

Cyanide is cheap and easy to obtain. The costs per 0.5 l solution are about Rp 5000. Small-scale operations use 2 bottles per diver per day-trip, medium-scale divers use 15 bottles per 3-day trip and the large-scale operations use some 750 bottles per 1-month trip. Catches of large-scale cyanide operations average around 2500 kg per trip. A regular medium-scale dive operation catches around 20 kg of live groupers per trip. Small-scale operations average 1 kg per trip. The cyanide fishermen in Indonesia receive prices ranging from US\$ 5.00 to US\$ 35.00 per kg, depending on species, size and quality. The net profits per boat-owner per month in the cyanide fishery are US\$ 100 for the small-scale operations (owner = crew), US\$ 413 for medium-scale operations and no less than US\$ 35 000 for large-scale operations. Crew members on average earn incomes per month of US\$ 100 in small-scale operations, US\$ 252 in medium-scale operations and US\$ 400 in large-scale operations.

The profits and incomes are higher than in any type of conventional fishery. The large financial rewards (although short-term) lure many fishermen into the practice, even when they are aware that the resources will eventually cease to provide them and future generations with employment, income and food. It is more a matter of greed than a matter of need (Pet-Soede & Erdmann, 1998). Even if fishermen have other options to make a living at sea, in many cases they deliberately choose this lucrative practice. Cyanide fishing is also a profitable enterprise for investors and boat owners.

The Fisheries Law No. 9, signed on 19/6/1985 by the President of Indonesia, includes a specific pro-

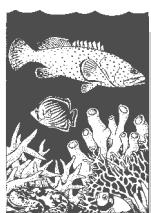
hibition of the use of destructive fishing techniques such as explosives and poison. The penalties are up to 10 years of jail and/or 100 million Rp. fine. The marine police and navy, together with the fisheries service, are responsible for law enforcement. Profit margins in the cyanide fisheries and live reef fish trade are large enough, however, to allow for very large bribes. Corruption therefore makes the eradication of this illegal and destructive fishing method extremely difficult. Very few cases of cyanide fishing are brought to court, and usually the offenders are released after payment of a 'fine'.

Corruption at the lower government levels is almost inevitable, considering the large bribes paid and the low salaries for government officials. This combined with a lack of funds and facilities for enforcement, lack of knowledge and awareness with the authorities, and lack of political will at all levels, means that the cyanide fishing still continues largely unhindered.

The biggest problem is finding support at higher levels for banning destructive practices. Most authorities seem disinterested. Political will has to be developed through increased awareness of macro-economical problems caused by destructive fishing such as its impacts on tourism and fishing.

Reference

PET-SOEDE, L. & M.V. ERDMANN. (1998). An overview and comparison of destructive fishing practices in Indonesia. SPC Live Reef Fish Information Bulletin 4: 28–36.



Krismon & DFP: some observations on the effects of the Asian financial crisis on destructive fishing practices in Indonesia

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Primary effect of the crisis: Increasing export fisheries

In recent months, various marine scientists and concerned environmentalists have approached us for information on the effects of the current Asian financial crisis (known as 'krisis moneter,' or 'krismon' in Indonesia) on destructive fishing practices (DFP) here. Specifically, we have often been asked to confirm if blast fishing has

increased as the Indonesian rupiah devalued precipitously and prices within the country soared. Our combined observations in the regions of South and North Sulawesi, Komodo, East Kalimantan and Maluku suggest that krismon has indeed had major effects on DFP in Indonesia, though different fisheries have been affected differently. In particular, fisheries targeting species for export (such as the live reef fish trade and lobster, shark fin, and tuna fisheries)

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have intensified, while those providing products for local consumption (such as blast fishing) have actually decreased. This phenomenon is rather easily explained by three interrelated factors:

1. Prices paid to the fishermen

Because exported fisheries products are generally valued (very loosely) in US dollar terms, rupiah prices for these products have risen as the rupiah devalues. On the other hand, the prices for fish in local Indonesian markets have risen only slightly (if at all) due to the perishable nature of the products. This discrepancy in prices seems to have influenced even more fishermen to abandon traditional, domestic fisheries in order to enter export-oriented fisheries. In the case of blast fishing, which also supplies local markets, this trend is enforced by the increasing cost of imported fertiliser, an ingredient in most home-made bombs.

2. Prices paid by the exporter

Although the prices paid to fishermen for export products have increased in rupiah terms, these prices have actually decreased in US dollar terms (see 'trends in prices' below). This has meant that exporters who sell their products overseas in US dollars have actually seen profit margins increase during the financial crisis. This seems to have spurred them into even more aggressive campaigns to source these products from local fishermen.

3. Decreased enforcement

Export-oriented fisheries using illegal capture techniques have even less to fear from enforcement agencies during the krismon period than previously. Not only are local enforcement agencies strapped for funding for patrols and other enforcement activities, but also, they are even more prone to accepting bribes as officials struggle to feed their families. Blast fishermen, on the other hand, have even less profit to divert to bribery.

These three factors have resulted in many fishermen giving up blast-fishing and other traditional fisheries (at least temporarily) in order to enter export fisheries.^{3,4} Without question, the live reef fish trade has shown a definite intensification during this period.

Unfortunately this has come at a time when grouper and Napoleon wrasse stocks were already being pushed to the point of collapse in Indonesia (Pet-Soede & Erdmann, 1998). Below, we discuss in more detail some of the trends we have observed over the past year of the financial crisis, as well as some new observations on the live reef food fish trade.

Trends in prices

As mentioned above, rupiah prices for many fisheries export products have risen considerably as the rupiah devalued from roughly Rp 3200/US\$ in October 1997 to a low of Rp 17 000/US\$ during the Jakarta riots in June 1998. However, these price increases have hardly kept pace with the devaluation; while rupiah prices paid to fishermen have roughly doubled since October 1997, the rupiah's value against the dollar has averaged 1/3 to 1/4 of its value at that date. Although the actual prices offered to fishermen vary greatly throughout the archipelago, the trend is similar everywhere. For instance, fishermen in South Sulawesi received on average Rp 60 000/kg (US\$ 18.75/kg) for live *Plectropomus leopardus* in October 1997, while in April 1998 they received up to Rp 100 000/kg (US\$ 10/kg). By comparison, fishermen in the Komodo area who used to receive Rp 30 000/kg (US\$ 12/kg) in mid-1997 for coral trout now receive Rp 60 000/kg (US\$ 6/kg). Similar trends are evident in prices for both *Cromileptes altivelis* and *Cheilinus undulatus*. With this situation, both fishers and exporters have even stronger incentives to enter or remain in this fishery.

Trends in prices paid to fishermen for other export fisheries followed similar patterns: live spiny lobsters (*Panulirus* species) and dried shark fin have roughly doubled in rupiah price throughout the archipelago, while high quality trepang has quadrupled in price (thereby maintaining a stable dollar price). Interviews with fishermen in South Sulawesi revealed that they were very aware (and quite angry) that the exporters and middlemen were now making a much larger profit, but felt quite helpless to do anything about it. Although price increases were gradual during devaluation of the rupiah, exporters almost immediately dropped the prices paid to fishermen when the rupiah subsequently strengthened against the dollar.

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3. In North Sulawesi and Maluku, where many fishermen are also land-owners with small clove, nutmeg or coconut (copra) plantations, a related trend has been for these fishermen to devote more and more time to their plantations, as these export commodities now command handsome prices as well.
 4. Also in North Sulawesi, tuna fishermen are altering their behaviour to maximise export-related profit. While they used to keep a certain proportion of their catch for personal consumption and sale within their villages, they now feel pressured to sell almost all of their catch to the local, export-oriented cannery, which pays them much higher prices for their fish than villagers can afford. Within the Bunuan National Marine Park, the unfortunate result is that many villagers, including some of the tuna fishers, are now illegally spear-fishing and gill-netting for small reef fish for their own consumption.

One exception to the above-mentioned trend is the price paid to South Sulawesi fishermen for Napoleon wrasse, *C. undulatus*. When we first noted declining prices for *C. undulatus* (Pet-Soede & Erdmann, 1998), it was explained to us as being a direct result of the governmental ban on export of adult Napoleon wrasse. The middlemen to whom the majority of these fishermen sell their fish claimed that the associated risks of storing the illegal fish justified the lower prices being paid. The trend has continued; in April 1998, fishermen there reported receiving only Rp 10 000/kg for larger specimens (less than US\$ 1.50/kg). However, this is clearly a case of dishonesty among middlemen; not only are Napoleon prices much higher in other areas of Indonesia, but one fisherman who 'freelances' and sells his fish directly to the exporters in South Sulawesi confided that he received Rp 320 000/kg for large specimens.

Trends in techniques

As described in Pet-Soede and Erdmann (1998), the live reef food fish trade in Indonesia is a very dynamic fishery, repeatedly undergoing wholesale changes in technique. As large-scale cyanide fishing boats become unprofitable in areas where grouper stocks dwindle, they are replaced by smaller-scale fishermen using hook and line and trap fishing to catch those grouper which remain. Now, in the Komodo region, another form of medium-to-small scale grouper fishing technique has become widespread in the past 6 months. 'Kedo-kedo', small, motorised outrigger canoes from which fishermen troll using steel wire with a feather and plastic fish lure, now dominate the coral trout fishery within Komodo National Park. Several fleets of up to 14 keto-kedo and one mothership have been actively operating in the area since at least August 1998, though recent enforcement activities seem to be working in driving these operations outside of park boundaries.

Unfortunately, these fishermen are no longer limited to *Plectropomus* species; both *Cephalopholis argus* and *C. miniata* are now actively targeted. Even more alarming, these fishermen are clearly targeting spawning aggregations of coral trout throughout the park.

Another fishery which seems to be intensifying is the capture of live aquarium fish for export. In recent months in the Komodo National Park, a number of boats from Java have been arrested with large quantities of cyanide, crowbars, ornamental fishes, and army or ex-army 'guardians' on board. In Ambon, capital of the Maluku province, several new ornamental fish operations have reportedly begun operating. According to a local hotelier, one of these operations is run by an European who

openly admits to cyanide use, claiming it is the only economical way to capture aquarium fishes.

Another company is avoiding censure by claiming to use clove oil as an alternative, 'natural' fish anaesthetic. This is a most interesting development, as clove oil (or eugenol in its purified form) is a moderately well-known anaesthetic for small fishes and crustaceans (e.g., Munday & Wilson, 1997; Soto & Burhanuddin, 1995). Recent research has shown clove oil to be a highly cost-effective and safer alternative to standard anaesthetics used in aquaculture such as quinaldine and MS-222 (Keene *et al.*, 1998; see also Erdmann, page 4, this issue). However, we are not aware of any research on clove oil's potential for collateral environmental damage to corals and other non-target reef organisms.

The first author's experience in using an ethanol/clove oil mixture to extract stomatopod crustaceans from coralline algae nodules suggests that coralline algae bleaches almost immediately upon contact with this mixture. According to Philip Munday (pers. comm.), this effect may be attributable more to the ethanol carrier than to the clove oil, and subsequent anecdotal experiments with pure clove oil squirted on *Pocillopora* spp. and *Acropora* spp. coral colonies *in situ* showed no observable ill effects. Additional research on its effects on corals especially would be most welcome in order to establish if this truly is a less environmentally damaging technique for catching aquarium fishes.

A final trend that we have noticed in Komodo National Park is a dramatic increase in long-lining for sharks (for shark fin) and large groupers, which are sold fresh-chilled for export. Prices for both of these products have increased dramatically in the past several months. This is most saddening, as Komodo National Park was one of the few areas in Indonesia where sharks and large grouper were regularly encountered by divers.

Different strokes... The East Kalimantan live reef food fish trade

One fascinating aspect of the live reef food fish trade in Indonesia is the range of techniques encountered throughout the archipelago for catching, storing, and trading fishes. A recent visit to East Kalimantan revealed a live reef fish trade with practices that were quite different from anything we have reported before from Indonesia—primarily driven by the remoteness of the area. Large river deltas along the eastern coast of Kalimantan have prevented extensive reef development here, with some notable exceptions such as the reef complex including Derawan and Sangalaki islands. The live reef fish trade in this area is controlled

exclusively by one businessman, who made his first fortune by dominating the trade in turtle eggs there (which he still does). By completely controlling the trade, this businessman keeps prices paid to fishermen at a minimum. For example, fishermen received Rp 15 000/kg (US\$ 1.50/kg) for *Plectropomus* spp. in April 1998, compared to the Rp 100 000/kg (US\$ 10/kg) paid to South Sulawesi fishermen at the same time.

Not surprisingly, the fishermen have little loyalty to this 'boss' and actively cheat him in one of the few ways they can. When the live fish transfer vessels (no airfreight in this region) arrive to collect shipments from this businessman, fishermen attempt to rendezvous with the vessels before they dock in order to sell fish directly to the vessel. In this manner, they can receive US\$ 40/kg (in dollars) for Napoleon wrasse, which would otherwise fetch Rp 25 000/kg (US\$ 8/kg) from the businessman.

Divers here do not use SCUBA or hookah to collect grouper and Napoleon wrasse. While they do use cyanide in large quantities, they free-dive to 20–30 m depth to collect the fish. Free diving to these depths is commonly reported for pearl divers in the south Pacific, but this is the first time we have encountered such practices in Indonesia. Given the amount of time it can take chasing a large grouper or Napoleon wrasse before it seeks shelter in an area where it can be collected with cyanide, this is impressive indeed. Divers interviewed here were all aware of the phenomenon of grouper spawning aggregations, and actively targeted them. They all mentioned how much easier it was to collect fish during these aggregations. They furthermore report that Napoleon wrasse were also known to aggregate in several of the same areas as the groupers, though at different times.⁵

Whatever happened to the large cyanide catcher vessels?

Recently we reported that the large-scale cyanide fishing boats which used to be common in South Sulawesi have become unprofitable in that region and have moved operations to more remote areas of eastern Indonesia where the grouper stocks are dec-

imated (Pet-Soede & Erdmann, 1998). In April 1998, one of us (MVE) had the opportunity to talk at length with Mr. Muddin, a diver who has been working for one of these operations since 1994. As Muddin had provided us with extensive information on the practices of large-scale cyanide vessels in the past (see Erdmann & Pet-Soede, 1996), we were interested to receive an update on these practices.

According to Muddin, many of the large boats which used to operate in South Sulawesi are now operating in south-east Sulawesi (Tukang Besi archipelago and surroundings) and remote areas in the Banda Sea. His mothership carries 12 fiberglass dinghies, each of which is manned by a crew of four (two hookah divers, one dive tender, one driver). They typically go to sea for one-month fishing periods, during which time they dive every day. Each of the dinghy teams cooperate in a highly professional manner; the boat owners keep salaries relatively low (Rp 250 000–300 000 per month, or US\$ 25–30 per month in April) and use a bonus system to motivate the teams. Teams receive a bonus of Rp 500–1000 per fish (split amongst themselves). Additionally, each team has a monthly goal of 500 kg of fish, and those who achieve the goal are given an extra Rp 1000/kg to split. Muddin reported that the base salaries have not been raised during the krismon period, but the bonuses have been roughly doubled from those of mid-1997.

Under this bonus system, the diving teams have become very efficient in their task. The two divers coordinate in chasing and cornering grouper and Napoleon wrasse as the boat driver deftly manoeuvres the dinghy above them and the tender keeps hookah lines untangled. Muddin said that all of these teams are aware of and skilled at locating spawning aggregations. Even cyanide use is more efficient than in years past: cyanide solution is now mixed in a ratio of one tablet of sodium cyanide to 15 l of water, and Muddin reports greatly reduced mortality from cyanide overdose. He said that some boats have resorted to diluting cyanide solution with soap solution in an attempt to even further reduce costs (see Pet & Djohani, 1998), but his bosses have strictly forbidden this due to supposed harmful effects on the fish.⁶

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5. Editor's note: Our research in Palau supports this observation (R.E. Johannes, L. Squire, T. Graham, Y. Sadovy, and H. Renguul. (in press). Spawning Aggregations of Groupers (Serranidae) in Palau. The Nature Conservancy and the Forum Fisheries Agency).
 6. Interestingly, Munday and Wilson (1997) mention that mixing detergent with commonly used fish anaesthetics often increases efficacy of the anaesthetic. Munday (pers. comm.) suggested that the detergent, acting as a surfactant, may keep many anaesthetic powders or oils well-dissolved in water, and may assist with transport of the anaesthetic across the gills. He commented that detergent is commonly added for this reason to rotenone as well. Munday and Wilson did not test cyanide solution among their anaesthetics, but this may be the answer to the 'detergent dilemma' posed by Pet and Djohani, (1998). This would correspond to Pet and Djohani 'reason #1 and #2: detergent is added to increase solubility and efficacy of the cyanide. On the other hand, Peter Rube (pers. comm.) informed us that his experience dictates that detergent is likely added for Pet and Djohani's 'reason #3': to increase visibility of the squirted cyanide solution. He reported incidents of divers in the Philippines and Indonesia adding milk, kerosene or gasoline to cyanide squirt bottles specifically to increase the visibility of the cyanide plume, and suggests that soap could be used for the same purpose.'

But this heightened efficiency has not been able to prevent the inevitable. While Muddin's mothership can hold up to 8 tons of live fish, they have not collected more than 3 tons per month for the past year. His team now catches no more than 4–5 fish per day of diving, and occasionally they go home empty-handed. Even with the krismon-adjusted bonuses, Muddin now only makes Rp 400 000–500 000 per month, compared with the Rp 700 000 he used to make in years past. He reports that many of his co-workers are now looking for work elsewhere, and with good reason: his bosses (from Hong Kong) have openly declared that they will shut down operations and leave Indonesia by mid-1999, as they can no longer reap the profits they require. A year late, perhaps, but Johannes and Riepen's 1995 prediction of a collapse in the live reef food fish trade in Indonesia within three years seems dangerously close to being fulfilled.

Conclusions

The above discussion illustrates again the extremely dynamic nature of destructive fishing practices in Indonesia. Far from being set in their ways, Indonesian fishermen respond quickly to changing market forces and can rapidly adopt new fishing techniques as they become profitable.

In general, the Asian financial crisis has affected Indonesian DFP in a most logical manner: export-oriented fisheries, with much higher prices offered, have intensified, while fisheries that provide domestic product have stagnated or declined. While Indonesia has always relied heavily on exports of its vast timber, oil, mineral and fisheries resources, the financial crisis seems to have resulted in government and businesses 'selling off' these resources at an even more alarming rate in order to generate desperately needed foreign capital.

A further example comes from Ambon, where local fishermen report a dramatic increase in foreign fishing vessels (mainly tuna fishers) during the krismon period. While no one can deny Indonesia the right to call upon its vast natural resources to help extract itself from the current financial crisis, there is a grave danger of government officials and private businessmen greatly undervaluing these resources and selling them off in a rushed and unwise manner. Most of these resources, including the fisheries discussed above, are of very high-value and have the potential to sustain the country and fuel its development in the future if carefully managed. Unfortunately, if Indonesia continues to undervalue these resources and export them in a desperate bid for foreign currency, it may emerge from the financial crisis only to find itself plunged even deeper into environmental crisis.

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References

- ERDMANN M.V. & L. PET-SOED. (1996). How fresh is too fresh? The live reef food fish trade in eastern Indonesia. NAGA, the ICLARM quarterly. 19: 4–8.
- JOHANNES, R.E. & M. RIEPEN. (1995). Environmental, economic and social implications of the live reef fish trade in Asia and the western Pacific. Report to the Nature Conservancy and the South Pacific Commission. 82 p.
- KEENE, J.L., D.G. NOAKES, R.D. MOCCIA & C.G. SOTO. (1998). The efficacy of clove oil as an anaesthetic for rainbow trout, *Oncorhynchus mykiss* (Walbaum). Aquaculture Research. 29: 89–101.
- MUNDAY, P.L. & S.K. WILSON. (1997). Comparative efficacy of clove oil and other chemicals in anaesthetization of *Pomacentrus amboinensis*, a coral reef fish. J. Fish Biology. 51: 931–938.
- PET, J.S. AND R.H. DJOHANI. (1998). Combating destructive fishing practices in Komodo National Park: Ban the hookah compressor! SPC Live Reef Fish Information Bulletin. 4: 17–28.
- PET-SOED, L. & M.V. ERDMANN. (1998). An overview and comparison of destructive fishing practices in Indonesia. SPC Live Reef Fish Information Bulletin. 4: 28–36.
- SOTO, C.G. & BURHANUDDIN. (1995). Clove oil as a fish anaesthetic for measuring length and weight of rabbitfish (*Siganus lineatus*). Aquaculture 135: 149–152.

