PHOTOS BY MARK EDMANN & LIDA PET-SOEDE

Plectropomus *spp. kept in very high densities in holding cage.*

How fresh is too fresh? The live reef food fish trade in Eastern Indonesia

Mark V. Erdmann and Lida Pet-Soede

Although the live reef food fish trade has become an increasingly "hot" topic in the environmental press in recent months, many of the sources reporting on this practice have tended to focus on issues related to the rampant use of sodium cyanide in the trade, rather than the more pressing matter of the looming potential for overexploitation engendered by this practice. We present here a brief overview of the live reef food fish trade as it is practiced in Eastern Indonesia — the methods used and the economics, geographic extent and numerous deleterious effects of the fishery — in order to demonstrate the rather dire situation facing the countries which allow this extremely unsustainable practice to continue in their waters.

The Live Fish Trade

The live reef food fish trade is fueled by the heavy demand in Hong Kong, Singapore, Taiwan, mainland China, and other Chinese centers for the "ultimate" in fresh fish: those which are selected live from restaurant aquariums only minutes before eating. Such fish are highly prized not only for their freshness and flavor, but also for their reputed virility-enhancing and overall health-promoting qualities. The target reef fish species include rock cod and groupers (*Epinephelus* spp.), coral trout (primarily *Plectropomus* spp., but also *Cephalopholis* and *Variola* spp.), barramundi cod (*Cromileptes altivelis*) and the Napoleon wrasse (*Cheilinus undulatus*). Nonreef species such as the sea bass (*Lates calcarifer*) are also part of this trade, but shall not be further considered in this article.

The prices paid for these highly prestigious fish are extraordinary: a single, large 40 kg Napoleon wrasse can sell for over US$5 000, including up to US$245 for the lips alone! Napoleon wrasse and barramundi cod are the two most sought-after species, followed by the more common coral trout and grouper species. R. Johannes and M. Riepen report that on average, live reef fish fetch prices 400-800% higher than identical, but dead, fish in Hong Kong. The economic rewards of this fishery are alluring to fishers and business persons alike; each year the ranks continue to swell as more companies are enticed into the business. The trade now stretches from the Maldives to the South Pacific Islands, with the Philippines and Indonesia supplying the vast majority of the fish to date. According to industry representatives, stocks in these two countries are expected to collapse within a few years, after which the trade will focus increasingly on Papua New Guinea and the Pacific Islands.

Capture of the fish by stunning them with cyanide solution is the most common method. In addition to cyanide-fishing, significant numbers of live fish are captured using hook and line, fish traps, or nets. In Indonesia, fish are collected by two types of fishers: individuals working alone or in small groups in locally modified boats, often with loaned equipment/cyanide, and by well-organized teams of divers working from large "catcher" ships equipped with 6-10 fiberglass dinghies and live-hold tanks that can accommodate 1-2 t of live fish. Such vessels can range much further afield than small boats, although both types deposit their catch in the same holding cages at central collection points. Fish then await collation into volumes large enough to justify pick-up and transfer by large transfer vessel ("storage" times can vary from only two weeks in the largest collection centers like Ujung Pandang and the Moluccas, to four months in smaller areas like the Togian Islands). Hong Kong is the primary destination for fish caught in Eastern Indonesia, although increasing volumes are now trans-shipped to mainland China as well.

Economics of the Trade

As mentioned above, the prices fetched for live fish make the trade irresistible to many Southeast Asian fishers. Table 1 summarizes the price structure for the most commonly targeted live food fish species, with a comparison to the most expensive chilled export species in Sulawesi, Indonesia. The figures are illuminating: fishers make 2-25 times more for live fish than for comparable dead ones, and the price roughly doubles at each step up in the business. For fishers, these are heady incentives; we calculate that fishers in the live trade receive US$150-500/month, which is 3-10 times the average monthly salary of artisanal fishers, and 1-3 times that of university lecturers! Local fish exporters can also make enormous gains, although many new ventures end in bankruptcy in this highly secretive and competitive business. The success of local businesses hinges on preventing high fish mortality; a well-managed cage operation with proper antibiotic/antifungal treatment, proper feeding, and optimal fish densities can maintain mortalities at a modest 10-25%. However, inexperienced operators can suffer up to 100% mortality due to rough capture/handling of the fish, inadequate shading of the cages, heavy wave damage, overfeeding, overcrowding and exceptionally long storage times.

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Accurate figures for the volume of live fish traded are extremely elusive; many exporting countries such as Indonesia have no official records for the live trade, while importing countries like Hong Kong can only provide statistics for gross weights of air/land shipments. In by far the most comprehensive study of the trade to date, Johannes and Riepen estimate that the total annual volume of wild-caught live reef food fish traded in the Asia/Western Pacific region is 11 000 to 16 000 t,

Table 1. Prices of selected live fish for fishers, local exporters and wholesalers/restaurants, 1995. All prices are for Sulawesi, Indonesia, unless otherwise noted. Restaurant prices are scarce in the literature and are therefore grouped with wholesale prices.

Species	Fishers (US$/kg)	Local exporters (US$/kg)	Wholesale/ Restaurants (US$/kg)
Epinephelus spp., *Plectropomus* spp., *Cephalopholus* spp.	5-12; 12[1]	25	70-100[2]
Cromileptes altivelis	20	50	90-150[2]
Cheilinus undulatus	20-25	50	90-180[2]
Scomberomorus commerson (chilled export)	2	3-5	—
Unspecified grouper (chilled export)	1-5	5-7	6-25[2]

Sources: [1] Philippines (Pratt 1995); [2] Hongkong (Johannes 1995).

Table 2. Annual volumes of selected fish exports from Ujung Pandang, South Sulawesi, Indonesia and the Philippines.

Area and type of fish	Amount exported (t/year)
Dead grouper from Ujung Pandang (1993)	305[1]
Live grouper from Ujung Pandang (1994/1995)	306[2]
Live grouper from Indonesia (1994/1995)	1 870[2]
Live reef fish from the Philippines (1995)	3 000[3]; 6 000[4]

Sources: [1]Official statistics; [2]Based on overall estimate of 360 t/year for all live reef fish exports, Ujung Pandang and 2 200 t/year for Indonesia. Of this, groupers comprise approximately 85% (35% Epinephelus spp., 45% Plectropomus spp., and 5% C. altivelis); C. undulatus is roughly 15%. [3]Based on exports for January-October 1995 (Pratt 1995); [4]Based on exports for January-July 1995 (Johannes 1995).

with Indonesia supplying roughly half of that volume in recent years. Although we cannot comment on the accuracy of their overall figure, our best estimate of total annual Indonesian live food fish exports is only 2 200 t for 1995, based on extensive interviews/personal observations throughout Eastern Indonesia. This figure is substantially lower than the Johannes and Riepen report, and is only 33-66% of the figures reported for Philippine exports in 1995 (Table 2).

Similarly, an evaluation of the relative significance of the live grouper trade to the overall grouper fishery in Indonesia gives conflicting results. In Ujung Pan-dang (one of the largest collection points for the live fish trade in Indonesia), the annual export volume of live groupers for 1994/1995 approximately equals the annual volume of dead groupers landed in 1993 (Table 2). While these figures are not completely comparable, it should be noted that a substantial percentage of the dead groupers landed are simply dead fish from the live cages. As such, it seems reasonable to suggest that for Ujung Pandang, the live grouper trade equals, if not surpasses, the traditional grouper fishery. The situation is different if one examines figures for Indonesia as a whole. Official government statistics record 21 757 t of dead grouper landed in 1992, ten times our estimate of the live food trade. These figures appear to relegate the live grouper trade to a less significant position within the overall grouper fishery.

Deleterious Effects of the Live Fish Trade

Grouper and other reef fish have traditionally supported important fisheries in many countries; the recent trend towards maintaining them alive can hardly be considered unfavorable in itself. However, certain aspects of the live reef fish trade, as it is practiced in most tropical Asian countries, make it an extremely damaging fishery.

The most well-publicized of the negative aspects of the trade is what Johannes and Riepen (1995) refer to as the "extensive collateral environmental damage" caused by the fishery, particularly by the use of sodium cyanide. Cyanide solution in concentrations used to capture large reef fish has been shown to be lethal to most reef organisms, including smaller fishes, reef invertebrates, and most importantly, the reef framework builders themselves: the hard corals. Filipino fishers and divers alike are increasingly reporting reefs "treated" with cyanide which are little more than bleached calcium carbonate deserts. In our experience, these reports are somewhat extreme; reefs in Eastern Indonesia which have been positively cyanide-fished often are most conspicuous for the complete absence of serranids (juveniles included) and the curious feature of a ring of dead, bleached coral surrounding virtually every hole in the reef structure. This apparent disparity in the effect of cyanide use is perhaps best explained by the interaction of the different environmental conditions experienced by these reefs; Filipino fishers appear to use much greater quantities of cyanide per unit area than do their Indonesian counterparts, and Philippine reefs may be subject to higher levels of synergistically-injurious sedimentation and pollution than reefs in remote Eastern Indonesia. Regardless, it seems unarguable that cyanide use is harmful to reef communities and deserving of its notorious reputation.

Another potential ill-effect of the live fish trade is the possibility of human health problems caused by consuming cyanide-tainted fish. To date there do not seem to be any cases of cyanide poisoning from eating live fish in the importing countries; however, these imported live fish did not receive lethal doses. In Indonesia, those fish which die from cyanide overdose are commonly sold on the local market. These fish would certainly present a greater health risk than the imported fish, but

Cheilinus undulatus *in holding pen in Sulawesi. Napoleon wrasse are illegal to export from Indonesia.*

Before release into holding cages, fish are treated with antibiotics.

the general lack of health care in fishing communities would presumably inhibit any epidemiological studies on cyanide effects. The effects discussed above relate primarily to the use of sodium cyanide, and are certainly noteworthy. However, we believe that the most alarming effect of the live reef food fish trade is irrespective of capture technique; the tremendous financial incentives provided by the fishery are sufficient to ensure that management will be extremely difficult and severe overexploitation of target stocks seems inevitable. The very high prices fetched for live reef fish encourage many fishers to enter the fishery. New fishers have no concept of traditional limits on fishing, and even experienced fishers may be lured by the large amounts of money involved to disregard traditional limits. Export companies provide the capital equipment and infrastructure to allow fishers to exploit remote areas which previously were only lightly fished. The trade is so lucrative that it has spread feverishly throughout Indonesia, opening live grouper fisheries in areas that traditionally concentrated only on pelagic and squid fisheries. Local overexploitation seems imminent: the sedentary nature of grouper species makes them very susceptible to overfishing. The likelihood of cyanide-related side kills of recruitment-limited serranid juveniles only enhances the potential for overfishing.

Despite the apparent logic of the above arguments, it is difficult to demonstrate overfishing caused by the live reef fish trade. On one hand, anecdotal evidence of overexploitation is abundant: fishers and dive operators 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 which are exhausted; they reportedly give the whole of Indonesia only three more years of financially viable operation. Hong Kong transport vessels which used to make collection visits in Ujung Pandang every two weeks are now much less regular in their schedules. Nonetheless, solid evidence is lacking. The above analysis of the importance of the Indonesian live grouper trade in relation to overall grouper landings does not appear to support assertions of overfishing; a practice which accounts for only 10% of the overall grouper fishery can hardly be claimed to cause overfishing. Even substituting a figure of 6 000 t/year of live grouper exported from Indonesia (as reported by Johannes and Riepen) fails to produce a potentially dominant position for the live grouper trade. The source of this major discrepancy in our assertion versus the above statistics is unclear; nevertheless, we maintain that the live reef food fish trade in its current form has tremendous potential to cause local overexploitation, if not local extinction, of target fish species' stocks.

Two final injurious effects of the live fish business on local communities are worth mentioning. First, this practice, especially when it involves sodium cyanide use, effectively robs communities of any diving ecotourism potential of their reefs. Dead corals and a lack of large fish are rarely considered diving attractions. Perhaps more importantly, diving accidents are commonplace among divers in the live fish trade. Very few of the local divers employed in the business have any knowledge of diving physics, and nearly 100% of the divers interviewed have suffered at least

Fishers transfer a recent catch to the holding cage complex.

minor symptoms of decompression sickness. Severe paralysis and even death are not uncommmon. Without enforced diver education, these conditions are likely to persist.

Prospects for Management

In most of the source countries, the live reef food fish trade is limited to some extent. Most countries prohibit the use of sodium cyanide to catch fish, but enforcement is generally lacking (local officials are either paid to look the other way, or may even be partners in the business). In Indonesia, it is only illegal to use cyanide for fish capture; possession of cyanide on fishing vessels is permitted for "tranquilizing" purposes. Legal loopholes such as this make enforcement virtually impossible. Both the Maldives and Indonesia prohibit or severely limit the capture of Napoleon wrasse. In Indonesia, this restriction is easily avoided by several means: individual operators simply photocopy the difficult-to-obtain permits, and Napoleon wrasse shipments are intentionally mislabelled as grouper (Johannes,1995). Again, the big money involved in the trade seemingly precludes any significant regulation of the live fish business.

To end on an even more pessimistic note, it seems that even the rapidly developing grouper aquaculture industry is unlikely to provide relief to pressures on wild stock. Johannes and Riepen conclude that "whatever species remain uncultured will hold special appeal for many Chinese consumers, for whom rarity and "wildness" are major gastroeconomic virtues..." With such a bleak outlook for the future of this trade, one is tempted to ask the question, "How fresh is too fresh?"

Further Reading

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M.V. Erdmann is a PhD candidate in coral reef ecology from the Department of Integrative Biology, University of California, Berkeley, CA 94720 USA. **L. Pet-Soede** is a PhD candidate in coral reef fisheries biology and management from Department of Fishculture and Fisheries, Wageningen Agricultural University, The Netherlands. Both authors are conducting their dissertation research in Indonesia.