

In response to these arguments, the government provided an exemption for hard corals or live rock that are taken incidentally to permitted dredging operations. The idea was that the aquarium industry might be able to negotiate with the dredging industry to remove the valuable top layer of hard corals and live rock before the dredgers moved in. This exemption would also provide for a cheap supply of coral rubble (coral rubble is a popular substrate for soft corals in the aquarium trade).

The third issue was the definition of 'cultured'. The industry lobbied for a fairly loose definition of 'cultured', arguing, for example, that *Acropora* branches clipped from wild colonies and subsequently grown in tanks for several weeks or months should be considered cultured. The industry also wanted to be able to lease areas of reef from the states, and argued that anything produced in such an area should be considered cultured.

The government's coral and rock export prohibitions were aimed at limiting the impact of the industry on coral resources to near-zero. It therefore opted for a more strict interpretation of the term 'cultured', and finally adopted the definition of 'bred in captivity' recommended by CITES. Although this definition is fairly strict, it does not preclude the possibility of farming corals or live rock in open reef areas. The key elements of the definition are simply that the organisms reproduce in a controlled environment and that the brood stock be managed to last indefinitely.

Conclusions

In adopting its *Regulations on the Collection of Marine Resources for Aquaria and Research*, the government of Palau has taken a significant step towards proactive management of its inshore resources.

A primary aim of the regulations is to minimise detrimental impacts to Palau's reef systems. The basic strategy is to put a cap on fishing effort so the industry does not expand out of control. If any species are found to be in need of special protection, the regulations are flexible enough so that additional controls on particular species can be put in place as needed.

The regulations also aim to manipulate the flow of benefits from the fishery, first by prohibiting foreign collectors, and second by providing a framework for the states (i.e. the villages) to control collecting in their waters and to levy access fees.

Less than one year has passed since the regulations went into effect, so it is not yet clear how well they are serving their objectives. The public is still learning about the regulations, and the national and state governments are still gearing up to fully administer and enforce them. In any case, the approach embodied in the regulations will serve as a precedent, if not a model, for more active management of Palau's other commercial fisheries.

Environmental, economic and social implications of the fishery for live coral reef food fish in Asia and the Western Pacific

by Bob Johannes & Michael Ripen

Summarised below is a just-released 33,000 word report on the environmentally devastating but not widely recognised live reef food-fish trade that is spreading for thousands of miles from its centre in South-East Asia. The report is based on an investigation which took the authors to nine countries in the region and involved interviews with several hundred individuals, including fishermen, divers, dive tour operators, social and biological researchers, members of national and international NGOs, live reef food-fish exporters and importers, government officials, aquaculture experts, fish farmers and village leaders.

Copies of the full report can be obtained from Carol Fox of the Nature Conservancy in Honolulu, Fax: (1) 808 545 2019. For more information contact, Dr Bob Johannes, 8 Tyndall Court, Bonnet Hill, Tasmania 7053, Australia, Phone: (61) 2 298 061, Fax: (61) 2 198 066 (e-mail: bobjoh@ice.net.au).

Scale of the industry

Growing economic prosperity in Asia has prompted the rapid and continuing expansion of the market for live reef food fish. Humphead wrasse (also known as Napoleon or Maori wrasse) and the highfin grouper (also known as polka dot grouper, barramundi cod, panther or mouse head), are the

most highly-valued species. Prime, plate-sized specimens sell to Hong Kong consumers for as much as US\$180 per kilogram. Next in value are the variety of other groupers (coral cod and coral trout).

The industry currently exports an estimated 25,000 tonnes of live reef food-fish per year, with about 60 per cent from wild capture.

The export trade is estimated to have an annual wholesale value of about US\$1 billion. Hong Kong is the largest consumer. But it is in Southern China, with its rapidly expanding economy, that demand is growing fastest. Figures are not available for domestic trade in the region, but it may be substantial. There are more Chinese in Indonesia, for example, than in Hong Kong.

Destructive fishing practices

The premium prices paid for these fish are encouraging the use of a fishing practice that is causing the widespread devastation of the world's richest coral reefs. Divers chase target fish into holes in the reef, then squirt a solution of the extremely toxic chemical sodium cyanide into the holes. This immobilises the target fish so that they can be easily captured. They are then revived and ultimately transported live to market, by ship or air.

Cyanide affects far more than just the target species. Smaller fish, and shellfish, are less resistant to cyanide. Many die for each target fish captured. Moreover, corals, which provide the basic foundation of reef community, also bleach and die. This has the same effect on reef life as clear-cutting trees has on forest animals; it destroys their habitat and they disappear.

As reef fish stocks dwindle, the use of cyanide by impoverished fishermen who are heavily dependent upon reef resources often becomes increasingly indiscriminate. While quart-sized squirt bottles are normally used to administer the poison, in some cases fishermen have dumped whole 55 gallon drums of the poison into shallow reef communities, transforming them into aquatic graveyards.

While devastating to reef communities, cyanide rarely reaches concentrations in target fish that are thought to be toxic to human consumers.

Intensive hook-and-line fishing for the live fish trade has also eliminated large spawning aggregations of groupers that have sustained coastal villagers for centuries. This has been recorded in Palau and also reported from Papua New Guinea. Because spawning aggregations are exceptionally vulnerable to depletion, it is possible that many others have been eliminated without record.

Geographic spread of the problem

The extent of the damage and the speed with which these practices are spreading are alarming. Fish buyers in Hong Kong and Singapore say that the

target species have been heavily depleted in the Philippines. A growing number of fishing grounds in Indonesia have been plundered and abandoned by the industry, and buyers estimate that within three to four years Indonesia's commercially harvestable stocks of target groupers and wrasse will also be largely exhausted. They say they look upon Papua New Guinea as their next major source.

Live reef fish are currently being caught for the Hong Kong and China markets from as far away as Vanuatu in the Pacific Ocean to the east and the Maldives in the Indian Ocean to the west, revealing the industry's wide geographic reach. It now encompasses an area stretching over one quarter of the world's circumference and containing one-third of the world's coral reefs. Areas affected include the most biologically diverse marine habitats in the world; the Philippines and Indonesia contain about 35 per cent of the world's fish species and well over 50 per cent of the world's reef coral species.

No slowing of consumer demand nor of the geographic expansion of the fishery is in sight.

Threat to divers

Fishing companies supply cyanide fishermen with air compressors for their diving but often neglect to give them instruction in their use. As a result, death or paralysis due to the bends has become widespread. Fishermen say the frequency of such accidents continues to increase as they find themselves forced to go deeper and stay down longer to get fish, after depleting stocks in shallower waters.

Among the 200 divers in one Filipino community, 30 got the bends and 10 died in 1993 alone. A recent informal survey in the Philippines revealed that in seven out of eight small coastal communities contacted, one or more divers had died due to the bends within the past three years.

Long-term effects on villagers

Coral reefs are vital to the lives of the coastal villagers of the region. By degrading or destroying these reefs for short-term gain, fishing companies are trading away their future.

Once seriously damaged, reef communities typically take several decades to fully recover—under favourable conditions. But it is unlikely that conditions will be favourable in many such areas, especially in South-East Asia. For centuries, villagers in the region have depended upon reef fish for their livings, as well as their main source of animal protein.

Today 80 per cent of Filipino coastal fishermen's families are under the official poverty line. A similar percentage are undernourished. Coastal populations in the region continue to rise.

The edible fish and invertebrates that begin to recolonise cyanided reefs are thus sought with increasing urgency. Understandably, under such conditions, fishermen are motivated to use any method available to catch fish to feed their families. As long as such conditions persist, their reef communities cannot recover.

The importance of village-based control of the fishing grounds

In South-East Asia the fishing companies often operate at will because local villagers (often the only witnesses to their activities) are powerless to intervene—either because the law does not recognise their right to do so, or due to poor communications or bribery of local officials. Many Pacific Island countries have somewhat better chances of protecting their marine resources because traditional village control over local fishing grounds is well-developed and often receives official government support.

The only places in the region where some effective control was being exercised over live reef fishing companies on the fishing grounds during this study were found to be those where villagers possessed some form of enforceable rights to local marine resources. Such rights provide an essential incentive for conservation. To be more effective, however, they need government support by means of supporting legislation, environmental education, and training and deputising of village fishermen for fisheries law enforcement.

The goal: sustainable fisheries—meeting the demand without destroying the supply

Catching and keeping fish alive for the live reef food-fish trade is a 'value-adding' form of fishery that need not deplete reef resources. We believe, therefore, that the trade should not be eliminated, but rather converted to sustainable operations. All stakeholders would benefit in the long run—consumers, the industry, fishermen and their families, as well as tourists and tourism. Specific recommendations to this end include the following:

1. Convince government regulatory agencies that the live reef food-fish trade is a distinctive form of fishery requiring special controls;

2. Provide villagers with the incentive to protect their marine resources by giving them the legal right to exclude outsiders from their fishing grounds, or, where that right already exists, provide stronger government backing. Train, deputise and support selected village fishermen as fish wardens;
3. Ban the possession of cyanide on boats, as Papua New Guinea has done;
4. Declare a moratorium on all fishing for live reef fish in areas where stocks are depleted, as parts of the Philippines (e.g. Palawan) have done;
5. Commission a study to determine the kinds of research and development needed to raise selected grouper species and humphead wrasse commercially from the egg in order to reduce the demand for wild-caught fish;
6. Instruct live reef fishing companies on inexpensive ways of reducing very high mortality rates of live reef fish due to unsatisfactory catching, holding and shipping practices;
7. Where logistics permit, set up cyanide detection laboratories (in import destinations such as Hong Kong, as well as source areas) in order to monitor live reef food fish and marine aquarium fish operations, as pioneered in the Philippines;
8. Support research on the effects of cyanide on corals and coral reef communities to get a better idea of their vulnerability and the magnitude of the 'clearcutting' affect;
9. Carry out research to improve non-destructive methods of catching species targeted by the trade;
10. Work with the governments of Indonesia, Thailand, Malaysia and China to ban the use of cyanide in the electro-plating industry and thus reduce its availability, as has already been done in most countries;
11. Ban the export of wild-caught fingerlings of target species.

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