Troubled times for trysting trio: Three aggregating groupers in the live reef food-fish trade

(from SPC Live Reef Fish Bulletin Volume 13, 2005)

Yvonne Sadovy[1]

The trade in live reef fish for food has a long history in Southeast Asia but expanded particularly rapidly during the 1990s and, today, is a multimillion (USD) dollar business that involves countries throughout much of the tropical Indo-Pacific region (Johannes and Riepen 1995; Sadovy et al. 2003). The geographic expansion of the international trade in live fish was partly due to improvements in economic climate and higher consumer demand, and partly the result of declines in fish stocks in the South China Sea. Improved air links also spurred the expansion, allowing for the more rapid transport necessary for live animals. With the increase in the number of source countries and their long distances from the trade centers of Singapore and, particularly, Hong Kong (as a gateway to mainland China), so too did the number of species in trade grow. Most of the species in the trade belong to just a few fish families, above all the groupers (Serranidae).

The groupers make up the bulk of the live reef food-fish trade in terms of both volume and value, comprising hundreds of tonnes each year, and fetching high unit prices at retail (Figures 1 and 2; Table 1). Groupers, however, tend to be susceptible to high levels of uncontrolled fishing because they are typically long-lived (it is not unusual to find groupers living 15 or 20 years, or even longer), slow to mature, and many species aggregate (form groups) to spawn (reproduce). Their long life and late sexual maturation mean that populations are typically slow to replace themselves, or to recover from overfishing, while their aggregating habit makes them easy to target in large numbers while spawning. In an economically valuable fishery, in which there is much interest in catching as many fish as possible in a short time and shipping them back to demand centres, spawning aggregations are particularly attractive to target. However, aggregation-fishing can very rapidly deplete spawning aggregations and, in more extreme cases, lead to serious declines in the fishery (Sadovy and Domeier 2005). All of the species in Table 1 are important live food fish, all aggregate to spawn, and their aggregations are sometimes targeted for the live fish trade.

In this article I chronicle our growing understanding of the particular vulnerability of, and biological interrelationships between, three of the most economically valuable species in the live reef food-fish trade: brown-marbled grouper, camouflage grouper and squaretail coralgrouper (Figure 2). I use this species trio to demonstrate how vulnerable aggregating species in the Indo-Pacific can be to unmanaged fishing (whether for live or dead fish) and explore what we need to know to manage them effectively.

[1] Society for the Conservation of Reef Fish Aggregations (www.scrfa.org), Department of Ecology & Biodiversity, University of Hong Kong. Email: yjsadovy@hkucc.hku.hk

Table 1. The most valued species in overall volume in the live reef food-fish trade centred in Hong Kong. Note that the mouse grouper, *Cromileptes altivelis*, and the giant grouper, *Epinephelus lanceolatus*, are also high in unit value but are not traded in high volumes. Almost all fish of the four listed species have been sourced from the wild.

Scientific name	FAO (Hong Kong trade name) name	Wholesale (retail) price (USD/kg) in Hong Kong and southern China (2001)[1]	Price paid to fisher (USD/kg) (1999-2001)[2]
Epinephelus fuscoguttatus	Brown-marbled (tiger) grouper	26 (51)	7-12 (Philippines) 1-2 (Indonesia) 4-5 (Australia)
Epinephelus polyphekadion	Camouflage (flowery) grouper	26 (51)	Same as for *E. fuscoguttatus* although depends on fish size as well
Plectropomus areolatus	Squaretail coralgrouper	Approximately between the prices for *E. polyphekadion* and *P. leopardus*	
Plectropomus leopardus	Leopard coralgrouper	38.5 (64)	7-28 (Philippines) 6-12 (Indonesia) 10-25 (Malaysia) 10-17 (Vietnam) 12-33 (Australia)

1. International Marinelife Alliance, Hong Kong Office – data from regular market surveys.
2. Sadovy et al. (2003) – the values are for guidance only since they can vary somewhat within country, according to fish size, etc.

Figure 1. Live groupers and a few snappers in a tank outside a restaurant in Hong Kong, awaiting sale to diners. All of the fish have been imported; the sources of live reef fish-fish found in Hong Kong's markets include Southeast Asia, the eastern Indian Ocean and the western Pacific Ocean. Hong Kong imports an estimated 60 per cent of all fish in the trade (Johannes and Riepen 1995).

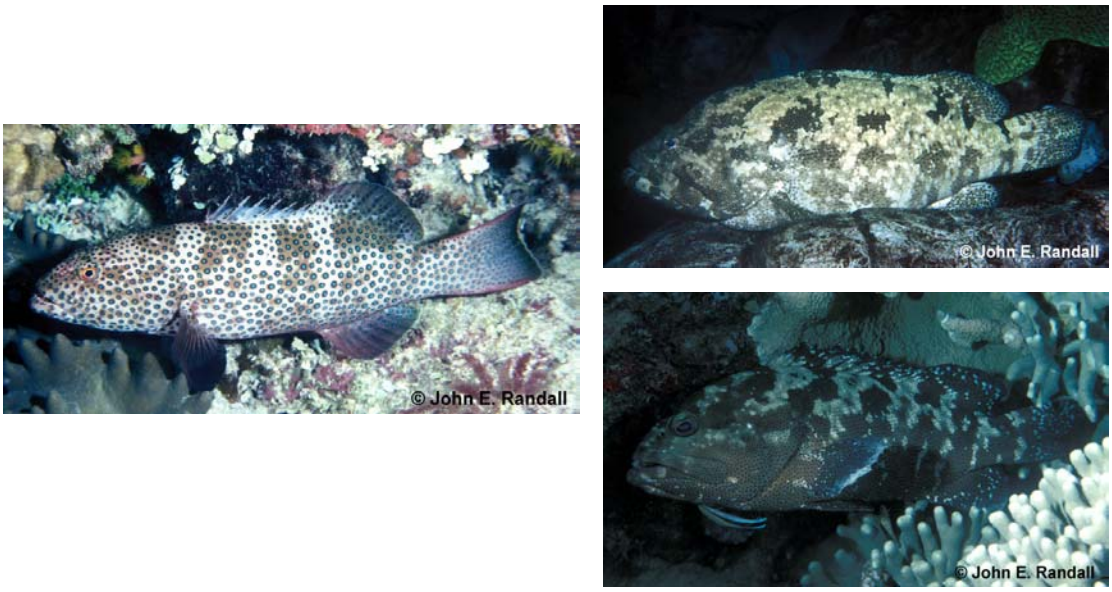

Figure 2. (a) *Epinephelus fuscoguttatus*, brown-marbled grouper (upper right); (b) *E. polyphekadion*, camouflage grouper (lower right); (c) *Plectropomus areolatus*, squaretail coralgrouper (left). Reproduced with permission from the Food and Agriculture Organization of the United Nations from the publication by Heemstra and Randall (1993).

A pattern that has emerged over the last three to four years of underwater observations and surveys of fishers is that, more than any other group of species known, the camouflage grouper, the brown-marbled grouper and the squaretail coralgrouper often form spawning aggregations, together, throughout much of their geographic ranges. The co-occurrence of the three species was initially noted in Palau (Johannes et al. 1994) but it was only when fisher surveys were conducted much more widely that it became apparent that this particular species association was quite widespread and, apparently, consistent (see the fisher survey reports database of the Society for the Conservation of Reef Fish Aggregations (SCRFA) at www.scrfa.org). Associations between at least two of the species, and often all three, have now been reported from Indonesia, Palau, Federated States of Micronesia, Solomon Islands, Papua New Guinea, Seychelles (no squaretail coralgrouper), New Caledonia (no squaretail coralgrouper), Malaysia, Maldives (no squaretail coralgrouper) and Fiji. The natural geographic ranges of the three species partially explain these patterns: while the camouflage and brown-marbled groupers have very similar global distributions, the squaretail overlaps with the other two only in some areas (Heemstra and Randall 1993). In at least one place where the squaretail coralgrouper does not occur, a different *Plectropomus* species makes up the trio. An example of this is *P. punctatus* in the Seychelles (Robinson 2004). In addition to forming large aggregations at sites shared by the two groupers, *P. areolatus* also spawns in other outer reef areas in small groupings and thus show signs of being a resident spawner (i.e. it may not travel far from resident sites to form spawning aggregations), like its congener, *P. leopardus* (Domeier and Colin 1997).

Despite these differences, the three species often spawn in the same general areas in outer reef passes or channels or along the outer reef slopes, often not far from passes. Within such shared sites, however, they typically occupy distinctly different areas or habitat, and may not all aggregate at exactly the same time, maybe separated by a month or so in spawning activity.

Moreover, different species will dominate in terms of numbers at individual sites, possibly a reflection of individual site characteristics. In some fisher interviews I have even noted that the more observant spearfishers can describe these different species' distributions in some detail.

The three groupers are economically valuable and vulnerable to uncontrolled fishing, as noted both from specific case studies as well as documented in fisher interviews. One early indication of their vulnerability came from Palau: several grouper spawning aggregations disappeared in or after the 1970s (Johannes and Riepen 1995), possibly due to overfishing. One of these aggregations consisted mainly of camouflage grouper and brown-marbled grouper and was lost in the 1990s. Another aggregation, mostly of squaretail coralgrouper and brown-marbled grouper, was almost eliminated from Denges channel in the late 1980s by a live grouper-for-export fishing business.

Fisher interviews conducted by SCRFA in several western Pacific countries during 2003 and 2004 revealed that many of the aggregations of one or more of these species were thought to be declining in terms of numbers of fish (Figure 3). Although these general trends could only be very crudely determined and await validation, different communities often reported very similar patterns for the same aggregation sites and species, suggesting that changes had been consistently perceived by interviewees.

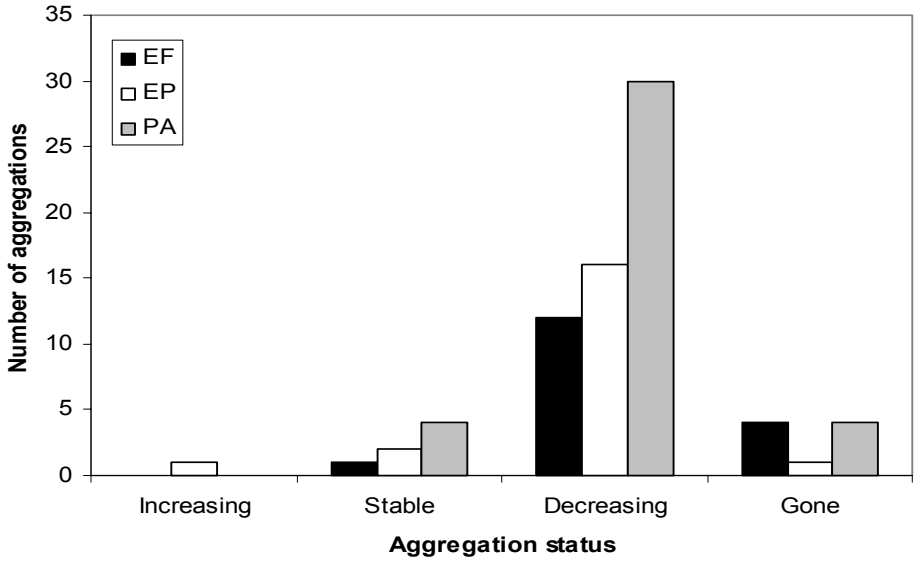

Figure 3. The status (in terms of 4 categories that refer to trends in catches) of 75 aggregations (according to not yet validated fisher surveys) of *Epinephelus fuscoguttatus*, brown-marbled grouper (EF), *E. polyphekadion*, camouflage grouper (EP) and *Plectropomus areolatus*, squaretail coralgrouper (PA) from 11 countries in the Indo-Pacific (see database at www.scrfa.org).

There is a growing realization that spawning aggregations are particularly vulnerable to fishing and that they often need management or protection from excess fishing activity. Fishing on aggregations can be for subsistence or commercial purposes, and for live or dead fish. It is the commercial level of fishing intensity that appears to pose a real threat to spawning aggregations. While the most intense threat in some places may be from the large-scale live reef fish operators (some of whom aim to catch more fish than they need to compensate for mortalities), there is a significant trade in chilled fish that is based on fish caught in aggregations. Moreover, some live fish traders prefer not to take groupers from aggregations because the stress experienced by the animals (especially females full of eggs) during those periods tends to result in high levels of mortality (Patrick Chan, pers. comm. 2003, Chairman, Chamber of Seafood Merchants, Hong Kong). Nonetheless, many fishers and traders continue to view these gatherings as a way to obtain many fish quickly, reduce crew costs, and in the case of traders, to sometimes benefit from the lower prices paid to fishers due to the large numbers of fish that suddenly become available on the market. The grouper trio aggregations are particularly attractive to fish and thus susceptible to overfishing.

To better manage aggregating groupers we need more information in several areas, among which the most pressing questions are:

- How far do fish travel from their home reefs to the aggregation site and, therefore, how big an area does a single aggregation site "service"? Answering this question is important for understanding the distance over which a fishery might be affected if an aggregation disappears from overfishing and for determining the management area that needs to be considered.

- How much of the annual landings come from aggregations and how much from fishing the species at other times of the year? Knowing this is important for determining when and how management is best implemented – management may be needed at both aggregating and non-aggregating times, for example.

- How should the aggregation be managed? Seasonal closures and sales bans are widely practiced but it is also possible to protect the spawning site itself. The best approach will depend on the location of the aggregation, enforcement capacity, etc.

- How should the aggregation be monitored, given local social and economic circumstances, enforcement capacity and the fishing pressure? Effective management is only possible with good monitoring (see the article by Sadovy, Colin and Domeier in this issue).

- How big is the aggregation area of all species combined? Each species tends to group in different areas within a larger site so the areas of all three species should be considered if area management is used.

- What are the spawning seasons for each species? This information is important for seasonal management. For example, although the three groupers share an aggregation area, they often do not overlap completely in terms of the timing (months) of aggregation, and, even within

one country, the aggregation months can vary widely. Therefore, national-level seasonal regulations may not be appropriate and locally relevant measures would need to be adopted.

- Does the value of the fish vary according to whether or not the species is taken during the spawning season or according to the number of fish on the market? For example, in Fiji, fish caught during the aggregating season are sold for 50 per cent of the price at non-aggregating times. Better economic data could help communities plan to get better value for their fish.

I have focused on the three grouper species because they are valuable and heavily sought for the live food-fish trade and because their aggregations can be very predictable in their location and timing (although studies are needed to better understand the patterns). Moreover, their potential economic yield makes them especially appealing to target. Careful management can ensure that the aggregations persist, and, with them, the fishes and their fisheries.

References

Domeier, M.L. and Colin, P.L. 1997. Tropical reef fish spawning aggregations: Defined and reviewed. Bulletin of Marine Science 60(3):698-726.

Heemstra, P.C. and Randall, J.E. 1993. Groupers of the world (family Serranidae, subfamily Epinephelinae): An annotated and illustrated catalogue of the grouper, rockcod, hind, coral grouper and lyretail species known to date. FAO Fisheries Synopsis No. 125, Volume 16. United Nations Food and Agriculture Organization, Rome. 382 p.

Johannes, R.E. and Riepen, M. 1995. Environmental, economic, and social implications of the live reef fish trade in Asia and the Western Pacific. The Nature Conservancy and the South Pacific Forum Fisheries Agency. 79 p.

Johannes, R.E., Squire, L. and Graham, T. 1994. Developing a protocol for monitoring spawning aggregations of Palauan serranids to facilitate the formulation and evaluation of strategies for their management. FFA Report 94/28. South Pacific Forum Fisheries Agency. 25 p.

Sadovy, Y. and Domeier, M. 2005. Are aggregation fisheries sustainable? Reef fish fisheries as a case study. Coral Reefs 24(2):254-262.

Sadovy, Y.J., Donaldson, T.J., Graham, T.R., McGilvray, F., Muldoon, G.J., Phillips, M.J., Rimmer, M.A., Smith, A. and Yeeting, B. 2003. While stocks last: The live reef food fish trade. Manila: Asian Development Bank. 147 p.