Protection Administration were planning to host a December 1997 workshop in Hong Kong on cyanide and other destructive fishing practices.

19. ICRI, 1996.

20. In May 1995, decrees from the Indonesian ministers of Agriculture and Trade banned, respectively, the capture and the export of napoleon wrasse, subject to exceptions spelled out by the Ministry of Agriculture. In September 1995, the Director General of Fisheries issued "Decree No. H.K. 330/DJ.8259/95 Concerning Size, Location, and Manners of Catching the Napoleon Wrasse (*Cheilinus undulatus Ruppell*)", spelling out these exceptions. The decree prohibits domestic or export marketing of all napoleon wrasse weighing less than one kg or more than 3 kg, except for domestic sales to fish-cultivating enterprises. Only researchers "for the purposes of research, development, and science" and "traditional fishermen" (defined as those using boats not exceeding five gross tons) may catch the fish, and then only with a government permit. The traditional fishermen are obliged to sell their catch to a collecting company designated by the head of the Provincial Fisheries Office, who also is authorized to determine the areas where the fish may be sought. Hook and line, rattan fish nets, and gill nets are the only permissible gear. All napoleon wrasse marketed locally or for export are required to have an official letter of origin issued by the Regency (sub-provincial) Fisheries Office. The Provincial Fisheries Director is required to report on a quarterly basis to the Director General of Fisheries on the number of permits and letters of origin issued in his province. The Indonesian "ban" actually sets up a system for licensing the capture and export of napoleon wrasse and gives the government the right to grant local monopolies over the trade. And although the use of cyanide for fishing has long been banned in Indonesia, the new system makes no provision for testing the fish for cyanide. The *Morning Sun*, discussed above, was carrying eight tons of napoleon wrasse, the majority far larger than three kg, and possessed official Indonesian government documents. Clearly the ban is currently having very little, if any, effect on the napoleon wrasse trade in Indonesia.

21. Throughout this report, the term "Southeast Asia" is used in a broad sense to include adjacent countries of the Pacific and Indian oceans, which share the same marine flora and fauna as part of the larger western Indo-Pacific marine biogeographical region and which are increasingly subject to the same cyanide fishing pressures and dynamics.

22. ICRI, 1995.

23. Rubec, 1988.

24. Colin & Arneson, 1995.

25. McManus, 1994.

26. Chou, 1994.

27. Valencia, 1990.

28. ADB, 1993.

29. Chua and Garces, 1994.

30. Rubec, 1988.
31. Ibid.
32. Cesar, 1996.
33. Wong, 1991.
34. Cesar, 1996.
35. Cesar (1996) notes that the net present loss arising from fisheries remains constant at about $109,000 per km^2 in all cases, with net present losses in coastal protection and tourism varying depending on circumstance. He concludes that in an area with little tourism potential and minor coastal construction, the net present loss figure would be only $137,300 per km^2 of reef.
36. See Rubec and Pratt, 1984; and Rubec 1987.
37. Heming and Thurston, 1984.
38. Hemming and Thurston, 1984; Rubec, 1987.
39. Rubec, 1988.
40. Johannes and Riepen, 1995.
41. A main reason for fish mortality is that fishermen do not decompress the gas bladders of groupers and wrasse or do so incorrectly. Such fish have gas bladders to maintain neutral buoyancy—like the buoyancy-control devices used by scuba divers. When they are rapidly hauled to the surface, the bladder expands too rapidly, making it impossible for the fish to swim correctly. The excess pressure can be released with a hypodermic in the side of the fish, leaving it unharmed, but many fisherman do so with a large-diameter instrument through the anus, rupturing the intestines and thus raising the chances of infection. Johannes and Riepen (1995) also report that apparent causes of mortality include excessive crowding in holding pens, poor water circulation and pollution in pens, rough handling of fish, inadequate shark protection, improper feeding, and similar problems.
42. Cruz, 1996.
43. Colin and Arneson, 1995.
44. Johannes and Riepen, 1995.
45. Rubec, 1987.
46. Eldredge, 1987.
47. Rubec, 1987.
48. Within 30 seconds of exposure to cyanide, coral polyps contract, and some corals exude a kind of mucus. The mucus disappears several hours later, and the polyps are re-extended, and the corals appear to recover for at least several weeks. But according to cyanide fishermen, they subsequently die, initially turning white, and then become overgrown with algae (Johannes and Riepen, 1995).
49. Rubec, 1987.
50. Coral bleaching occurs when coral reef organisms expel the zooxanthellae algae that normally live within the coral structure in a symbiotic relationship. The algae give color to the otherwise white coral skeleton and also produce carbon compounds that are believed to nourish the coral. Bleaching can be caused by the stress of

water that is too warm or too cold, salinity too high or low, disease, turbidity, increased ultraviolet radiation, or pollutants (such as cyanide). Some bleached corals may recover; others die. Seaweed grows over the dead areas, boring animals tunnel into the limestone, and the coral skeleton eventually crumbles (Earle, 1995).

51. This study, carried out by Dr. Robert Richmond of the University of Guam, was reported in Johannes and Riepen (1995), based on their personal communication with Dr. Richmond. Final results of the study have not yet been published.

52. Jones, 1997.

53. Rubec, 1987.

54. Erdmann and Pet-Soede, 1996.

55. Johannes and Riepen, 1995.

56. Johannes and Riepen (1995) point out, however, that "a stand of dead but structurally undamaged corals is not, by itself, proof of exposure to cyanide. Crown-of-thorns starfish, disease, excessive sedimentation, or abnormally high water temperatures can have the same effect."

57. McManus et al., 1995.

58. IMA-USA is currently conducting research to more accurately assess the rate at which fish metabolize and excrete cyanide after exposure. Cyanide can still be detected in some fish 2-3 weeks after exposure (Rubec, 1997).

59. The Tambuyog Development Center (1996) reported that in Bicol, Philippines, cyanide-laced bait is used to catch large pelagic fish such as tuna and swordfish. The cyanide weakens the fish, enabling fishermen to land them more easily.

60. *People's Journal*, 1993.

61. Rubec, 1987.

62. Letter from Chief of Police Dan Edonga, Busuanga, Palawan, to the chief examiner, Cyanide Detection Test Laboratory, Palawan, 7 September 1995. The government filed a charge of "Double Frustrated Homicide Through Reckless Imprudence" against the fisherman but the accused, out on bail, did not show up at his first hearing, and the case remains unresolved. IMA's Palawan cyanide laboratory gave testimony twice in the proceedings to verify that the confiscated substance was in fact sodium cyanide.

63. PADI, 1993.

64. Cesar, 1996.

65. Johannes and Riepen, 1995.

66. Rubec, 1987.

67. Erdmann, 1995.

68. Robinson, 1983a.

69. Erdman, 1995.

70. To address the problems of diver safety in the live fish trade, IMA and the Hyperbaric Dive Center based in Great Britain are planning to introduce dive safety training as part of the regular IMA Cyanide Fishing Reform Program training program. (Reformed live food fishermen do not need to dive—they use hook-and-line gear. Fishermen collecting aquarium fish must dive even if they do not use cyanide, because the fish are

caught in hand-nets on the reef.) This new program will provide reformed fishermen with an air-filter system for their "hookah" compressors and an X-ray machine at each training site to screen for injuries. As of mid-1997, the proposal was seeking funding.

71. Barraclough and Finger-Stich, 1996; Konphalindo, 1996.

72. Chua and Garces, 1994; Weber, 1994.

73. Saeger, 1993.

74. Wong, 1991.

75. WRI, 1996.

76. The majestic angelfish, which sells in the Philippines for about $28, fetches as much as $350 on the U.S. market; the imperator angelfish, available in the Philippines for about $16, goes for $250 in the United States.

77. Bridges, 1958.

78. Rubec, 1987.

79. Ibid.

80. Live fish exports are generally reported by the gross weight—including water and packing material. The net weight (actual fish) for aquarium fish exports equals about 3 percent of gross weight, 40 percent of gross weight for live food fish species. The 2 million kg of aquarium fish exported from the Philippines in 1980, therefore, equals approximately 60,000 kg (60 metric tons)—about 6 million individual fish (assuming an average weight-per-fish of ten grams.) See Box 2.2 for details on how fish export weights are calculated.

81. See, for example, Robinson, 1983a, 1983b, 1984a, 1984b; Rubec and Pratt, 1984; Robinson, 1985; Rubec, 1987.

82. Rubec, 1987.

83. Cesar, 1996.

84. The balance between food fish and aquarium fish exports has see-sawed back and forth but averages about 50/50. In 1995, live food fish export volume from the Philippines was about 3.8 million kg; and about 2.9 million kg of aquarium fish. For the first 11 months of 1996, the two were about 2.1 million kg each.

85. Cesar, 1996.

86. Unless otherwise cited, information in this section is drawn from the survey of the live reef fish trade in Asia and the western Pacific conducted in 1994-95 by Johannes and Riepen (1995) with funding from The Nature Conservancy, the South Pacific Forum Fisheries Agency, and the Pew Scholars program.

87. Robinson, 1986.

88. Sadovy, in press.

89. Cesar, 1996.

90. Johannes and Riepen, 1995.

91. Erdmann and Pet-Soede, 1996.

92. Hong Kong's Census and Statistics Department further elaborated its system for collecting and reporting live-fish import statistics in January 1997, allowing for much more detailed tracking of imports. Hong Kong flagships, however, are exempt from declaring live seafood cargo, a significant loophole (Sadovy, 1997).

93. The 51 Chinese cyanide fishermen were convicted and sentenced to 8 years in prison, and their vessel confiscated. After 5 months, however, the whole crew was pardoned by the resident and sent back to China on a chartered plane. Ownership of the Spratly Islands is disputed by China, the Philippines, and Vietnam.

94. IMA and BFAR, 1997.

95. Sadovy, 1997. The giant grouper is fairly rare in the live food-fish trade, highly coveted, and extremely expensive, selling in 1997 for nearly $100 per kg.

96. Erdmann and Pet-Soede, 1996.

97. These extrapolations of the total value of the wild-caught, reef food-fish trade are by the authors, based on data in Johannes and Riepen, 1995.

98. The Philippines and Indonesia supply some 85 percent of the aquarium fish in the global trade, which has a total value of $200 million (International Year of the Reef, 1997). The retail value of the aquarium fish sourced from Southeast Asia is, therefore, at least $170 million—85 percent of the $200 million total.

99. Johannes and Riepen, 1995.

100. Lao, 1996.

101. There are several reasons why the percentages of fish tested for cyanide in the Philippines are relatively low, although it should be noted that this low figure represents nearly 160,000 food fish and more than 1.1 million aquarium fish caught with cyanide in 1996. First, the number of samples taken is quite low in comparison to the volume of the trade because the capacity of the laboratory network, discussed in Chapter Three, has only recently expanded to a degree where mass sampling is possible. Second, the testing system is currently voluntary—something slated to change in late 1997 with the issuance of a regulation requiring tests on all live fish exports at much higher sampling ratios. Third, little is known about the rates at which cyanide is excreted from the tissues of live fish, although it is thought to happen relatively quickly. Where fish have been kept in sea-pens for some period of time, not all cyanide-caught specimens will test positive for cyanide. Finally, the Cyanide Fishing Reform Program discussed in Chapter Three has caused many fishermen to switch to cyanide-free techniques. In short, the cyanide test results indicate that cyanide fishing is still a widespread problem numerous—fish from all major reef areas still test positive—but is probably not currently as rampant as it is on the cyanide frontier in Indonesia and other countries in the region.

102. Cesar, 1996.

103. Responses to the WWF-Indonesia survey came from nongovernmental organizations and university researchers in Sulawesi, the Moluccas, Irian Jaya, Sumbawa, Komodo, Flores, Timor, and Sumatra.

104. WWF-IP, 1996.

105. Cruz, 1996.

106. Information in this section is drawn from Johannes and Riepen (1995), except as otherwise noted.

107. Aquaculture of aquarium fish is not technically or economically viable at the present time, which is attested to by the booming demand for wild-caught species. Experiments in the Caribbean have been able to reproduce only a few species. In addition, the vast numbers of species utilized in the aquarium trade—as opposed to the much smaller numbers in the live food fish trade—mean that the research and development costs are extremely high. An inventory taken in the Philippines in December 1994 by IMA, for example, recorded exports that month of aquarium fish from at least 42 families, subfamilies, or genus. Each of these species is likely to have its own unique feeding requirements and reproductive idiosyncracies.

108. Sadovy, in press.

109. Unlike the fingerlings of many grouper species, those of the napoleon wrasse do not aggregate to the same extent (Johannes and Riepen, 1995).

110. Fox, 1997.

111. Barraclough and Finger-Stich, 1996; Konphalindo, 1996.

112. Cesar, 1996.

113. Ibid.

114. Galvez et al., 1989.

115. Robinson, 1983b; Johannes and Riepen, 1995.

116. IMA and BFAR, 1997.

117. Johannes and Riepen, 1995.

118. Ibid.

119. Cesar, 1996; Erdmann and Pet-Soede,1996.

120. UNEP and DENR, 1996.

121. Ibid.

122. ADB, 1993.

123. UNEP and DENR, 1996.

124. ADB, 1993.

125. Hancock, 1994.

126. Ibid.; ADB, 1993.

127. For analysis of weaknesses and corruption in the Philippine state, see Hawes, 1992; Hutchroft, 1991; and Fallows, 1987.

128. Magno, 1993.

129. Rubec (1997) argues that the total amount of cyanide released on Philippine reefs may be as great as 1,000 tons annually. He argues that there are 4,000 aquarium fish collectors using cyanide in the Philippines, and each one uses at least 150 kg of cyanide per year, for a total of 600 tons annually. Adding to that 10 grouper vessels fishing 35 weeks per year and using about 625 kg per week (based on what one vessel seized in 1986 was using)—a total of more than 400—tons the total would be 1,000 tons.

130. Exact figures on the number of cyanide divers in the Philippines do not exist. Based on its monitoring and training programs in the field, IMA estimates that the current number may be around 4,000, down from perhaps 5,000-7,000 a decade ago.

131. Figures for the average wholesale value of live fish exported from the Philippines during January-November 1996 are based on the following assumptions. As noted in Chapter Two, net weight is about 3 percent of gross weight for aquarium fish and 40 percent of gross weight for food fish. The average wholesale price per ten-gram aquarium fish, conservatively, is about $5, while the surveys undertaken by Johannes and Riepen (1995) suggest an average wholesale price for live food-fish in Hong Kong of about $40 per kg.

132. The gross weight of food fish exports in 1995 was 3,841,640 kg (versus 2,089,444 in 1996); aquarium exports fell from 2,903,661 kg in 1995 to 2,124,872 kg in 1996 (IMA and BFAR, 1997).

133. Abregana et al., 1996; Pimentel, 1993.

134. Hutchcroft, 1991.

135. Broad and Cavanagh, 1993.

136. Barber, 1996.

137. Lynch and Talbott, 1995.

138. Robinson, 1983a; 1983b; 1984a; 1984b; Rubec and Pratt 1984; Rubec 1987.

139. The Cyanide Detection Test laboratories are located in Manila, Puerto Princessa (Palawan), Zamboanga City (Mindanao), Palo (Leyte), and Cebu City.

140. The CDT liaison and monitoring posts have been established in Coron (Palawan), Batangas City (a major port two hours south of Manila), and Virac (Catanduanes Island).

141. Formalin—embalming fluid—is widely used (illegally) to give chilled fish an appearance of greater freshness. In April 1997 at the central fish market in Tawi- Tawi, an isolated island province in the far southwest Philippines, one of the authors encountered use of formalin so extensive that it made his eyes water.

142. When groupers are submitted for testing, the sample fish is killed to extract the internal organs that are used for the test procedure. To support the University of Hong Kong research on grouper breeding cycles, the labs now collect and store the gonads and otoliths for shipment to Hong Kong. So far, more than 400 samples have been examined from more than 35 grouper species.

143. Fisheries Administrative Order on Rules and regulations governing the exportation of live reef fish from the Philippines, Final Draft, 1996.

144. "An Act to Regulate the Importation, Sale and Possession of Sodium Cyanide, Providing Penalties for Violations Thereof, and For Other Purposes." Introduced by Rep. Abueg, Republic of the Philippines House of Representatives, Tenth Congress, First Regular Session, 1996.

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

146. Because local government is so important for the success of the CFRP in the Philippines, IMA has concluded memoranda of agreement with many local government units to implement the CFRP. These include agreements with local and provincial governments to run the CDT labs and monitoring stations, with three municipal governments in Romblon for training programs, and with the Coast Guard Station in Davao (Mindanao) for establishing a new monitoring station and eventually a CDT lab. Many more such agreements, especially with regard to training programs, will need to be concluded and implemented in the coming years.

147. Government of Hong Kong, 1997.

148. Sadovy, 1997.

149. Groups involved in the establishment of the Marine Aquarium Fish Council include Environmental Solutions International, the National Aquarium, Ocean Voice International, International Marinelife Alliance-Philippines,

The Nature Conservancy, World Wildlife Fund, the Pet Industry Joint Advisory Council (PIJAC), the American MarineLife Dealers Association, and other representatives of the aquarium trade.

150. OFI, n.d. The statement in full says:

> OFI (UK) condemns the use of cyanide for the capture and collection of coral reef fish. We believe that the use of such techniques degrades the habitat, by killing coral and non-target species. It also compromises the welfare of the livestock, often leading to their early death. The use of this technique undermines the efforts of those collectors around the world using sustainable methods, e.g. the use of small hand nets to collect fish guided to a stop net of 2-3m in length. OFI welcomes any initiative to bring this deplorable practice to a halt.

151. International press coverage has had important impacts in the Philippines. When *Time* magazine featured the cyanide fishing problem as part of a June 1996 coral reef cover story, Philippine President Fidel Ramos read it, annotated the article with his own handwritten comments, and sent it to senior cabinet members with instructions to report to him fully on what was being done to deal with the issue.

152. See IMA, 1997b.

153. For analysis of the Philippines' many community-based coastal resources management initiatives, see Carlos and Pomeroy, 1996; Ferrer et al., 1996.

154. McCullough, 1996. The 1983 survey of coral reef status in the Philippines was conducted by the Marine Sciences Institute (MSI) of the University of the Philippines. It concluded that only 5 percent of reefs remained in excellent condition, 25 percent were in good shape, and the rest were in varying stages of deterioration (see Alcala et al., 1987.) Since then, there has been no follow-up work to verify or update the MSI findings.

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