Asia-Pacific Marine Finfish Aquaculture Network

Magazine

SKRETTING

Some insights into the live marine food fish markets in the region

Sih Yang Sim

Network of Aquaculture Centres in Asia-Pacific, PO Box 1040, Kasetsart Post Office, Bangkok 10903, Thailand.

Marine finfish species such as groupers, snapper, seabass and other coral reef species command premium prices when sold live in seafood restaurants in the Asia-Pacific region. For example, a plate size seabass (*Lates calcarifer*), 400-700 g may cost 100-150 Baht/kg (US$1 = Baht 41) in a supermarket or wet market in Bangkok, but in local restaurants the table served prices can range from 120-250 Baht/fish or 300-357 Baht/kg. In the premium seafood places in the Central Business District of Bangkok, live seabass fetch as high as 500 Baht/kg, excluding costs of cooking and preparation.

Epinephelus coioides (green grouper or orange-spotted grouper) is the most common grouper species farmed in Thailand. At one stage during the SARS period, the price dropped to 120 Baht/kg at the farm gate but it has steadily increased to around 220-240 Baht/kg. The green grouper is priced at around 700-900 Baht/kg in most live seafood restaurants in Bangkok central business district. In Singapore, the buying price for imported live green

Network supported by:

Australian Government
Australian Centre for International Agricultural Research

APEC

Marine Finfish Aquaculture Magazine
An electronic magazine of the Asia-Pacific Marine Finfish Aquaculture Network

Contact
Asia-Pacific Marine Finfish Aquaculture Network
PO Box 1040
Kasetsart Post Office
Bangkok 10903, Thailand
Tel +66-2 561 1728 (ext 120)
Fax +66-2 561 1727
Email grouper@enaca.org
Website http://www.enaca.org/marinefish

Editors
Sih Yang Sim
Asia-Pacific Marine Finfish Aquaculture Network, c/o NACA
sim@enaca.org

Dr Michael J. Phillips
Environmental Specialist & Manager of R&D, NACA
Michael.Phillips@enaca.org

Simon Wilkinson
Communications Manager, NACA
simon.wilkinson@enaca.org

Dr Mike Rimmer
Principal Fisheries Biologist (Mariculture & Stock Enhancement)
DPIF, Northern Fisheries Centre
PO Box 5396
Cairns QLD 4870
Australia
Mike.Rimmer@dpi.qld.gov.au

grouper from Malaysia is around S$15/kg (US$8.90) as at September 2004.

In Hong Kong, live marine finfish traders expect the price for green grouper to increase toward the end of the year during the festive seasons. It is also expected that consumption of green grouper will remain high as it is the most common grouper species used for special banquets such as wedding, birthdays and company dinners.

Cultured vs wild grouper

Although many claim that the taste of cultured grouper and wild grouper cannot be differentiated by professional tasting panels, consumers from China, Hong Kong, Singapore and Malaysia still prefer wild grouper. Could this be merely the taste that consumers preferred or could it be the perception that wild products taste better and are healthier than the farmed products? As a comparison, Malaysia's "kampung chickens" or Thailand's "kai baan", native chickens that are grown in a free range condition without (or with limited) commercial poultry feed always command a higher price due to its taste and lower fat levels relative to commercially farmed chickens.

When we discussed this issue with traders from Singapore, Hong Kong and China they said that those consumers who have more cultivated "taste buds", can tell whether a grouper or other marine fish is farmed or wild caught. For example, green groupers from Thailand are considered low quality due to a muddy taste from traditional culture in mangrove creeks and earthen ponds. Similarly seabass farmed in earthen ponds or freshwater also tend to have an off flavor and can be distinguished by their darker colouration, which is a marketing problem and leads to a lower price.

They also pointed out that farmed *Cromileptes altivelis* (mouse grouper, barramundi cod) can be identified visually, as farmed mouse groupers generally have a shorter and fatter body than their wild cousins. Farmed mouse groupers are also more difficult to handle and transport as they are less hardy then the wild ones. A trader from Singapore reported that a 150kg air shipment of table size mouse groupers to Hong Kong recently turned out to be a total disaster with all of the fish dying during transit. Could the problem have been poor packing and handling, or are farmed mouse groupers genuinely less hardy ? Hong Kong traders also confirm that farmed mouse groupers are less tolerant of handling, more susceptible to stress and suffer higher mortality. Such losses would add to costs and may be one factor affecting the premium price for mouse grouper in Hong Kong and China. Farm gate prices for mouse groupers in Indonesia are US$30-40/kg, while the wholesale prices in Hong Kong and China seafood markets are around US$ 84/kg. The challenge then for aquaculture is to produce high quality, tasty, and hardy fish.

Hong Kong traders are actively looking for sources of wild caught groupers species such as *E. polyphekadion*, *E. fuscoguttatus*, and *Plectropomus* spp. Recently, a 30 ton live fish vessel was put on hold at Hong Kong due to ciguatera, which was suspected to be coming from East Timor region. Import of live coral reef fish species from the Pacific islands are also falling due to ciguatera problems. With the export quota enforced on live coral reef fish exports from Queensland, Australia in July 2004, it is very likely that species such as *Plectropomus* spp., the major species exported from Australia will be in short supply leading to an escalation in price.

Domestic vs international markets

Most farmers only focus on export markets for live marine finfish. There is no doubt that prices for markets such as Hong Kong and China are higher, but the risk is also high for sellers and buyers. For example, if an Indonesian exporter sends an air shipment of live marine finfish to Hong Kong the mortality rate on arrival may be 10%. In this case the exporter will bear the financial losses for this 10% mortality and eventually the loss may be passed on to the farmers. Dead grouper can be sold at the market but the price is generally less than one third of the live fish.

Should marine finfish farmers in the region only target Hong Kong and China live fish markets or should they also consider domestic markets for

larger fish? In Malaysia, with about 30% Chinese population, the eating habits for the Chinese community are similar to those in Hong Kong or China. A visit to the local fresh market has provided an indication that groupers are also sold here as fresh fish, in addition to the live fish segment of the hotel and restaurant industries. Groupers sold in the fresh market are mostly green groupers. Most are more than 1 kg and sold as fillet or "block", priced at around RM 37/kg (US$ 9.74). Although groupers in this market only make up a very small part of the wide variety of marine finfish species sold the market demand can be considerable if every fresh market in Malaysia is selling similar quantities. Indonesia, the Philippines and Thailand might also wish to consider developing their domestic markets for grouper species. A good example is the successful replacement of the export market for *Penaeus vannamei* shrimp by domestic consumption in PR China and Thailand. A stable domestic market can absorb a portion of farmed production, reducing risk when extraordinary events in Hong Kong and China cause prices for grouper to fall. A more stable market would be a significant benefit for farmers, particularly small-scale operators, providing a buffer from financial turmoil from such events.

Mr Sih Yang Sim of NACA is currently registered with Deakin University, School of Ecology and Environment, Australia, for a PhD research program on "An economic analysis of the grouper aquaculture industry in selected countries in the Asia-Pacific".

Focus on markets, trade and economics

Welcome to the second edition of the Asia-Pacific Marine Finfish Aquaculture Network's e-Magazine. The quarterly e-Magazine complements the fortnightly e-News by publishing full-length articles on various aspects of marine finfish aquaculture in the Asia-Pacific region.

This edition focuses on market, trade and economic issues. The rapid development of marine finfish aquaculture in the region is to a large extent in response to the strong demand and high prices for many marine finfish species, such as snappers and groupers. Information on markets and trade is valuable for farmers, aquaculture suppliers and managers.

The next issue will feature nutrition, feeds and feeding practices. We encourage the submission of articles on these topics from network participants. Send submissions to:

Asia-Pacific Marine Finfish Aquaculture Network (APMFAN).
c/o: NACA, PO Box 1040
Kasetsart Post Office,
Bangkok 10903, Thailand
Tel: 66-2-561 1728 (Ext 120);
Fax: 66-2-561 1727
Email: grouper@enaca.org
Website: www.enaca.org/marinefish/

This issue also introduces a new sponsor for APMFAN: Skretting Australia Pty Ltd. Skretting have agreed to sponsor the network for the next two years, including sponsoring this e-Magazine and the e-Newsletter. We gratefully acknowledge Skretting's contribution to the development and growth of APMFAN and look forward to continuing to work with Skretting towards the development of sustainable marine finfish aquaculture in the region.

Sih Yang Sim, Michael J. Phillips, Simon Wilkinson and Mike Rimmer.

Farming practices, market chains, and prices of marine finfish in Malaysia

Sih Yang Sim[1], Paolo Montaldi[2], Alessandro Montaldi[2] and Hassanai Kongkeo[1]

1. Network of Aquaculture Centres in Asia-Pacific, PO Box 1040, Kasetsart Post Office, Bangkok 10903, Thailand.
2. Terre des hommes Italy (TDH). c/o Andaman Sea Fisheries Research and Development Center, 77 Sakdidej Road, Wichit, Amphur Muang, Phuket 83000, Thailand

This article summarises findings from field trips to Malaysia conducted as part of a regional survey of NACA/TDH (Terre des Hommes Foundation - Italy) in cooperation with the Asia-Pacific Marine Finfish Aquaculture Network. The surveys were conducted in March-August, 2004 facilitated by the Department of Fisheries, Malaysia

Marine finfish are widely cultured in Malaysia. This may be due to three main factors: The Malaysian government's strong promotion of aquaculture, particularly of marine finfish farming; the economic success of many marine finfish farms, and continued domestic and regional market demand for marine finfish. The annual fish consumption per-capital in Malaysia is around 50 kg.

In 2004, more than 16 marine fish species are being cultured in Malaysia either for local consumption or export, based on local hatchery produced or imported fingerlings. Species commonly found in Malaysian farms include *Epinephelus coioides* (green grouper), *E. fuscoguttatus* (tiger grouper), *E. lanceolatus* (giant grouper), *Lates calcarifer* (seabass), *Lutjanus argentimaculatus* (mangrove snapper), *L. johnii* (John's snapper), *L. stellatus* and *Trachinotus blochii* (pompano). Other marine finfish

Aerated larvae tank with newly hatch larvae and live food organisms.

Hapa system used in an open pond hatchery system in Penang.

Earthen ponds used for seabass culture in Penang.

species such as *Cromileptes altivelis* (humpback grouper), *Cephalopholis miniata* (coral hind), *Eleuthonema tetradectylum* (fourfinger threadfin), *Gnathanodon speciosus* (golden trevally), *Pomadasys unimaculatus* (red patched grunter), *Rachycentron canadum* (cobia), *Chanos chanos* (milkfish), *Caranx ignobilis* (giant trevally) are farmed but less common.

The following observations are based on field visits to three areas in West Malaysia (Penang, Kedah, and Johor) where there is substantial marine finfish farm development. Hatchery and farming practices currently being adopted in these three areas are described together with information on market chains and fish prices.

Hatchery systems for marine finfish species

There are two common types of hatchery systems in Penang; concrete tanks and earthen ponds. Hatchery systems with concrete tanks are usually roofed but not enclosed. These are high-density larviculture systems normally used for grouper species, particularly for *E. fuscoguttatus*. This system consists of a big larval rearing tank about 6 x 6 metres in size and about 1 metre in depth. Each larval rearing tank is fully aerated by air stones through a blower. Artificial diets are not commonly used; rather rotifer, copepods and *Artemia* nauplii are used extensively.

The earthen pond hatchery system is based on the open pond hatchery system traditionally used in Chinese Taipei. The ponds are aerated by both paddle wheels and blowers, averaging 0.25 hectare and are stocked with 2-3 eggs per litre. There are two methods in which the fertilized eggs are stocked into the earthen pond, either directly, or using a hapa system. The hapa system basically uses a mosquito net or canvass to enclose a small section of the pond. In this way, observation of the newly hatched larvae is easier and if the hatching rate is poor the hatchings can be removed and a new batch stocked. The hapa system is only used for a short period (i.e. five days), after which the hapa are removed to allow the fish larvae to grow in the earthen pond feeding on zooplankton.

Direct stocking basically involves releasing the fertilized eggs directly into the pond. The disadvantage of direct stocking is that hatching and survival of larvae is hard to monitor.

The natural pond productivity is supplemented with additional rotifers and copepods produced through fertilization. When problems of low copepod productivity are sometimes experienced *Artemia* biomass (either produced in tanks or imported from Thailand) is used as a supplementary food for the marine fish larvae in the pond. Marine finfish species produced using this system are mainly threadfin and snapper. Survival rates are relatively low but overall this is a simple and economical production system that can be used for producing a wide variety of species.

Grow-out systems for marine finfish species

There are two main farming systems in the three areas we visited, floating cages and pond culture. Floating cages are more widely used for a large variety of marine fish species while pond culture is normally used for species such as threadfin and seabass, although these two species are also being farmed in floating cages.

Seabass farm in Penang

Ponds for seabass culture are commonly around 6,000 m^2 in area with a rectangular shape. Paddle wheels are used to provide aeration and generally 4 to 6 long shaft paddlewheels (5 wheels per shaft) will be used per pond, each driven by a 10 hp diesel engine. The stocking density is around 45,000 fingerlings per pond (average total length 7.5cm) at the seabass farm in Penang. The cost of fingerlings is approximately RM 0.50/piece. The farm we visited imports its fingerlings from Thailand as the farmer considers importing to be cheaper than producing them locally.

The growth of fingerlings in the ponds is rapid, reaching 100 grams at two months, 500-800 grams at seven months, and more than 2 kg at 18 months. The main production target is large size seabass for export to Singapore, with fish sold ex-farm to middlemen at RM 12.00/kg who resell to

Packing of seabass at the auction area on Penang fishing pier.

300-400 g threadfin being harvested at a Penang farm and ready for market.

Long floating cage for milkfish farming in Johor.

Singaporean traders for RM 14.00/kg. The silvery colouration of the seabass produced in Malaysia is preferred by both the local and Singapore markets over the darker coloured seabass produced under lower salinity culture in Thailand. The market price for Malaysian seabass is also higher compared to the Thai seabass.

The productivity for the Penang seabass farm is around 6-10 tonnes/ cycle at average 600 grams. The average survival is 60%, the lowest 30-40%. There is no significant record of disease so far.

Feeding is carried out two times per day, early morning and evening. It is common to use a mixed diet of trash fish and floating pellets to accustom fish to all-pellet diet when trash fish feeding must be discontinued because of seasonal scarcity. The farm we visited has tried several seabass feeds from Grobest and CP, but they have now found a generic "fish" feed with 38% protein content to be better in terms of performance and price, which they source from a company based in Chinese Taipei. They do not find it difficult to wean large (7.5cm) seabass fingerlings to pellets. At the beginning of weaning the pellets are squeezed into trash fish pieces and the fish is starved to accelerate acceptance.

The partial use of floating pellets seems to allow extended culture to produce large seabass as less trash fish waste accumulates on the pond bottom but the whole operation is running on tight margins. It appears that the Malaysian pond farming model for seabass allows better control over culture inputs (energy, labor, and specifically FCR) and overall farm economics.

Fourfinger threadfin

The farming of fourfinger threadfin in earthen ponds is similar to the seabass system but the stocking rate of 5 – 7.5cm fingerlings is only about 3-4 pieces per square metre. This fish is extremely aggressive and very sensitive to dissolved oxygen in the water, with low levels leading to mass mortality. Under optimal conditions the survival rate to harvest size is around 80-90%. The fish are fed with CP seabass dry feed (30% protein) and the estimated FCR is above 2. The fish can

Marine fish farm in Johor, showing workers grading tiger grouper fingerlings.

Giant grouper at a Johor marine fish farm.

Pompano fingerlings at a Johor marine fish farm.

grow to 300-400 grams within 10 months. Export to Singapore is feasible if local Penang markets (300 kg/day) have been saturated.

Farming threadfin in floating cages is also being carried out in Johor and the feed used for grow-out is also seabass feed. Threadfin are aggressive feeders.

Milkfish

Milkfish are farmed in Johor in floating cages of 6 x 60 x 3 metres in size, much larger than the normal floating cages used for marine fish. Production per cage is about 10-15 tons with average milkfish weight around 500-700 g. The production cycle is about 18 months.

The prices for milkfish range from US$1.05, US$1.20 to US$2.00 per kg depending on the size, with larger fish receiving a higher price per kilogram. Milkfish fry are all imported from either Indonesia or Chinese Taipei.

Grouper, snapper and other marine finfish

Floating cages are the most common system used for farming of grouper, snapper and other marine finfish in Malaysia. The most common net cage used for farming is 3 x 3 x 3 metres. Carnivorous species such as grouper and snapper are mostly fed trash fish. Other species such as pompano and threadfin are generally fed with floating seabass feed. Many of the floating cages in Malaysia are located in estuaries close to the river mouth. The water tends to be a bit more turbid.

Grouper species generally take more than ten months to reach marketable size, while survival rates are usually low. Some farms may even experience 30% survival rate post stocking of 5cm fingerlings. An increasing trend in grouper farming in Johor is to grow giant grouper from imported fry (from 3 cm size) to 1 kg, and sell to other farmers that will on-grow the fish to larger sizes for the market. The price for 1 kg giant grouper "fingerlings" is extremely high, around RM 80.00/kg in August 2004 mainly due to high price of small fry imported from Chinese Taipei, around US$ 1.00-1.20 per 3cm fry.

Other marine finfish species, such as pompano are considered a "cash crop" as they only take about 4-6 months to reach marketable size from 2.5cm fingerlings. The farm gate price for pompano is about US$6.50/kg in Johor (August 2004) for the Singapore market.

Fishing pier at Johor where farmed fish are being transported by 'taxi' to market.

Fresh market in Penang selling farmed snapper and grouper in fillet or block forms.

Market chains for live marine food fish in Malaysia

Generally, the farming areas for marine finfish are located close to fishing piers or fisheries landing ports. Most of these also function as a small auction ground for live or fresh seafood.

Farmers can sell their produce either at the auction floor to buyers or sell direct to exporters who come to the farm to pickup by boat or truck. Some Hong Kong buyers go direct to the farming areas and buy live marine food fish from the farmers and ship them back by boat, which normally has a capacity of 10-15 tons.

Other than grouper species, many of the marine finfish cultured in Malaysia also find their way to the Singapore market. Seabass, pompano, threadfin and snapper are some of the marine finfish that are commonly sold across the border to Singapore, live or chilled.

Although Singapore and Hong Kong markets generally command higher prices, some of the farmed marine finfish species are also sold locally in either restaurants or fresh markets. It is not uncommon to see

large (more than 2 kg) farmed groupers sold in local markets as fillets or blocks.

Farm gate, retail, and restaurants prices

The following prices are based on a field survey visit conducted from 28 March-2 April, 2004. These prices are for reference only as seasonal variation in prices should also be taken into consideration. Malaysian Ringgit to US Dollar conversion rate is US$ 1.00 = RM 3.80.

Farmed snapper and grouper species are sold at a fresh market in Penang.

Table 1: Farm gate prices at Penang

Common Name	Scientific Name	RM/Kg	Comments
Giant trevally	*Caranx ignobilis*	14.00-15.00	--
Green grouper	*Epinephelus coioides*	18.00	--
Tiger grouper	*Epinephelus fuscoguttatus*	38.00-45.00	0.7-1.2 kg (live)
Fourfinger threadfin (large)	*Eleutheronema tetradactylum*	22.00	CNF Singapore (300 g/fish)
Fourfinger threadfin (small)	*Eleutheronema tetradactylum*	10.00	7 pieces/kg
Fourfinger threadfin (large)	*Eleutheronema tetradactylum*	22.00	500-700 g
Cobia	*Rachycentron canadum*	5.00	--
Seabass (small)	*Lates calcarifer*	9.00	500-700 g
Seabass (large)	*Lates calcarifer*	12.00	2 kg fish

Table 2: Sungai Udang fishing pier

Common name	Scientific name	RM/Kg	Comments
Giant grouper	*Epinephelus lanceolatus*	40.00-45.00	Cage culture, chilled
Green grouper	*Epinephelus coioides*	17.00-18.00	Cage culture, chilled
Tiger grouper	*Epinephelus fuscoguttatus*	38.00-45.00	Cage culture, chilled
Mangrove snapper	*Lutjanus argentimaculatus*	17.00	Cage culture, chilled (500 g)
Seabass	*Lates calcarifer*	13.00-14.00	Cage culture, fresh chilled
Fourfinger threadfin	*Eleutheronema tetradactylum*	22.00-23.00	Wild

Table 3: Penang retail fresh market

Common name	Scientific name	RM/Kg	Comments
Sixband grouper	*Epinephelus sexfasciatus*	20.00	Small
Green grouper	*Epinephelus coioides*	36.70	-
Mangrove snapper (large)	*Lutjanus argentimaculatus*	20.00	Large
Mangrove snapper (small)	*Lutjanus argentimaculatus*	17.50	Small
Seabass (small)	*Lates calcarifer*	13.30-23.30	Small
Seabass (large)	*Lates calcarifer*	40.00	Large -wild
Fourfinger threadfin	*Eleutheronema tetradactylum*	20.00	Small

Table 4: Live seafood restaurants in Penang (Batu Muang and Bukit Tambun)

Common name	Scientific name	RM/Kg	Comments
John's snapper	*Lutjanus johnii*	32.00	Live
Mangrove snapper	*Lutjanus argentimaculatus*	20.00-32.00	Live
Blubberlip snapper	*Lutjanus rivulatus*	35.00	Live
Seabass	*Lates calcarifer*	28.00-32.00	Live
Green grouper	*Epinephelus coioides*	50.00-65.00	Live
Humpback grouper	*Cromileptes altivelis*	260.00	Live
Giant grouper	*Epinephelus lanceolatus*	60.00	Live
Pompano	*Trachinotus blochii*	20.00	Live

Table 5: Fish prices at Carrefour-Mid Valley Megastore Kuala Lumpur

Common name	Scientific name	RM/Kg	Comments
Fourfinger threadfin	*Eleutheronema tetradactylum*	15.80	Fresh chilled, (small)
Milkfish	*Chanos chanos*	8.80	Fresh chilled, (30 cm)
Sixband grouper	*Epinephelus sexfasciatus*	15.80	Fresh chilled, (small)
Seabass	*Lates calcarifer*	12.90	Fresh chilled, (0.8-1 kg)
Mangrove snapper	*Lutjanus argentimaculatus*	19.90	Fresh chilled, (0.5-0.8 kg)
Grouper fillet	-	9.50	Frozen shelf, (300 g)
Coral trout whole	-	22.90	Frozen shelf, (600 g)

Grouper farming, market chains, and marine finfish prices in Indonesia

Sih Yang Sim[1], Paolo Montaldi[2], Alessandro Montaldi[2] and Hassanai Kongkeo[1]

1. Network of Aquaculture Centres in Asia-Pacific, PO Box 1040, Kasetsart Post Office, Bangkok 10903, Thailand.
2. Terre des hommes Italy (TDH). c/o Andaman Sea Fisheries Research and Development Center, 77 Sakdidej Road, Wichit, Amphur Muang, Phuket 83000, Thailand

This article summarises findings from field trips to Indonesia conducted as part of a regional survey of NACA/TDH (Terre des Hommes Foundation - Italy) in cooperation with the Asia-Pacific Marine Finfish Aquaculture Network. The surveys were conducted in April-September, 2004 and was facilitated by the Directorate General for Aquaculture Development, Indonesia.

Indonesian marine finfish farming has developed rapidly over the last five years, particularly for high priced species such as grouper. Breakthroughs in grouper breeding techniques from 1999 by various research centers in Indonesia such as the Research Institute for Mariculture, Gondol; National Seafarming Development Center, Lampung; Brackishwater Aquaculture Development Sub Centre, Situbondo; together with a government focus on mariculture development, have led to major developments in grouper farming in Indonesia.

Kawahara and Ismi (2003) provided a good statistical report on the development of grouper hatcheries in Indonesia. In 1999, there were only five hatcheries producing grouper fingerlings in Indonesia located at Bali (1), Lampung (2) and East Java (2). However, by 2001 grouper hatchery development had intensified with 123 hatcheries producing grouper fingerlings in Bali (114), Lampung (5), and East Java (4). The boom in hatchery production led to overproduction and the price for grouper fingerlings dropped substantially. This drove many small hatcheries to switch to other species and by 2002 only 67 hatcheries were still producing grouper fingerling. The decline was most evident in Bali with only 55 hatcheries still producing grouper fingerlings, a 50% drop, while in Lampung (6) and East Java (7) more hatcheries were producing grouper. This may be due to the fact that the 50% of the hatcheries in Bali switched to milkfish fry production, due to market opportunities. Grouper seed production statistics for Indonesia from 1999-2002 show that the total production of tiger grouper (*Epinephelus fuscoguttatus*) fry has grown continuously from around 63,000 pieces to 2,656,000 in 2002 while humpback grouper (*Cromileptes altivelis*) fry has grown from 123,000 pieces in 1999 to 1,114,000 pieces in 2001 with a sharp decline to 698,000 in 2002.

New marine finfish species such as coral trout (*Plectropomus* spp.) and napoleon wrasse (*Cheilinus*

Live seafood restaurant in Bali with display aquaria of various marine finfish varieties.

Small quantity of coral trout fingerlings produced at RIM-Gondol.

undulatus) are being produced in captivity. The refinement of larviculture technique for these species may lead to extensive farming if fingerlings can be mass-produced in the hatchery. However, rapid market saturation may also occur.

Hatchery system for grouper species in Indonesia

The hatchery system used for grouper fingerlings production was based on the Backyard Multi-species Hatchery System (BMHS) developed in the Research Institute for Mariculture Gondol. For more details on this system refer to "Study on economics and socio-economics of small-scale marine fish hatcheries and nurseries, with special reference to grouper systems in Bali, Indonesia" by Susana v Siar, William Lee Johnston and Sih Yang Sim, 2002. A new publication "A Guide on Small-scale Marine Finfish Hatchery Technology" by ACIAR/NACA also provides details on this aspect. Check website www.enaca.org/marinefish/ for availability.

The development of grouper grow-out in Lampung

In 1999, there was only one grouper farm in Lampung with eight units (i.e. one unit is four cages measuring about 4 x 4 metres or 3 x 3 metres). With the increase in availability of grouper fingerlings and government promotion for marine finfish culture in Indonesia, the number of farms growing grouper in Lampung had escalated to 42 farms with a total of 388 units (1,552 cages) by 2002 (Kawahara and Ismi, 2003). In 2004, there are some 800 marine fish cage units (3,200 cages) in Lampung. The two main species cultured here are humpback grouper and tiger grouper, mainly based on availability of fingerlings from hatcheries. There are also some farms that obtain fingerlings of various grouper species from the wild or import from Taiwan Province of China (giant grouper) for stocking or fattening before being sold to exporters.

Most of the marine finfish farms seen in Lampung are relatively large and well constructed. The walkways are wide and allow easy movement and operations. It is common to see cages and walkways shaded with permanent netting tents and equipment such as high-pressure pumps for net cleaning. Many rafts are directly supplied with freshwater (personal use, fish treatment) delivered from land sources via pipes. Grouper farming in this area is clearly a middle- to large-scale investment and certainly not a small-scale fishermen affair.

The farming practice is a mixture of feeding artificial feed produced by commercial feed companies, or "trash" fish. Most humpback groupers are fed with artificial diet while other grouper species are mostly fed with trash fish.

Tiger grouper and humpback grouper can reach marketable size (400-700 g) within 9-12 and 16-24 months, respectively. However, if larger fingerlings are stocked it may shorten the culture period, for example 15 cm humpback grouper fingerlings will take about 9 – 10 months to reach 450 g. On the other hand, giant grouper is a fast growing species that can reach 300 g within 4 months from an initial stocking size of 4 cm.

Market chains for live reef food fish in Indonesia

The live reef food fish supply in Indonesia comes from two sources, wild caught and aquaculture. Most of the tiger and humpback groupers from Indonesia are now produced from aquaculture.

The market chains for cultured live marine finfish are rather simple, the farmers buy fingerlings from the hatchery or via traders, grow these fingerlings to marketable size in 9-24 months depending on grouper species, and sell the produces in live, mainly to local exporters, Hong Kong buyers (either by live fish vessel or by air shipment), or to local restaurants.

The market chains for wild-caught finfish are more complex. Fishermen may sell their catches through various channels (such as to collectors, fish farmers, traders, exporters, restaurants, and Hong Kong buyers) depending on the locality of the fishing area and how accessible it is to various market channels. However, most fishermen probably sell to collectors as fishing grounds are generally located in a remote area such as Eastern Indonesia and Irian Jaya and collectors are the only accessible channel to market for them.

From collectors, fish may be distributed to various channels with undersized fish going to farmers for on-growing to marketable size, and table sized fish going directly to traders, exporters, local restaurants or Hong Kong buyers.

Farm gate, retail, and restaurant prices in Indonesia

The following prices are based on a field survey visit conducted in April 11-19, 2004. These prices are for reference only as seasonal variation in prices should also be taken into consideration. All prices are converted from Rupiah to US Dollar at an exchange rate of US$1.00 = Rupiah 9,000.

References

1. Kawahara, S. and Suko Ismi, 2003. Grouper Seed Production Statistics in Indonesia (1999-2002). Research Institute for Mariculture-Gondol, Indonesia.
2. Siar, S.V., Johnston, W.L. and Sim, S.Y. (2002). Study on Economics and Socio-economics of Small-scale Marine Fish Hatcheries and Nurseries, with Special Reference to Grouper Systems in Bali, Indonesia. 36 pp., Report prepared under APEC Project FWG 01/ 2001 - 'Collaborative APEC Grouper Research and Development Network'. Asia-Pacific Marine Finfish Aquaculture Network Publication 2/2002. Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand.

Large-scale marine fish farm in Lampung growing mainly tiger and humpback groupers.

Live fish transport boat cruising around a marine floating cage farm in Bali to collect marketable size marine finfish for Hong Kong.

Wild caught Plectropomus laevis selling at a seafood market in Jakarta.

Price differentiation for wild capture species according to size, *Plectropomus leopardus*

Size	Details	US$/Kg	Comments
Large	(> 1.3 kg)	14.40	Rupiah 130,000
Medium	(0.9-1.3 kg)	12.20	Rupiah 110,000
Super	(5-9 ounces)	22.20	Rupiah 200,000
Baby	(2-5 ounces)	11.10	Rupiah 100,000
Undersized	(< 2 ounces)	5.60	Rupiah 50,000

Marine finfish prices at live reef fish exporter in Denpasar (buying prices from farmers or fishermen)

English common name	Scientific name	US$/Kg	Comments
Tiger grouper	*Epinephelus fuscoguttatus*	8.90	1.5-5 kg fish at Rupiah 80,000/kg, wild
Tiger grouper	*Epinephelus fuscoguttatus*	4.40-5.60	Rupiah 40-50,000/kg for cultured fish at marketable size
Tiger grouper	*Epinephelus fuscoguttatus*	5.60	Big size > 5 kg, Rupiah 50,000/kg
Humpback grouper	*Cromileptes altivelis*	33.30	Rupiah 300,000/kg for wild capture
Humpback grouper	*Cromileptes altivelis*	30.00	Rupiah 270,000/kg for cultured fish
Napoleon wrasse	*Cheilinus undulatus*	33.30	Rupiah 300,000/kg
Green grouper	*Epinephelus coioides*	6.70	Rupiah 60,000/kg
Camouflage grouper	*Epinephelus polyphekadion*	9.40	Rupiah 85,000/kg
Coral grouper	*Epinephelus corallicola*	10.20	Rupiah 92,000/kg
Areolate grouper	*Epinephelus areolatus*	8.90	Rupiah 80,000/kg

Fingerling prices for various marine finfish in Indonesia (April 11-19, 2004)

Details	Bali (Rupiah)	Lampung (Rupiah)	Comment
Milkfish egg	0.5/egg	-	April 11-19, 2004 (low demand)
Milkfish egg	5/egg	-	August 23, 2004
Milkfish	7-10/fish	-	1 cm fry at farm gate
Milkfish	10-15/fish	-	1 cm fry at exporter
Milkfish	500-800/fish	-	10 cm fish for tuna bait
Tiger grouper egg	1/egg	-	
Humpback grouper egg	2.5-4.0/egg	-	
Tiger grouper	700-750/cm	-	RIM-Gondol
Tiger grouper	1,000/cm	1,000/cm	
Humpback grouper	1,000-1,250/cm	-	RIM-Gondol
Humpback grouper	1,500/cm	1,000-1,250/cm	
Humpback grouper	2,000/cm	-	August 23, 2004
Giant grouper	-	40,000/fish	4 cm fingerling imported from Taiwan

Farm gate prices for marine finfish in Lampung, Indonesia

English common name	Scientific name	US$/Kg	Comments
Green grouper	*Epinephelus coioides*	5.00-6.50	Live
Tiger grouper	*Epinephelus fuscoguttatus*	7.00-10.50	Live
Humpback grouper	*Cromileptes altivelis*	15.00-40.00	Live
Mangrove snapper	*Lutjanus argentimaculatus*	3.00	Live
Areolate grouper	*Epinephelus areolatus*	6.50	Live
Giant grouper	*Epinephelus lanceolatus*	12.00-15.00	Live
Coral trout	*Plectropomus leopardus*	19.00-20.00	Live, Rupiah 175,000
Barred-cheek coral trout	*Plectropomus maculatus*	17.00	Live, Rupiah 150,000
Squaretail coral trout	*Plectropomus areolatus*	14.00	Live, Rupiah 125,000
Napoleon wrasse	*Cheilinus undulatus*	45.00	Live

Market prices at the integrated fish market & restaurant model, Jakarta

English common name	Scientific name	US$/Kg	Comments
Mix of small size grouper species	*Plectropomus leopardus; Cephalopholis sonnerati*	2.40	0.2-1.0 kg chilled fish, price is given in Rupiah 21,500
Blacksaddled coral grouper	*Plectropomus levis*	28.90	Price is given in Rupiah 7,450/ons(chilled), so per kg price in Rupiah is 260,000
Grouper fillet	-	8.90	Price is given in Rupiah 80,000, and species is not identified
Napoleon wrasse	*Cheilinus undulatus*	66.70	Live fish at Rupiah 600,000/kg
Tiger grouper	*Epinephelus fuscoguttatus*	2.40	Chilled small fish

Live reef marine finfish prices at seafood restaurant in Bali, Indonesia

English common name	Scientific name	US$/Kg*	Comments
Tiger grouper	*Epinephelus fuscoguttatus*	98.00	Rupiah 25,000/once
Coral trout species	*Plectropomus* spp.	196.00	Rupiah 50,000/once
Blackspot tuskfish	*Choerodon schoenleinii*	137.20	Rupiah 35,000/once
Reef stonefish	*Synanceia verrucosa*	98.00	Rupiah 25,000/once
Napoleon wrasse	*Cheilinus undulatus*	294.00	Rupiah 75,000/once
Green grouper	*Epinephelus coioides*	78.40	Rupiah 20,000/once
Wrasse – mixed species		137.20	Rupiah 35,000/once
*Note: These prices seem excessively high, but this restaurant is targeting the tourist market, and the prices are inclusive of cooking cost. Most species are wild caught and small sizes, less than 1 kg.			

Marine finfish markets in Hong Kong

Sih Yang Sim[1], Paolo Montaldi[2], Alessandro Montaldi[2] and Hassanai Kongkeo[1]

1. Network of Aquaculture Centres in Asia-Pacific, PO Box 1040, Kasetsart Post Office, Bangkok 10903, Thailand.
2. Terre des hommes Italy (TDH). c/o Andaman Sea Fisheries Research and Development Center, 77 Sakdidej Road, Wichit, Amphur Muang, Phuket 83000, Thailand

This article summarises findings from a field trip to Hong Kong conducted as part of a regional survey of NACA/ TDH (Terre des Hommes Foundation - Italy) in cooperation with the Asia-Pacific Marine Finfish Aquaculture Network. The survey was conducted on June 3-4, 2004 and was facilitated by the Agriculture, Fisheries and Conservation Department (AFCD) Hong Kong.

Hong Kong with a population of 6.8 million is one of the most important consumption markets for live marine finfish in the world, particular grouper species (family Serranidae). The annual per capita consumption of fish is currently around 37 kg, a decline from previous levels of 40-45 kg prior to the 1997 Asian economic crisis and the 2003 SARS outbreak.

Hong Kong is also the main entry hub for live marine finfish to China markets via Guangzhou. Hong Kong adopts a free trade policy, with some limits set by food safety monitoring and CITES. Importers are required to provide trade declarations using the Hong Kong Import & Export Classification List and its regularly revised harmonised codes.

In 2003, the total imports were estimated at around 194,000 tons for seafood (including 80,000 tons of shellfish, 100,000 tons of marine fish and 12,000 tons of live fish). Approximately 35% (67,000 tons) of seafood was re-exported.

Although the live fish segment constitutes a relatively small volume of the total annual marine fish imports it accounted for over US$ 82 million in value with average prices ranging from US$ 4.10-18.30/kg. In the 1990s, rapid economic growth and an increase in the number of tourists led to a sharp growth in live marine fish imports to 20,000-25,000 tons. However, marine fish consumption has subsequently

Table 1: Major sources of live marine fish imports to Hong Kong (Source: FMO)

Country	Quantity (mt)	%	Average price (US$/kg)	Country subtotal (US$ million)
Thailand	3,182	30	4.10	13.10
China	2,605	25	1.80	4.70
Philippines	1,585	15	12.60	20.00
Australia	1,137	11	18.30	20.90
Indonesia	1,000	9	15.60	15.70
Malaysia	644	6	10.90	7.00

Traders weighing the live marine fish in live fish transport vessel at Kwun Tong market

declined due to the impact of the 1997 Asian economic crisis and SARS. Consumption has stabilized recently and is now starting to increase again. The 2003 Fish Marketing Organization (FMO) figures for live fish imports from major suppliers are presented in table 1.

The FMO figures highlight the differential role of the major suppliers. Thailand is historically the leader in terms of quantity, but with low average value products (mainly *Epinephelus coioides*). China is emerging as bulk supplier of lower value fish such as mangrove snappers, and is growing in terms of overall volume. Other regional sources such as Australia, Indonesia and the Philippines have higher average prices as traditional key exporters of top value, mostly wild groupers such as wrasse, humpback grouper and coral trout.

According to the FMO the bulk of the live fish imports arrives by air (64%), followed by road transport (20%), fishing vessels (12%), long distance fish carriers (4%) and river carriers (0.01%).

Local production of live marine finfish species

There are 1,160 small-scale farms covering a total of 209 hectare of water surface areas in 29 specially designated Fish Culture Zones of Hong Kong and culturing more than 18 marine finfish species. These species are mainly from family of seabream, snapper, grouper and others. The marine finfish species farmed in Hong Kong are listed in table 2. As the price for seabream has decreased through the years, farmers have shifted to culture more valuable species such as grouper. In 2003 local cultured fish production was 1,500 tons for a value of US$ 9.7 million, accounting for about 10% of the live fish consumption in Hong Kong. The remaining 90% of seafood consumed in Hong Kong is imported, and live marine fish species mainly originate from Asian countries. Green groupers (42%) accounted for the bulk of Hong Kong's 1,500 tons of production followed by snappers (28%) and others such amberjack, cobia, pompano (17%), tiger groupers (9%) and other groupers (4%). The competitive edge for local producers is their proximity to the market, which provides better survival

Ma Wan Fish Culture Zone at southern side of Hong Kong, with a cluster of small wooden rafts with floating cages.

Live fish stall at Aberdeen market using sandfilter to keep the water at the holding facility in good condition

Wholesale trader stall at Kwun Tong with mix variety of marine fish

Table 2: Marine finfish species recorded under culture in Hong Kong

Common English Name	Scientific Name
Gold-lined seabream	*Sparus sarba*
Yellowfin seabream	*Acanthopagrus latus*
Black seabream	*Acanthopagrus schlegeli*
Mangrove red snapper	*Lutjanus argentimaculatus*
Russell's snapper	*Lutjanus russellii*
Malabar red snapper	*Lutjanus malabaricus*
Cobia	*Rachycentron canadum*
Pompano	*Trachinotus blochii*
Greater amberjack	*Seriola dumerili*
Orange-spotted (or green) grouper	*Epinephelus coioides*
Tiger grouper	*Epinephelus fuscoguttatus*
Brown-spotted grouper	*Epinephelus chlorostigma*
Hong Kong grouper	*Epinephelus akaara*
Areolate grouper	*Epinephelus areolatus*
White blotched grouper	*Epinephelus multinotatus*
Red drum	*Sciaenops ocellatus*
Head grunt	*Pomadasys kaakan*
Japanese croaker	*Collichthys niveatus*

Table 3: Ex-farm prices for marine finfish species in Hong Kong

Species	HK$/kg	Comment
Green groupers	83.30	Size 300-500 gram/fish, original price is HK$ 50.00/cattie (1 year culture)
Green groupers	150.00	Size 1.5 kg/fish, original price is HK$ 90.00/cattie (2 years)
Tiger grouper	167.00-333.00	Size 1.2 kg/fish, original price is HK$ 100.00-200.00/cattie

Parrotfish on display at the trading floor in Aberdeen market

in the restaurant's displayed aquarium tanks and the possibility to cater directly to restaurants.

The majority of the marine fish fingerlings used for grow-out are imported from various countries such as PR China, Thailand, Philippines, Malaysia, Vietnam, Chinese Taipei and Indonesia. Annual marine fish fingerlings imported accounted to 11 million pieces valued at around US$5 million. Only seabream fingerlings are collected from local waters. The culture period ranges from 1-3 years, depending on the species and the size of the fingerlings stocked.

Fish Marketing Organization (FMO)

The Fish Marketing Organization (FMO) is a self-financing organization, under the supervision of the Agriculture, Fisheries and Conservation Department of Hong Kong (AFCD-HK). It was established under the Marine Fish Marketing Ordinance to provide facilities and services for the seafood trade and it currently operates seven major wholesale fish markets in Kwun Tong, Shau Ket Wan, Sai Kung, Tai Po, Aberdeen, Cheung Shawan and Castle Peak. FMO markets conduct wholesale seafood trade through registered agents.

The major markets for live fish are Kwun Tong, Aberdeen and Cheung Sha Wan for a total of 35 stalls with registered agents importing live seafood from the Asia-Pacific region. However, several independent traders reportedly operate in Hong Kong with their own facilities outside the FMO. In 2003 the total trade through the FMO network was 42,000 tons of fresh seafood and 4,000 tons of live seafood, or approximately one fourth of the 251,000 tons estimated as the total consumption in Hong Kong.

Kwun Tong Wholesale Fish Market

The Kwun Tong Wholesale Fish Market is historically the main live fish trading venue and hosts the office of the Hong Kong Chamber of Seafood Merchants. Our visit to the stalls at Kwun Tong provided a visual confirmation of the broad diversity of the marine finfish species traded. The average prices quoted for common grouper species during our visit were US$ 10.00/kg for *E. coioides*, US$ 15.00-20.00/kg for *E. fuscoguttatus*, US$ 17.00/kg for large (10 kg) *E. lanceolatus*. Lower trophic level fish commonly sighted in the display tanks were scats (US$ 7.15/kg) and several species of parrotfish (*S. rivulatus*, *S. prasiognathos*, *S. ghobban*). It was reported that for some parrotfish the price could reach as high as US$20.00-40.00/kg because mortality easily

occurs during shipment and storage in aquariums.

We observed more than 48 marine finfish species in the aquarium displays of the various agents at the Kwun Tong Wholesale Fish Market during our visit, listed in Table 4.

Aberdeen Fish Wholesale Market

Aberdeen Fish Wholesale Market is located on the southern side of Hong Kong island. The market is the largest in Hong Kong and was busy during our visit with several fish carrier boats moored in front of the market and live fish transport trucks moving in and out.

The main market stalls consist of batteries of aquarium tanks lined in series in the main auction building, allowing a straightforward inspection of the seafood displayed. An additional series of stalls equipped with live seafood holding tanks occupy an open area along the quay just outside the main building. The variety of the live marine finfish displayed here is similar to the species observed at the Kwun Tong market. The prices for the live marine finfish are listed in Table 5.

Market prices for marine finfish at live seafood restaurants in Hong Kong

The marine finfish diversity in the Hong Kong consumption of live marine finfish could be observed at a cluster of seafood restaurants located at Lei Yue Mun close to the Kwun Tong Wholesale Fish Market and at a large floating restaurant (Jambo) near the Aberdeen Wholesale Fish Market. The restaurant prices (cooked prices) for live marine finfish at these two areas are listed in Table 6.

Seafood sector at Wellcome Department Store, Kowloon

The fresh chilled seafood selection on display at the Wellcome Supermarket in Kowloon was very basic. All products were portion size and presented in film-sealed polystyrene trays. The main species and prices that were available are listed in Table 7.

Table 4: Species on display at the Kwun Tong Wholesale Fish Market

English Common Names	Scientific Names
Napoleon wrasse	*Cheilinus undulatus*
Triple tail wrasse	*Cheilinus trilobatus*
Blackspot tuskfish	*Choerodon schoenleinii*
Green grouper	*Epinephelus coioides*
Aerolate grouper	*Epinephelus aerolatus*
Longfin grouper	*Epinephelus quoyanus*
Malabar grouper	*Epinephelus malabaricus*
Tiger grouper	*Epinephelus fuscoguttatus*
Potato cod	*Epinephelus tukula*
Giant grouper	*Epinephelus lanceolatus*
Red grouper	*Epinephelus akaara*
Yellow grouper	*Epinephelus awoara*
Tomato hind	*Cephalopolis sonnerati*
Peacock grouper	*Cephalopolis argus*
Humpback grouper	*Cromileptes altivelis*
Coral trout	*Plectropomus leopardus*
Blue spotted grouper	*Plectropomus maculatus*
Coronation trout	*Variola albimarginata*
Slender grouper	*Anyperodon leucogrammicus*
Emperor red snapper	*Lutjanus sebae*
Mangrove snapper	*Lutjanus argentimaculatus*
Russel's snapper	*Lutjanus russelli*
Yellow spot grunt	*Plectorhinchus cinctus*
Black porgy	*Acanthopagrus schlegeli*
Yellowfin seabream	*Acanthopagrus latus*
White seabream	*Acanthopagrus berda*
Goldlined seabream	*Sparus sarba*
Red seabream	*Pagrus major*
Cobia	*Rachycentron canadum*
Scat	*Scatophagus argus*
Spotted sicklefin	*Drepane punctata*
Spinefoot	*Siganus fusescens*
White spotted rabbitfish	*Siganus canaliculatus*
Chinese filefish	*Monacanthus chinensis*
Spotbelly batfish	*Platax teira*
Yellow scale parrot	*Scarus ghobban*
Surf parrot	*Scarus rivulatus*
Quoy's parrot	*Scarus quoyi*
Red speckled parrot	*Cetoscarus bicolor*
Pompano	*Trachinotus blochii*
Turbot	*Scophthalmus maximus*
Flounder	*Pseudorhombus* spp.
Tongue sole	*Cynoglossus* spp.
Brown banded catshark	*Chiloscyllium punctatum*
Grey bamboo shark	*Chiloscyllium griseum*
Snake moray	*Ophichthys* spp.
Pike moray	*Muraenesox* spp.
Giant moray	*Gymnothorax* spp.

Summary

The Kwun Tong and Aberdeen markets are active in trading activities and there are many live marine food fish species being trade on daily basis. The facilities for holding the live marine food fish here are equipped with sand filter to keep the water quality at optimum level. The consumers preference for live marine food fish can be observed at various live seafood restaurants at nearby area which are stocked with a wide variety of high value and middle price species.

Table 5: Prices of live marine fish at Aberdeen Fish Wholesale Market

English Names	Scientific Names	HK$/Kg	Comment
Green grouper	*Epinephelus coioides*	166.67	Original price at HK$100.00/cattie (1.5 kg fish)
Tiger grouper	*Epinephelus fuscoguttatus*	116.67	Original price at HK$ 70.00/cattie (ciguatera fear)
Green wrasse	*Cheilinus trilobatus*	133.33	Original price at HK$ 80.00/cattie
Cobia	*Rachycentron canadum*	50.00	Original price at HK$ 30.00/cattie
Pompano	*Trachynotus blochii*	33.33	Original price at HK$ 20.00/cattie
Red snapper	*Lutjanus argentimaculatus*	58.33	Original price at HK$ 35.00/cattie
Scat	*Scatophagus argus*	80.00	Original price at HK$ 48.00/cattie
Mullet	*Mugil* spp.	20.00	Original price at HK$ 12.00/cattie
Yellow scale parrot	*Scarus ghobban*	75.00	Original price at HK$ 45.00/cattie
Red speckled parrot	*Cetoscarus bicolor*	50.00	Original price at HK$ 30.00/cattie
Rabbitfish	*Siganus fusescens*	20.00	Original price at HK$ 12.00/cattie

** 1 cattie = 600g.*

Table 6: Restaurant prices for live marine finfish at Lei Yue Mun

Species	HK$/Fish	HK$/Kg*	Price HK/pound
So mei fish (*Napoleon wrasse*)	1,800	1,327	600
Spotted grouper (*P. areolatus*)	780	664	300
Green wrasse	800	664	300
Red coat (mangrove snapper)	250	-	-
Common grouper	250	-	-
Snapper	500	425	192
Teeth parrot fish	550	531	240
Potato grouper (small size)	1,000	-	-
Dark/Big green grouper	500	-	-
Cabrilla (humpback grouper)	2,200	1,327	600
Spotted grouper (*P. leopardus*)	1,380	929	420
Parrot fish (green & yellow)	550	531	240
Red grouper	1,380	929	420
Yellow fin snapper	-	584	264
Horse head	-	584	264
Stone fish	-	531	240
Yellow fin pomfret	-	266	120
Spade grouper	-	797	360
**This is based and converted from original price in HK$/pound*			

A view of the live seafood restaurant area in Lei Yue Mun

Live fish transport vessel docking at Kwun Tong market

Table 7: Species & prices of marine finfish at Wellcome Supermarket, Kowloon

Product	Details	HK$/kg
Nile tilapia	Whole	27.8
Seabass	*Lates calcarifer* (small size)	50.9
Coral trout	*Plectropomus leopardus*	95
Silver pomfret	*Pampus argenteus*	50

Below: Pompano on display at the trading floor in Aberdeen market

Marine finfish aquaculture in China

Zhigang Zhou PhD and Zhengnan Wang PhD

Feed Research Institute of Chinese Academy of Agricultural Sciences, No.12 ZhongGuanCun South Street, Haidian, Beijing 100081, China, Tel: +86-(0) 10-62136896, Fax: +86-(0)10-68975127, Email: zhouzhigang@caas.net.cn

Marine aquaculture, regarded as the "fourth aquaculture revolution" in China, is increasing rapidly with a total output of 12.5 million tons from 1.5 million hectares of farming area (Figure 1). Marine finfish aquaculture is the most active component in marine aquaculture and has increased from less than 200,000 tons in 1996 to over 500,000 tons in 2003. Although the total farming areas for marine finfish only increased by 15% during that period the output jumped by 185% (Figure 2). This may be the result of improved aquaculture techniques and production efficiency for marine finfish farming, which is evident by the increase in yield per hectare from 2.75 tonnes to 6.84 tonnes between 1996 and 2003.

There are several major areas along the coast of China for farming marine finfish; from the south to the north these are: Hainan Province (Figure 3); Guangxi Province (Figure 4); Guangdong Province (Figure 5); Fujian Province (Figure 6); Zhejiang Province (Figure 7); Jiangsu Province (Figure 8); Sandong Province (Figure 9); Tianjin City (Figure 10); Hebei Province (Figure 11); and Liaoning Province (Figure 12). Among these areas, Guangdong Province is the biggest producer of marine finfish in China in terms of production and culture areas. In 2001 Guangdong produced a total output of 230,732 t from 42,154 hectares of farming areas (Figure 5). Hainan, Jiangsu and Tianjin have lower outputs with less than 10,000 tonnes produced per year between 1996 -2001. However, Hainan has the biggest potential for development of marine finfish aquaculture in China due to the large areas available for marine aquaculture and good quality seawater.

Marine finfish species farmed in China during 2003 are listed in Table 1, which provides detailed statistics on the marine finfish species produced in 2003. Sea bass accounted for 15% of the total marine finfish output with 78,500 tonnes. Species with a farmed output exceeding 25,000 tonnes in 2003 were various grouper, flounder, sea bream, red fish, large yellow croaker and sea bass. Grouper is the most diverse group of cultured marine finfish species in China, with the following species under culture: *Epinephelus merra*, *E. fario*, *E. akaara*, *E. awoara*, *E. fuscoguttatus*, *E. microdon*, *E. fasciatomaculatus* , *E. septemfsaciatus*, *E. moara*, *E. malabaricus*, *E. coioides*, *E. tauvina*, and *Cromileptes altivelis*. It is anticipated that farming of grouper species in China will increase in the near future, as demand and price are high. Some shrimp farmers are also considering switching to grouper farming following the shrimp anti-dumping case with America.

In China, tilapia and shrimp are the two biggest farmed export commodities. Cultured marine finfish contribute to a small percentage of export earnings and most of marine finfish are consumed domestically in Hong Kong, Macao, Guangzhou, Shanghai and other major cities in China. Live marine finfish are preferred by many Chinese consumers and therefore command better market prices. Prices of marine finfish also depend very much on the distance required to transport fish from farming areas, fish size, and the different months of the year, particularly during festive events. Some extraordinary events such as SARS and Avian Influenza also had an impact on marine finfish consumption and demand, thus the prices. The prices of *Sparus macrocephelus* (individual biomass >300g) in Shanghai and Hangzhou are listed in Figure 13 and Figure 14. Prices in Hangzhou are always higher than in Shanghai because the transportation costs are greater. During the Avian Influenza period, most Chinese avoided consuming poultry and switched to aquatic animals, driving prices up rapidly in both Shanghai and Hangzhou markets during May-June, 2004. The market prices for *Lates calcarifer* in Quanzhou and Suzhou is shown in Figure 15, displaying increasing price trends during the Avian Influenza period.

Although the market demand for marine finfish in China is high and farming technology has improved in recent years, it is not without problems and constraints. The main issues are a shortage of fingerlings, particularly for grouper species; high investment costs; limited international markets; pollution and environmental issues; disease and the availability of good commercial feeds. Therefore, it is important for China to develop sound hatchery techniques and nutritionally complete feed to support increasing production from marine finfish aquaculture. China is interested in cooperating with research institutes in the region on marine finfish aquaculture research and development.

Table.1: Cultured marine finfish output in China, 2003

Species	Output (t)	Scientific names
Plaice	5,355	*Kareius bicoloratus; Verasper moseri; V. variegates*
Puffer	10,141	*Fugu rubripes; F. flavidus; F. pseudommus; F. bimaculatus; F. obscurus; F. xanthopterus*
Amberjack	11,572	*Seriola aureovittata; S. dumerili*
Cobia	16,481	*Rachycentron canadum*
Grouper	26,790	*Epinephelus merra; E. fario; E. akaara; E. awoara; E. fuscoguttatus; E. microdon; E. fasciatomaculosus; E. corallicola; E. septemfasciatus; E. moara; E. malabaricus; E. coioides; E. tauvina; Cromileptes altivelis*
Flounder	36,227	*Paralichthy olivaceus; Scophthalmus maximus*
Sea bream	42,276	*Pagrosomus major; Sparus macrocephelus; S. latus; S. berda; Rhabdosargus sarba; Hapalogenys nitens*
Red fish	44,925	*Sciaenops ocellatus*
Large yellow croaker	58,684	*Pseudosciaena crocea*
Sea bass	78,346	*Lateolabrax japonicus; Lates calcarifer; Parapristipoma trilineatum; Pomadasys hasta*
Total	**519,157**	

Figure 1: Marine Aquaculture Output and Culture Area in China for 1996 to 2003

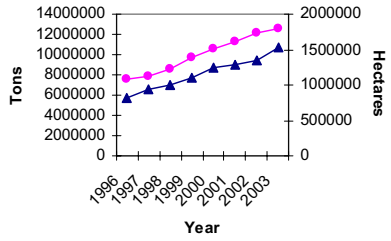


Figure 2: Marine Finfish Output and Culture Area in China for 1996 to 2003

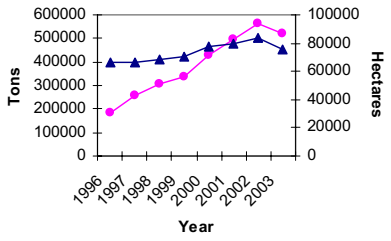


Figure 3: Marine Finifsh Output and Culture Area for Hainan from 1996 to 2001

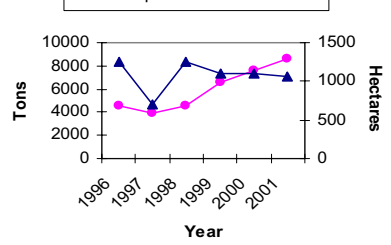


Figure 4: Marine Finifsh Output and Culture Area for Guangxi from 1996 to 2001

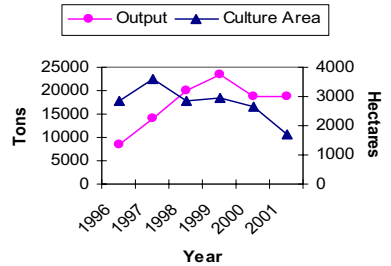


Figure 5: Marine Finifsh Output and Culture Area for Guangdong from 1996 to 2001

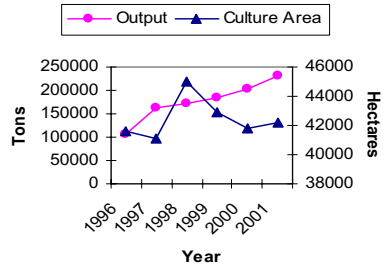


Figure 6: Marine Finifsh Output and Culture Area for Fujian from 1996 to 2001

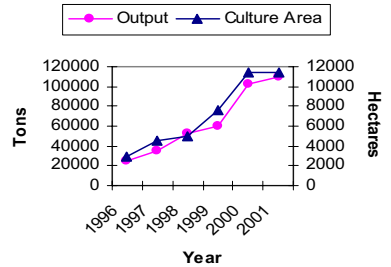


Figure 7: Marine Finifsh Output and Culture Area for Zhejiang from 1996 to 2001

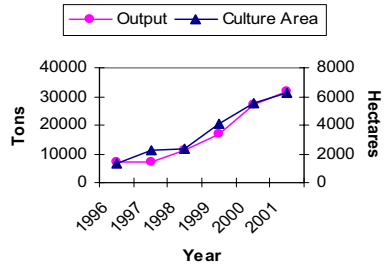


Figure 8: Marine Finifsh Output and Culture Area for Jiangsu from 1996 to 2001

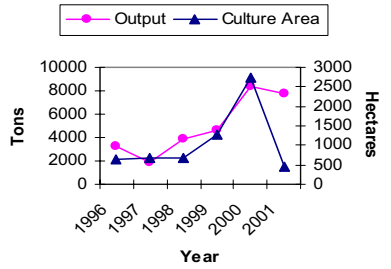


Figure 9: Marine Finifsh Output and Culture Area for Sandong from 1996 to 2001

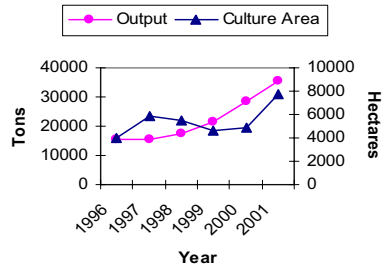


Figure 10: Marine Finfish Output and Culture Area for Tianjian from 1996 to 2001

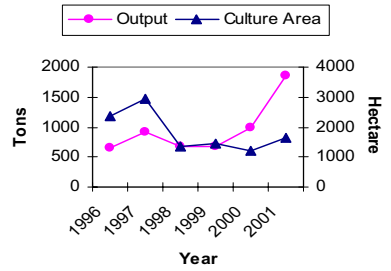


Figure 11: Marine Finifsh Output and Culture Area for Hebei from 1996 to 2001

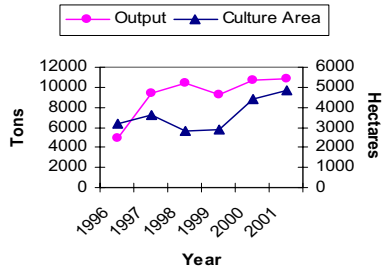


Figure 12: Marine Finfish Output and Culture Area for Liaoning from 1996 to 2001

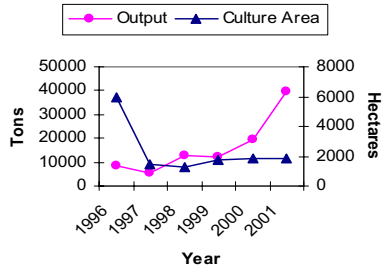


Figure 13: The median prices for *Sparus macrocephelus* (>300g) in Jinjiang Farm Produce Market in Hangzhou City of Zhejiang Province

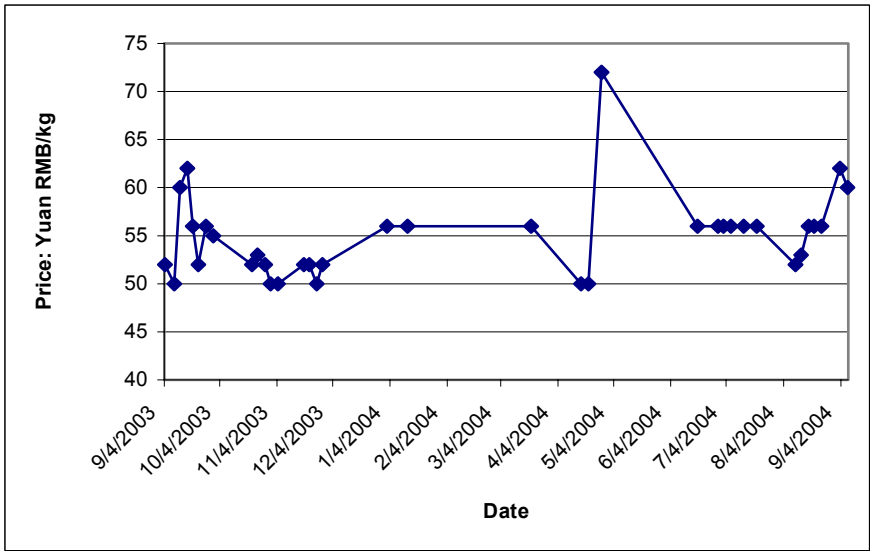


Figure 14: The median prices of *Sparus macrocephalus* (>500g) in Tongchuan Fishery Market in Shanghai

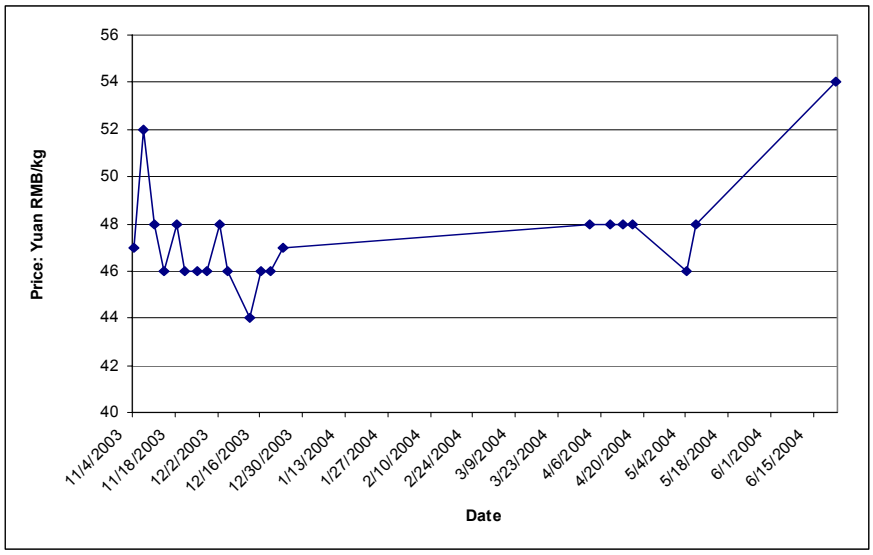
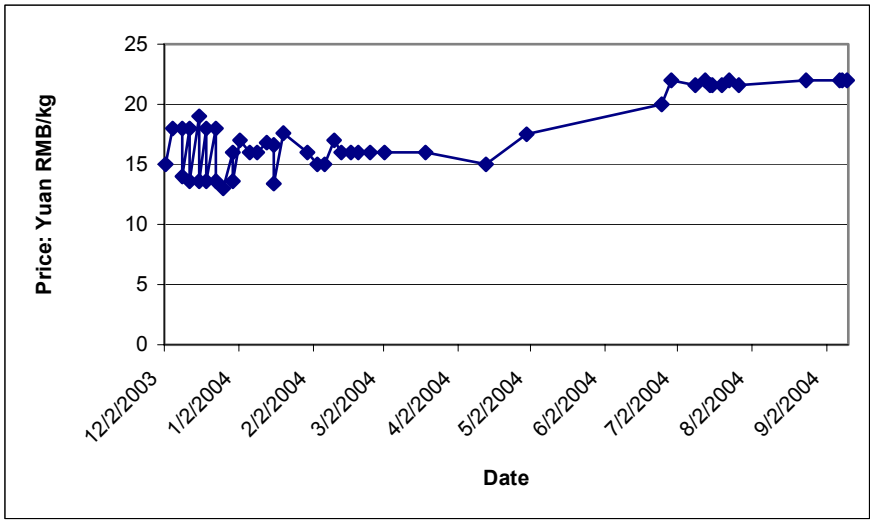


Figure 15: The median prices of *Lates calcarifer* (250-500g) in Nanhuan Fishery Market in Suzhou City of Jiangsu Province



Spawning and larval rearing of coral trout at Gondol

Ketut Suwirya

Coral trout *Plectopomus leopardus* is a popular candidate for mariculture in the Asia-Pacific region. The Research Institute for Mariculture (RIM) at Gondol, Bali, Indonesia, is currently researching the development of hatchery technology for this species, known locally as sunu. Ninety wild broodstock, ranging in size from 1.3 to 3.5 kg, were collected in 2003 and 2004. Sixty broodstock were maintained in a 150 m^3 concrete tank, and the remainder in a 100 m^3 concrete tank – both tanks were supplied with flow-through seawater supply at ambient temperature. Coral trout broodstock were fed trash fish and squid (2:1 ratio). The fish commenced spawning after seven months in the broodstock tanks, and produced between 500,000 and 2,500,000 eggs/day (both tanks combined) for 3–7 days every month.

Fertilized eggs were stocked in a 5 m^3 concrete larval rearing tank. Starting on the second day of hatching, larvae were fed with rotifers at a density of 5 individuals/ml. Rotifer density in the larval rearing tank was maintained at 10–30 individuals/ml until day. From day nineteen larvae were fed *Artemia* nauplii until metamorphosis (35 days after hatch). Juvenile coral trout were fed live tiny shrimp. At the time of writing, there are still a total of 195 juvenile coral trout at RIM. These fish are being used to assess the general grow-out husbandry of this species.

A hatchery-reared juvenile Plectropomus leopardus

First successful hatchery production of Napoleon wrasse at Gondol Research Institute for Mariculture, Bali

Bejo Slamet and Jhon H. Hutapea

Napoleon wrasse (*Cheilinus undulatus*) is one of the most expensive live fish for consumption in Asian markets, especially Hong Kong, Singapore and China. Nowadays, its capture and export is protected in many Asian countries, including Indonesia. The Research Institute for Mariculture at Gondol, Bali, Indonesia, initiated research on hatchery production technology for Napoleon wrasse in 1997. Captive broodstock began spawning in 1998, and numerous attempts were made to rear the larvae. After many years of research on gonadal development, spawning and larval rearing, RIM researchers finally produced 120 juvenile Napoleon wrasse in 2003. This is the first reported hatchery production of this species.

Rearing Napoleon larvae is more difficult compared to other marine finfish such as snapper and grouper. The difficulty reflects the small size of the newly hatched larvae and their small mouth gape. Egg diameter is only 620–670 µm, total length of newly hatched larvae is 1.5–1.7 mm, and mouth gape at initial feeding is only 133 µm.

RIM researchers attribute the successful larval rearing to the provision of high quality feed to broodstock, resulting in good quality eggs. In addition, researchers were able to provide good quality and appropriately sized live food (40-80µm) to the larvae during the initial feeding period before the yolk and oil globule were exhausted.

RIM researchers note that growth of Napoleon wrasse is extremely slow; at around 6 months of age the juveniles were only 5–6 cm total length. This feature may limit their attractiveness for aquaculture, despite the high price of this species in the live reef food fish trade.

Figure 1: Growth pattern of Napoleon wrasse larvae

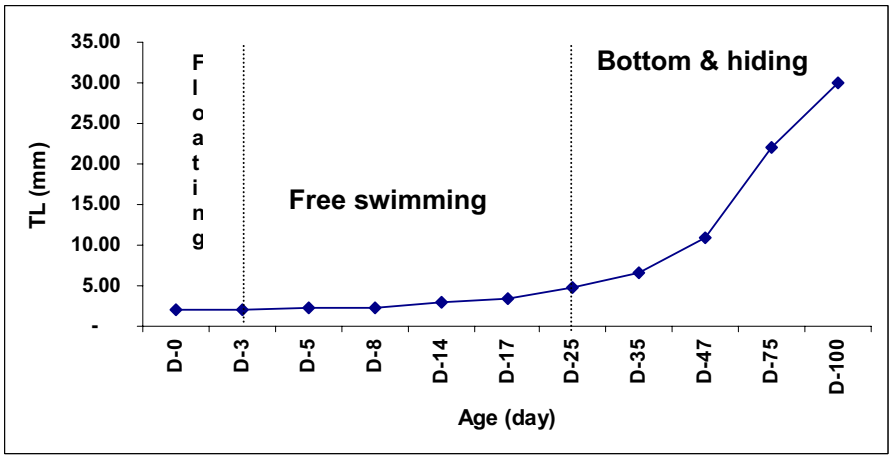
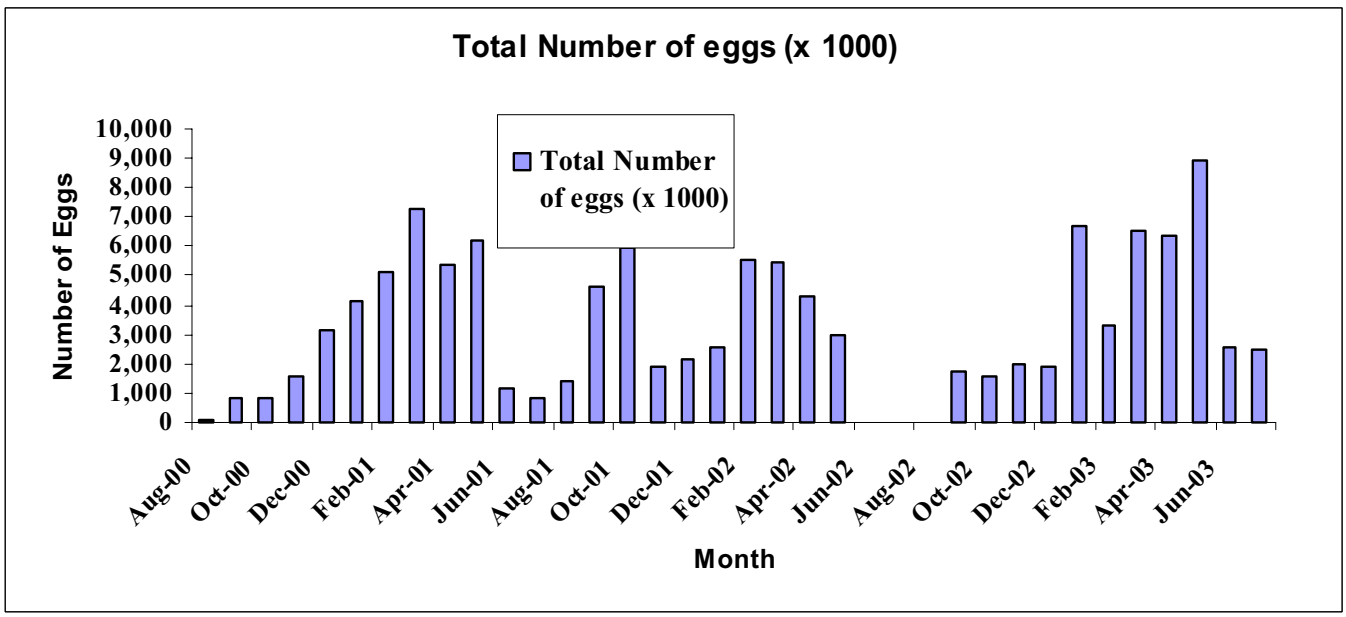


Figure 2: Egg production by Napoleon wrasse broodstock at Research Institute for Mariculture from 2000 to 2003.



New ACIAR project – Economic and Market Analysis of the Live Reef Food Fish Trade in Asia-Pacific

Geoffrey Muldoon[1], Liz Peterson[2], Brian Johnston[3]

1. CRC Reef Research Centre Limited, PO Box 772, Townsville QLD 4810, Australia. Email: g.muldoon@impac.org.au.
2. Advanced Choice Economics P/L, 30 Dean Road, Bateman WA 6150, Australia. Email: Liz.Petersen@tpg.com.au.
3. Asia-Pacific School of Economics and Government, Australian National University. Email: njvj@austarmetro.com.au.

In 1998 the Australian Centre for International Agricultural Research (ACIAR) funded a project to look at the "Sustainable Management of the Live Reef Fish Trade-Based Fishery in Solomon Islands". A review of this project, which concluded in 2001, indicated that detailed economic analysis of marketing of the live reef fish trade would provide significant benefits to a range of stakeholders (ANREI/1998/094). Subsequently, it was acknowledged that any economic analysis should be extended to incorporate the whole Asia-Pacific and include the key Asian producers of live reef food fish (LRFF), which have a longer and more active history in the trade than the Pacific Islands. As such the study will focus on supply from: Indonesia, Thailand, Australia, Papua New Guinea, Vietnam, Fiji, and Solomon Island (although not presently a supplying country, Solomon Islands has in the past supported a LRFF fishery and there is potential for it to reopen in the future) Other key suppliers such as the Philippines will be incorporated through the involvement of multilateral agencies such as the WorldFish Center in Malaysia and the Network of Aquaculture Centres in Asia-Pacific (NACA).

In July 2003, a nine-month feasibility study was commissioned by ACIAR, with a view to developing a more comprehensive proposal. The feasibility study undertook a review of a number of aspects relating to the trade, including: availability of price, quantity and trade data; suitable methods for quantifying short and long-term demand and supply of live reef fish; suitable economic frameworks for measuring the beneficiaries of improvements in demand or supply; and key cost and risk components of the marketing chain. In addition, a network of potential collaborating organizations and universities were identified, such as the Secretariat of the Pacific Community (SPC), the WorldFish Center and Bogor University (Indonesia).

Following the feasibility study, a proposal for a larger 2-½ year project was submitted to ACIAR. This project; "An Economic and Market Analysis of the Live Reef Fish Food Trade in Asia-Pacific"; commenced in July 2004 with a research team comprising Dr. Brian Johnston as project leader, Dr. Elizabeth Petersen, and Mr. Geoffrey Muldoon. It will also include research collaborators Dr. Mahfuzuddin Ahmed, Dr. Madan Dey and Dr. Reohlano Briones from the WorldFish Center in Malaysia, Mr. Being Yeeting from SPC in Noumea, Dr. Akhmad Fauzi from Bogor University and Dr. Sonny Koeshendrajana from the Research Institute for Fisheries Product Processing and Social Economics in Indonesia.

Aquaculture has been identified as both an alternative livelihood to engaging in often-destructive fishing practices and as a means of meeting future demand for the "higher-value" grouper species when many fish stocks in Southeast Asia are showing signs of severe depletion. It is estimated that approximately 40 per cent of all LRFF in the trade are supplied from aquaculture, although the majority of these fish come from grow-out of wild-caught juveniles to market size. Any benefits from substituting wild-caught with cultured species depend on how successfully the mariculture industry relieves its dependence on wild stocks for juveniles and trash fish for feed through increased hatchery production and development of new diets (Sadovy et al. 2004). Moreover, the market impacts, and specifically price impacts, of this substitution may have significant effects on fisher income.

ACIAR provides funding assistance to a number of mariculture projects of live reef fish species in Indonesia and Vietnam[1], such as one looking at improved technology for hatchery and grow-out of marine finfish in the Asia-Pacific (FIS/2002/077). These projects have identified a need for economic analysis to quantify key supply and demand relationships in the market, especially with respect to assessing the potential contribution of mariculture in assisting the long-term sustainability of the trade. Linkages have been established with these mariculture-related projects and we will be collaborating closely with them.

Project overview

The trade in LRFF is largely unregulated, which has led to some undesirable biological, social and economic consequences. The anticipated research outputs from this project will benefit industry participants and management agencies alike, for both existing and potential fisheries. Empirical modelling of supply and demand will enable further analysis of who the major beneficiaries are likely to be from new technologies, economic growth or policy options aimed at improving market performance by, for example, regulation of fishing effort or removing inefficiencies and distortions along the market chain. Another key output will be the inclusion of key cost and revenue components along the market chain, including key risk factors, into a benefit-cost model. A spreadsheet model of the market chain will be constructed that will aid capture fishery managers and the aquaculture sector in assessing the future viability of LRFF capture and aquaculture fisheries in their countries[2]

The study will focus on the following supplying countries: Indonesia, Philippines, Australia, Papua New Guinea, Thailand, Vietnam, Fiji and the Solomon Islands. During the feasibility study phase of this project, collaborative partnerships were

established with the WorldFish Center, SPC and Bogor University. The first is hosting a regional collaborative project involving mainland China, Indonesia, Malaysia, Philippines, Thailand and Vietnam, looking at "Fish Supply and Demand in Asia", while the latter two will assist with information on developments in LRFF fisheries in Southeast Asia and the Pacific.

The overall aim of the project is to enhance the sustainable economic development of the live reef food fish trade, through economic analysis of policy options for improving market performance. The main beneficiaries of this research are likely to be small-scale and subsistence fishers in supplying countries and government agencies charged with the sustainable management of their wild-caught fisheries and investigating the potential for mariculture. The specific research objectives of the project are to:

- Quantify short- and long-term demand of LRFF in Hong Kong and southern mainland China sourced from the Asia-Pacific, including developing countries;
- quantify short- and long-term supply of LRFF from wild-caught and aquaculture production sourced from Asia-Pacific, including developing countries;
- measure the key cost and risk components of the marketing chain;
- quantify likely future changes in supply and demand for LRFF arising from new technology, management practices and economic growth, and to identify the beneficiaries of these developments;
- identify highly-valued product attributes (e.g. colour, taste, texture) of wild-caught and aquacultured LRFF and to examine these preferences through panel taste evaluation tests;
- identify possible policy options to improve market performance such as catch and effort controls and adoption of improved technologies in production, storage and transportation; and
- build capacity in economic assessment throughout the Asia-Pacific in order to provide and coordinate economic research and disseminate information on the trade utilising the existing LRFF research and development networks (NACA, SPC, WorldFish Center).

Key research outputs of the project are:

- Empirical modelling of supply and demand, taking account where possible of new technologies, changing consumption patterns and income growth;
- policy analysis for improving market outcomes for the industry in various stages of the marketing chain (including options for fishery regulation) and identification of the beneficiaries of market improvements;
- a spreadsheet model of all costs and revenues along the market chain, including risk factors, for Australia and two Southeast Asian and two Pacific supply countries to aid fishery managers and the aquaculture sector to assess the future viability of LRFF capture and aquaculture fisheries in their countries; and
- dissemination of results of consumer preference surveys comparing attributes of wild-caught and aquacultured LRFF products to other ACIAR and NACA mariculture research projects in order to improve hatchery production technologies and the development of new diets.

The information from these outputs will feed into a number of forums over the two-year course of the project. These include research workshops to be held in conjunction with key research collaborators in the region, workshops held by the ACIAR Mariculture Grouper project, the Asia-Pacific Economic Cooperation (APEC) Fisheries Working Group project to develop Industry Standards[3], the annual conferences of the Australian Agricultural and Resource Economics Society (AARES) and the biennial international conference of the International Institute of Fisheries Economics and Trade (IIFET). There are also good extension opportunities for the outputs of the project through the SPC Live Reef Fish extension network.

Anyone interested in finding out more about the project or discussing it with project participants is encouraged to contact the authors.

Footnotes

1. Projects include FIS/1997/073 "Improved hatchery and grow-out technology for grouper aquaculture in the Asia-Pacific region", FIS/2002/077 "Improved hatchery and grow-out technology for marine finfish aquaculture in Asia-Pacific region" and FIS/2003/027 "Environmental impacts of marine cage aquaculture in Australia and Indonesia".
2. In A Collaborative Strategy to Address the Live Reef Food Fish Trade (Graham 2001), developing a cost-effective method for assessing the viability of export-based LRFF fisheries was identified as a key objective.
3. For an overview of the Industry Standards project see the article by Kusumaatmadja et al. in the previous issue of this Bulletin (Number 12, February 2004, pages 30-33, http://www.spc.org.nc/coastfish/News/LRF/12/index.htm).

References

ANREI/1998/094. Sustainable management of the LRFT-based fishery in Solomon Islands, ACIAR Project Review Report. Canberra, Australia: Australian Centre for International Agricultural Research.

Graham, T. 2001. A collaborative strategy to address the live reef food fish trade. Asia-Pacific Coastal Marine Program, Report #0101. Honolulu, Hawaii: The Nature Conservancy.

Petersen, E., Muldoon, G. and Johnston, B. 2004. Economic modelling of the live reef fish trade in Asia-Pacific: Developing an approach and preliminary analysis, paper presented to the 48th Annual Conference of the Australian Agricultural and Resource Economics Society, 11-13 February 2004, Melbourne.

Assessment of the use of coded wire tags (CWT) to trace coral trout (*Plectropomus leopardus*) in the live reef food fish trade

Mike Rimmer[1], Sarah Kistle[1] and Geoffrey Muldoon[2]

1. Queensland Department of Primary Industries and Fisheries, Northern Fisheries Centre, PO Box 5396, Cairns, Queensland 4870, Australia
2. Marine Aquarium Council, c/- Level 6, Northtown Tower, 280 Flinders Mall, Townsville, Queensland 4810, Australia.

This activity forms part of the Asia-Pacific Economic Cooperation (APEC) endorsed project to develop Industry Standards for the Live Reef Food Fish Trade – a collaborative project of the Marine Aquarium Council (MAC) and The Nature Conservancy (TNC).

As part of food quality and safety requirements of developing the standard, traceability of the fish from point of capture through to the restaurant has been identified by consumers of the live reef food fish trade (importers, wholesalers) as an issue of importance. This controlled tagging experiment was undertaken to assess the potential to implement traceability in the live reef food fish trade (LRFFT) in terms of 'tracking' the fish from point of capture to markets in Hong Kong.

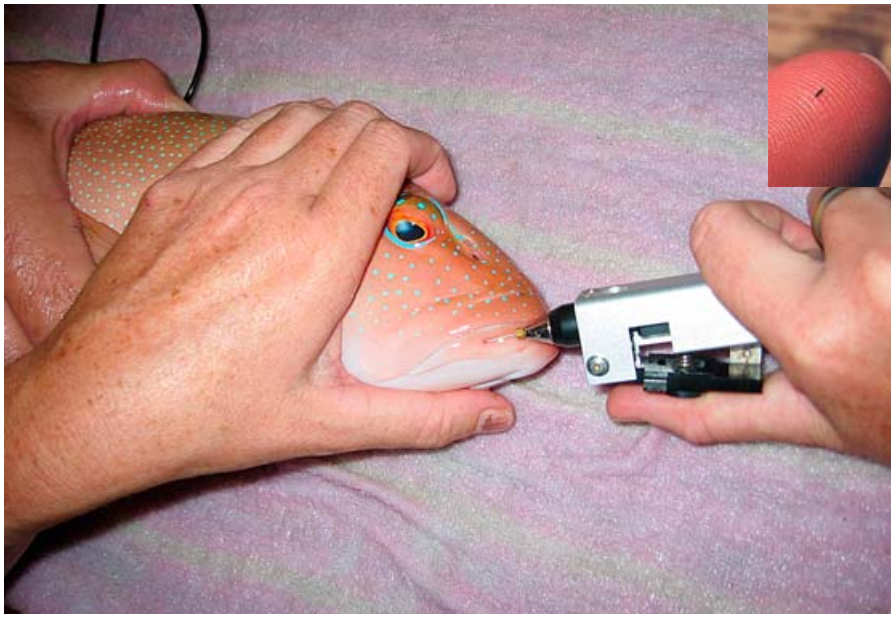
Coral trout (mainly *Plectropomus leopardus*) are captured using hook and line and transported live to collection facilities in the major ports along the coast of Queensland. From here they are loaded into live shipment bins and transported live to Hong Kong by air, in oxygenated bins. From Hong Kong they are either sold to local restaurants, or transhipped to mainland China.

Tagging, holding and transport

Tagging

An essential approach to any tagging of high-value marine finfish is that it does not significantly devalue the fish. The high wholesale and retail prices obtained in the live reef food fish trade are based in part on the aesthetic appeal of the fish, which includes colour and general appearance. For this reason, the use of external tags was rejected for this experiment as external tags typically cause significant damage to the skin, and over time often cause unsightly ulcerations. The wounds may directly lead to fish health problems because they provide a site for pathogen access.

The tags used in this study were coded wire tags manufactured by Northwest Marine Technology Inc. (NMT). Advantages of these tags over traditional plastic skin-penetrating tags is that they are (1) small, (2) bio-



Binary coded wire tags allow decimal coding (etching) that allows for either batch or individual identification. Here a tag is being inserted into the lower mandible of fish

Checking for tag retention following unloading of fish in Hong Kong wholesale facility.

compatible, and (3) nothing remains penetrating the skin, thus preventing aesthetic damage and improving fish health. With no protrusion, the tags used in this study allow the wound to heal, removing any infection path.

Coded wire tags were injected in the mandible of each fish using a Handheld Multi-shot Tag Injector. Fish were routinely checked immediately after tagging, using a Handheld Wand Detector to determine that the tag had been injected. A full transport bin load of fish (280 fish, ~350 kg total weight) was tagged for this study

Due to a technical difficulty with the tag injector, only about 150 fish were tagged on Day 1 with the remaining 130 fish being tagged on Day 2. A tagging rate on Day 2 of around 150 fish per hour was achieved although the hourly rate would likely improve with experience.

Pre-transport holding

After tagging, the tagged fish were kept in a 10 m^3 circular tank in a recirculating system, and held at about 20°C (standard holding practice for Australian live reef food fish traders). The 150 fish tagged on Day 1 were checked for tag retention on Day 2 with the retention check taking approximately 15 minutes for the 150 fish. Of those fish checked, two had lost tags. Both these fish were retagged prior to shipment.

Transport

All 280 fish were loaded into a standard live fish transport 'oxygen' bin. These bins are around 0.8 m^3 capacity and can transport 300–350 kg of live coral trout for around 12 hours total transport duration. Oxygen is supplied to the fish during transport from a self-contained pressurised oxygen gas cylinder, and excess oxygen bleeds off from the bin to the outside atmosphere.

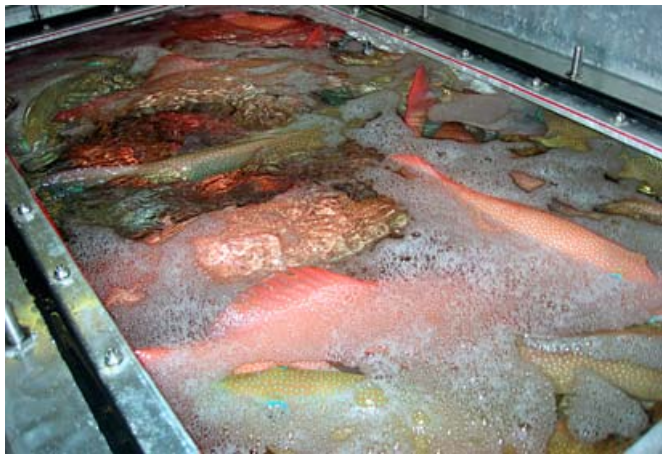
The fish were loaded onto a commercial flight from Cairns, Queensland, Australia to Hong Kong, China, at 0900 (GMT+10) and were offloaded in Hong Kong at 1900 (GMT+8) for a total transport duration of 12 hours. The fish, once unloaded in Hong Kong were given approximately 30 minutes to re-condition and acclimatise before being checked for tag retention. The rechecking the entire of batch of 280 in Hong Kong took 30 minutes.

Results and Discussion

Tag retention on receipt in Hong Kong was 278 fish out of 280 (96%). There was no mortality of transported coral trout.

It is likely that tag retention could be improved with additional experience. Some adaptation of the tag placement was required during the initial part of the tagging exercise so that the morphology of the fish assisted in the ease of needle/tag insertion. This decreased the fish handling time and reducing the likelihood of damage to the fish as well as tagging equipment. The initial tag site was to the centre of one side of the fish's mandible, which was found to be difficult to penetrate, causing the tagging needle to bend. The crevice towards the tip of the fish's mandible provided a natural guide for the tagging needle and a fleshier area for tag placement.

Below: Pack-out of live leopard coral trout from land based holding tanks into oxygenated bins and air transport containers for transhipment by air to Hong Kong.



Conclusion

This feasibility study ably demonstrated the efficacy of tracing live reef fish from their port of origin using coded wire tags. Whilst this represented a positive step toward addressing food safety and health in the consumption of live reef food fish, the characteristics of the LRFFT imply that additional testing be undertaken to identify the most suitable tagging approach for widespread application throughout the LRFFT. Given that the trade is artisanal in nature, comprises a large number of fishers who are geographically dispersed over a wide area, and has numerous sites for landing and holding fish catches before shipment, the tagging method used will need to be relatively simple to use and inexpensive to operate.

Acknowledgments

We thank Adam, Chris and the rest of the staff at Kenneth Aquamarine, Cairns, for their assistance with tagging and checking the fish. We thank Kenneth Vy (Kenneth Aquamarine Products) for providing support and assistance in both Cairns and Hong Kong. We also thank the staff of Northwest Marine Technology Inc. particularly Lee Blankenship and Stan Moberley for their support.

APEC workshop on environmental principles and policies in aquaculture administration - workshop statement

More than 90 per cent of the world's aquaculture production is carried out and marketed within the APEC region. This production represented a market value of about 52 billion dollars in year 2000. Within the APEC economies, few, if any, other industrial sectors, dominate such a high percentage of global production and commerce.

The continued sustainable development of aquaculture is crucial for progress in the region, and can be fostered by trade and investments. As aquaculture production increases at a faster pace than global terrestrial livestock production and harvests from capture fisheries, urgent action is required by APEC economies to develop enabling frameworks of laws and policies that specifically recognize the unique characteristics of aquaculture to both protect aquatic environments and foster sustainable development. As the leader in global aquaculture production and trade, APEC can provide strategic interventions and support to secure the role of APEC economies.

A workshop to analyze aquaculture priorities and discuss environmental principles and policies for all APEC economies was held in Iquique, Chile from 1-3 September 2004. The workshop was attended by representatives from nine APEC Economies, the WorldFish Center, the Center for International Sustainable Development Law, Aquades (NGO), aquaculture experts from five regional universities, representatives of the private sector, individual experts, and a consultant team that was contracted to prepare the background paper.

The workshop builds on previous APEC initiatives and responds to the APEC oceans ministers call in the Seoul Oceans Declaration to: "*improve and strengthen market-based instruments, regulations and enforcement mechanisms for the sustainable management of marine resources*"; "*facilitate, through exchange of information, effective regional implementation of global fisheries instruments in achieving responsible fisheries and sustainable aquaculture*"; and "*strengthen cooperation for building capacity, sharing information and expertise, including for marine science and technology, responsible fisheries and sustainable aquaculture, and coastal and marine management in an integrated manner*".

The analysis of the status of aquaculture development and information exchanges clearly demonstrated the critical importance of aquaculture and trade in the region and the corresponding need for expansion of responsible environmental management for the benefit of current and future generations. To achieve these goals, the following urgent actions were recommended:

1. Develop an APEC Sustainable Aquaculture Strategy, including elements for environmentally sound aquaculture, employment opportunities, product quality and safety assurances, and promotion of high aquatic animal health and welfare standards.
2. Create a web-based Information Network and Database on Sustainable Aquaculture for improving stakeholder and information exchanges
3. Undertake capacity building (training) for policy-makers to enhance sustainable aquaculture development and policies in the Asia Pacific Region.
4. Foster collaborative regional research on sustainable aquaculture, leveraging regional expertise towards mutual recognition or equivalency of standards for production and other processes linked to trade and strengthening consumer acceptance and confidence in aquaculture food products.

As became clear at the workshop, many APEC economies are in the process of finalizing or developing new laws and policies to ensure more sustainable aquaculture. A joint strategy would greatly benefit their efforts and presents a unique opportunity for APEC cooperation. The delegates of the workshop call upon APEC to urgently support a meeting of experts and representatives of APEC economies to develop a first draft APEC Sustainable Aquaculture Strategy and support the information exchange, capacity building and regional research objectives. *For further information contact Dr Alex Brown, Head of Environmental Affairs, Undersecretariat for Fisheries, Chile. Email: abrown@subpesca.cl.*

Trade and market trends in the live reef food fish trade

Geoffrey Muldoon[1], Liz Peterson[2], Brian Johnston[3]

1. CRC Reef Research Centre Limited, PO Box 772, Townsville QLD 4810, Australia. Email: g.muldoon@impac.org.au.
2. Advanced Choice Economics P/L, 30 Dean Road, Bateman WA 6150, Australia. Email: Liz.Petersen@tpg.com.au.
3. Asia-Pacific School of Economics and Government, Australian National University. Email: njvj@austarmetro.com.au.

Introduction

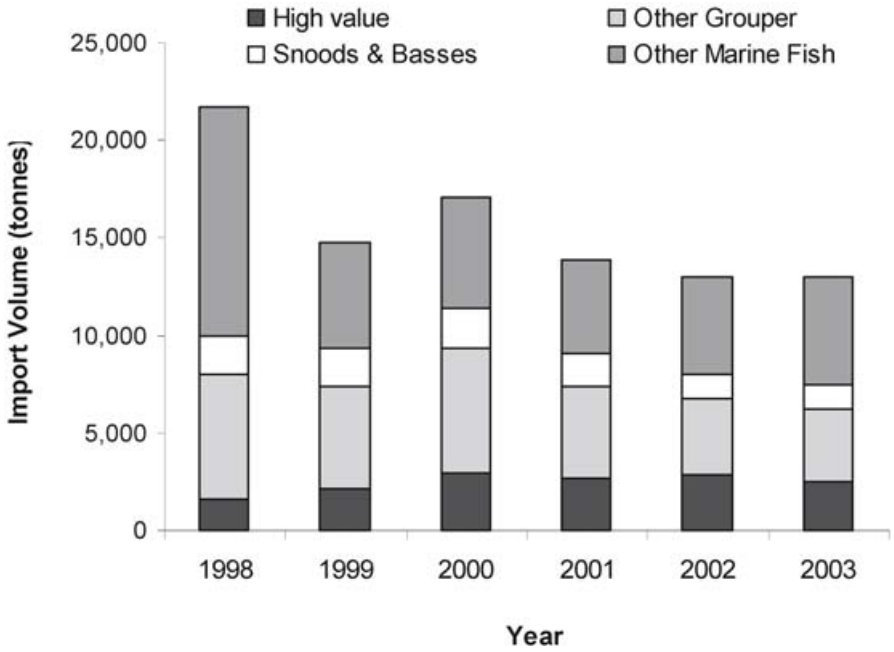
Live reef food fish are currently sourced from more than 20 countries in the Asia-Pacific region, some, located close to the principal demand centre of Hong Kong, having been in the trade for some time while other more distant countries are only recent, and infrequent, participants (HKCSD, unpublished data). Total recorded imports of LRFF into Hong Kong, China (Hong Kong) and the People's Republic of China (PRC), while declining from the peaks of the late 1990s, have remained stable since then (Figure 1).

Recent estimates, based on declared imports of LRFF into Hong Kong, put the annual volume of trade into Hong Kong at 13-14,000 tonnes, with a retail value of approximately US$400 million. As there is no requirement for the approximately 100 Hong Kong licensed live-fish transport vessels to declare imports entering Hong Kong by sea, these estimates are almost certainly lower than actual imports, which are more likely to be 15-20,000 t annually. The total regional trade has been estimated to be as high as 30,000 t per year (Sadovy et al. 2004).

A range of undesirable economic, environmental and social outcomes have often been identified as being associated with the trade, with the focus mainly on environmental issues. These include over-exploitation of coral reefs and coral reef fishes and the environmentally damaging aspects of some harvesting techniques, including cyanide fishing, targeting of spawning aggregations and the capture of immature fingerlings and juveniles for grow-out (Cesar et al. 2000; Sadovy and Vincent 2002). Other aspects of the trade are not well understood and would benefit from further research, particularly demand issues.

On the demand side, the future market potential for wild-caught and cultured live reef product is largely unknown. As incomes in Asia rise over the next decade and product sourced from aquaculture become more readily available, there is an expectation that consumer demand for LRFF will likewise increase. The trade, however, is susceptible to the economic environment, as evidenced in a downturn during the Asian economic crisis from which it has not yet fully recovered, and more recently, although to a limited extent, as a result of the Severe Acute Respiratory Syndrome (SARS) outbreak.

Figure 1: Annual volumes of reported imports of all live reef food fish into Hong Kong, China 1998-2003.



High value species include highfin grouper, humphead wrasse, giant grouper, leopard coralgrouper, and spotted coralgrouper. Other grouper include the green grouper, tiger grouper, flowery grouper and other grouper. Other marine fish include wrasses and parrotfish, mangrove snapper and other fish.Source: Hong Kong Census and Statistics Department (HK CSD) and the Agriculture, Fisheries and Conservation Department (HK AFCD).

Trade data

Although the LRFF trade has been flourishing for several decades, economic and trade information is scant. Prior to 1997, data on the LRFF imports into Hong Kong were coarse with both marine and freshwater live fish categorized broadly as either food or ornamental fish. The Harmonized Code System (HCS) used in Hong Kong to monitor food imports was improved in 1997 to identify live reef food fish categories. Refinement of the HCS in 1999 enabled LRFF imports to be distinguished by key species and country of origin, further improving monitoring capacities. Trade agreements between Hong Kong and PRC provide for low tariffs on LRFF entering PRC through Hong Kong, with the result being that upward of 60% of all LRFF entering Hong Kong are re-exported to the PRC. With lower tariffs on foodstuffs likely when the PRC joins the WTO as expected, LRFF may soon enter the PRC directly. At present, there is limited capacity to record and monitor such imports.

Total recorded imports into Hong Kong have remained relatively stable since 1999, when import volumes

declined considerably relative to previous years (Figure 1). The Hong Kong economy remained fairly robust for the duration of the Asian economic crisis that began in 1997, and only began to show signs of a downturn from the end of 1998. This downturn coincided with a fall in declared imports of approximately 30 per cent in 1999, mainly in the categories of the lower-value "other marine fish" and "other groupers". In 2003, while total imports into Hong Kong rose slightly (less than 0.5%), the SARS epidemic during that year may have influenced consumer demand for particular species. In 2003, the volume of high-value imports fell by 15 per cent. In contrast imports of the lower-value "other marine fish" category, which had declined figurin three of four previous years, rose 10 per cent. The results are described in more detail in the next section

Import volumes of major species by country of origin

The main exporting countries of wild-caught and farmed live reef fish remain mainland PRC; Thailand; Indonesia; Philippines; Australia; Malaysia; Viet Nam; and Taipei, China. Indonesia, Malaysia, Philippines, and Australia are the major exporters of high- and medium-priced wild-caught live reef fish, while smaller quantities are exported from Thailand, Cambodia, Viet Nam and the Maldives[4]. The largest quantities of farmed grouper are exported from Thailand and Taipei, China[5], mainly green grouper, while the PRC is the dominant supplier of other marine fish and snooks and basses. Infrequent and irregular exports of LRFF, mainly coral grouper and other groupers have also been reported from Fiji Islands, Marshall Islands, PNG, Seychelles, Singapore, and Solomon Islands[6].

The volumes of imports into Hong Kong of all major high- and medium-priced groupers and hump-head wrasse during 1999–2003 are shown in Figure 2. Indonesia and the Philippines are major suppliers of most species, although exports of coral groupers, green grouper, and flowery groupers from Indonesia have all declined during this period. Since 1999, total imports of coral groupers have increased by more than 60%, with new Australian exports making up more than 85% of this increase up to 2002. In 2003 Australian imports of coral grouper declined by almost 34% while coral grouper imports from the Philippines rose by almost 50% and total imports fell only slightly. In contrast, total imports of green grouper had declined by 35% from 1999 to 2002, primarily on the back of significantly lower exports from Thailand. In 2003, green grouper imports rose by more than 30%, with exports from Thailand in 2003 more than doubling. During the period 1999 to 2003, total imports of tiger grouper have more than tripled while total imports of flowery grouper have declined by almost two-thirds. These results are discussed in more detail in the context of the SARS epidemic in the next section.

Market trends and recent economic events

In general, the market has contracted somewhat over the past five years, becoming more focused on fewer species - primarily the high-value and mid-priced groupers. The main causes of these past and likely future market shifts are thought to be:

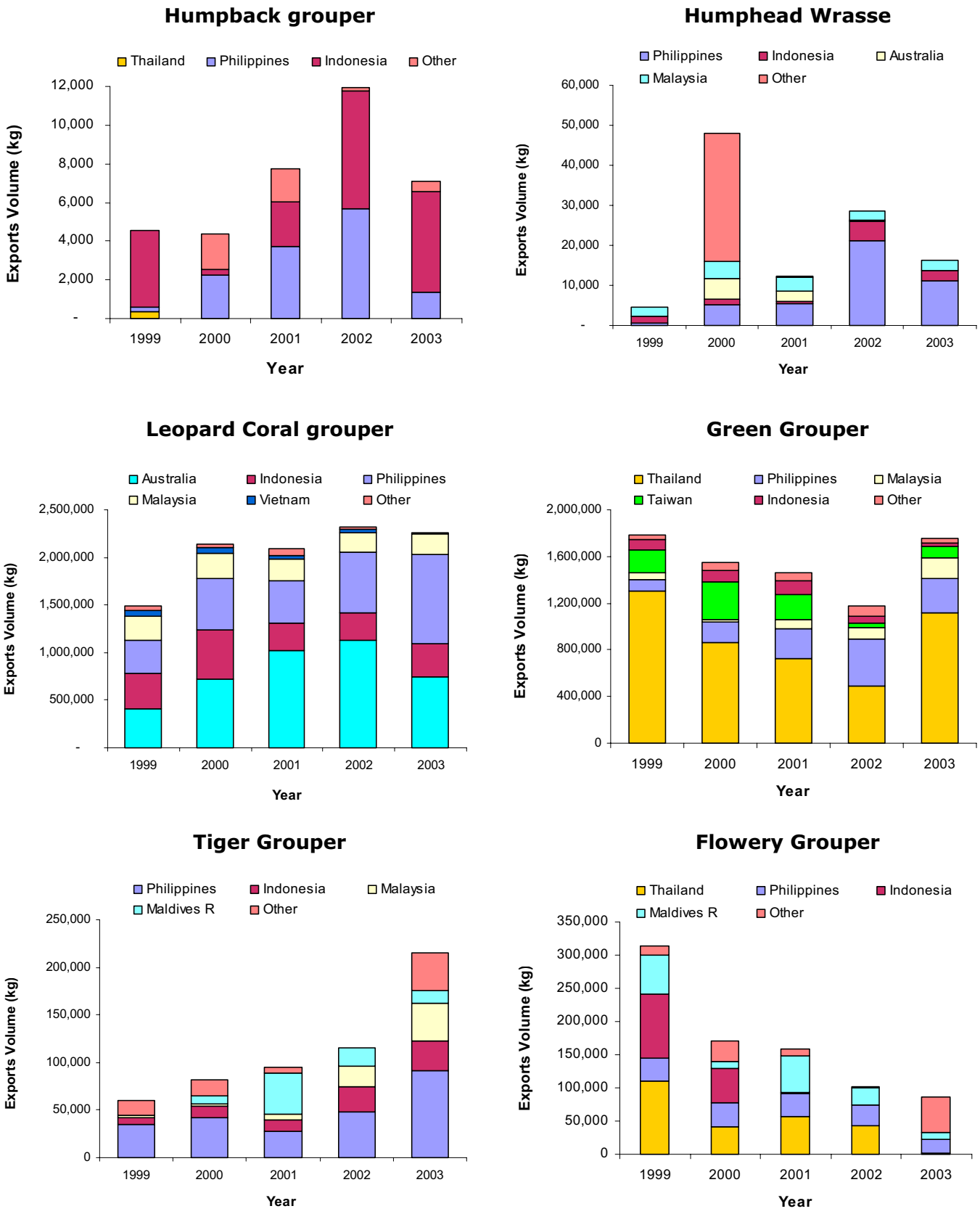
- Overall improvements in transport technology and access to air transport that have helped to increase imports of high-value species. This has been reinforced by relative increases in variable costs (fuel, fish feed, ship maintenance and insurance) of transporting fish to markets by sea[7].
- A decline of ~40% in the LRFF market since 1998. This falling demand has led to weaker retail prices, making the purchase and transport of lower-priced fish that make up the bulk of imports financially unviable, resulting in Hong Kong traders reducing volume of imports by sea.
- Increased aquaculture production of lower-priced "groupers". Grow-out of undersized wild-caught fish has expanded considerably in Southeast Asia. The increase in grow-out from hatchery production is seen as a positive industry development, but there is growing concern over the parallel increase in grow-out of wild-caught juveniles for market[8].
- Downturn in general business because of international health scares such as SARS and Ciguatera poisoning.

The remainder of this section will present empirical and anecdotal evidence on trade impacts of SARS to illustrate the vulnerability of supply countries to events and economic conditions in the major demand centre of Hong Kong.

Anecdotal evidence suggests a number of market responses to SARS influenced these changing consumption patterns. Following the first SARS reports in Hong Kong, restaurants began reporting cancellations of banquet bookings. Restaurants are traditionally the place where the higher-value and medium-value species are purchased and consumed, and so consequently much of their product is imported from overseas sources. With the number of patrons dining out at these restaurants falling markedly, many restaurants closed down for the duration of the SARS scare and, with the lower demand for high- and medium-value fish, many traders stopped buying fish from overseas suppliers. Conversely, with consumers preferring to eat fish at home as opposed to dining out, the demand for the lower-value and domestically caught fish is thought to have increased[9].

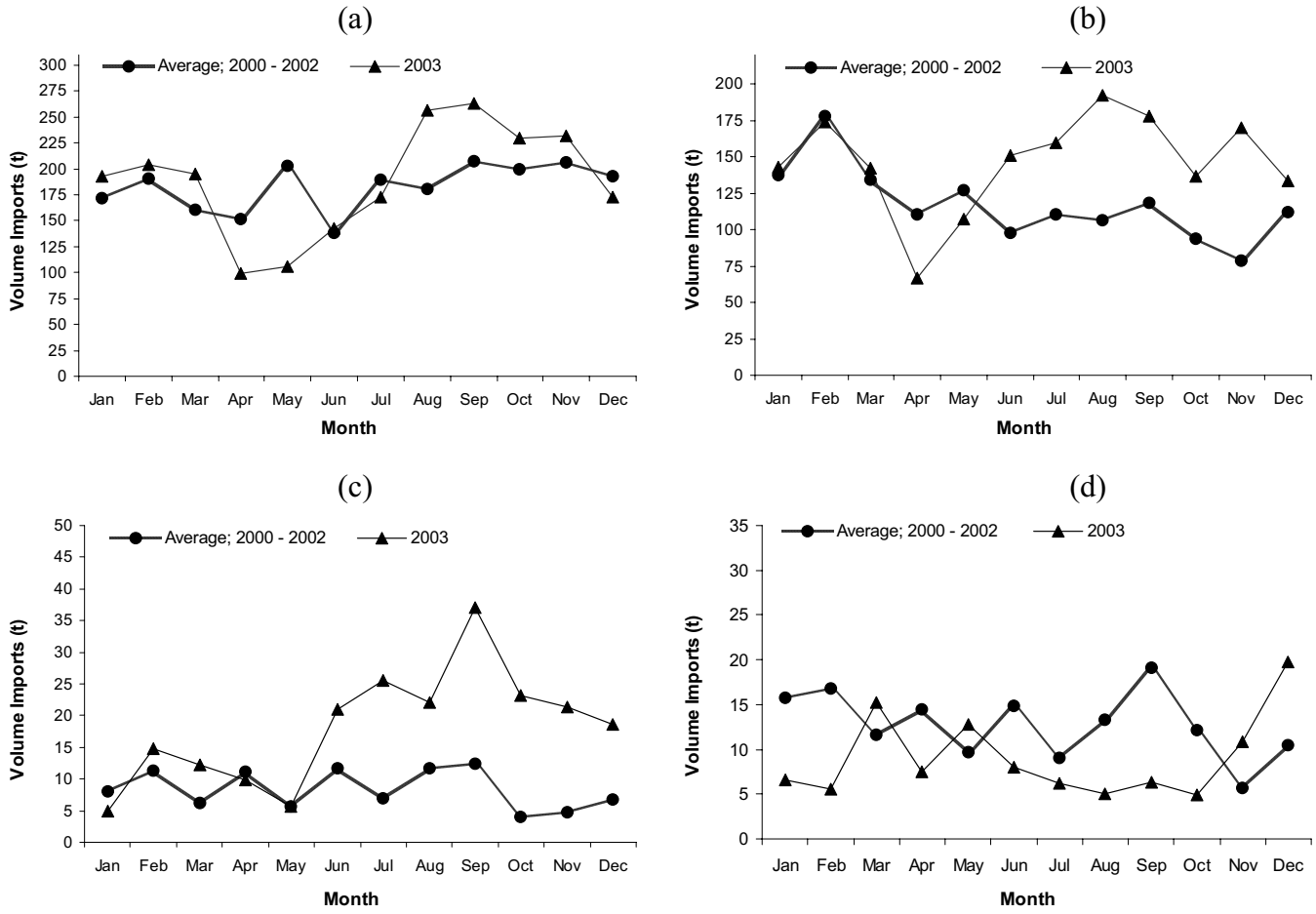
The impact of the SARS epidemic, during April and May of 2003, on individual species can be examined by looking at trends in both prices and import volumes across recent years. There were no real discernable impacts of SARS on the import prices of most high-value and mid-value species (see Figure 1 caption), including leopard and spotted coral grouper, highfin grouper, green grouper and tiger and flowery grouper (Pet-Soede et al. 2004). The SARS epidemic however, does appear to have had an impact on the demand for a subset of high-value species and other grouper species. Figure 3, which compares monthly imports in 2003 and monthly imports averaged across the years 2000-2002, illustrates declines in imports of four key species or species groups in the months affected by the SARS epidemic. In April and May of 2003 imports of leopard coral grouper were 34 per cent and 48 per cent lower, respectively, than the average annual imports over

Figure 2: Import volumes for 6 species imported into Hong Kong, by country of origin for 1999–2003



Note: Those countries that make up the "other" category vary by species. In most cases, these countries do not export regularly. Countries that export several species include Cambodia, PRC, Singapore, Thailand, and Viet Nam. Source: Hong Kong Census and Statistics Department, Agriculture, Fisheries and Conservation Department, and International Marinelife Alliance (Hong Kong).

Figure 3. Total monthly volume of imports of four major species or species groups: a) leopard coral grouper, b) green grouper, c) tiger grouper, and d) flowery grouper imported into Hong Kong, China from 2000 through 2003. Monthly import volumes have been averaged across the years 2000–2002.



Source: Hong Kong Census and Statistics Department and Hong Kong Agriculture, Fisheries and Conservation Department, and International Marinelife Alliance (Hong Kong).

the years 2000-2002. Imports were also lower for green grouper and "tiger grouper" species in April (39% and 11% lower, respectively) and May (16% and 1% lower, respectively). While imports of flowery grouper were 48 per cent lower in April than the 2000-2002 average, imports in May were 31 per cent higher than the 2000-2002 average. While recognising that the SARS event was likely a market demand phenomenon, it is possible that supply constraints influenced these observed declines in import volumes[10].

During the SARS outbreak, imports from countries in closer proximity to the Hong Kong market did not decline by as much as those from countries further away, compared with previous years. For example, imports of leopard coral grouper from the Philippines were not significantly lower than the 2000-2002 average, while imports of this species from Australia dropped by roughly 50 per cent in both April and May 2003. One reason might be that proximity implies lower transport costs, and hence lower total import costs, while another would be the availability of substitute markets. In Australia, local wholesalers reported beach prices being offered to fishers for live fish as low as 15 Australian dollars (AUD) per kilogram during the peak of the SARS outbreak, compared with an average price in April and May across all years from 1997 to 2002 of AUD 25.1 and AUD 25.9, respectively (G. Muldoon, unpublished data; T. Must, Fish Wholesaler, personal communication). According to several wholesale buyers spoken to during and after the SARS outbreak, many fishermen in Australia either sold their fish fresh or frozen[11] to domestic and overseas markets rather than live, or did not fish at all during this period.

Pet-Soede et al. (2004) noted in a previous issue of this Bulletin that prices of two high-value species, leopard coral grouper and highfin grouper, showed little, if any, change in price in response to SARS. They did, however, note substantial price reductions in beach prices received by fishers in Indonesia for live grouper. Similarly discounted prices were "offered" to fishers in Australia, with beach prices during the SARS outbreak 40 per cent lower than average prices for those months over the previous five years (G. Muldoon, unpublished data). Although only anecdotal accounts are available for the Philippines, live fish exporters noted that beach prices paid to fishers fell by 20 per cent during the SARS outbreak (B. Cheng, personal communication). These discrepancies in price variations in response to SARS that were experienced by participants in supply and demand countries may be cause to point to market distortions and profit taking by retailers in Hong Kong, at the expense of fishers and middlemen in supplying countries.

Such inferences, however, based on these observations and with limited knowledge of the dynamics of supply and demand, would be difficult to substantiate.

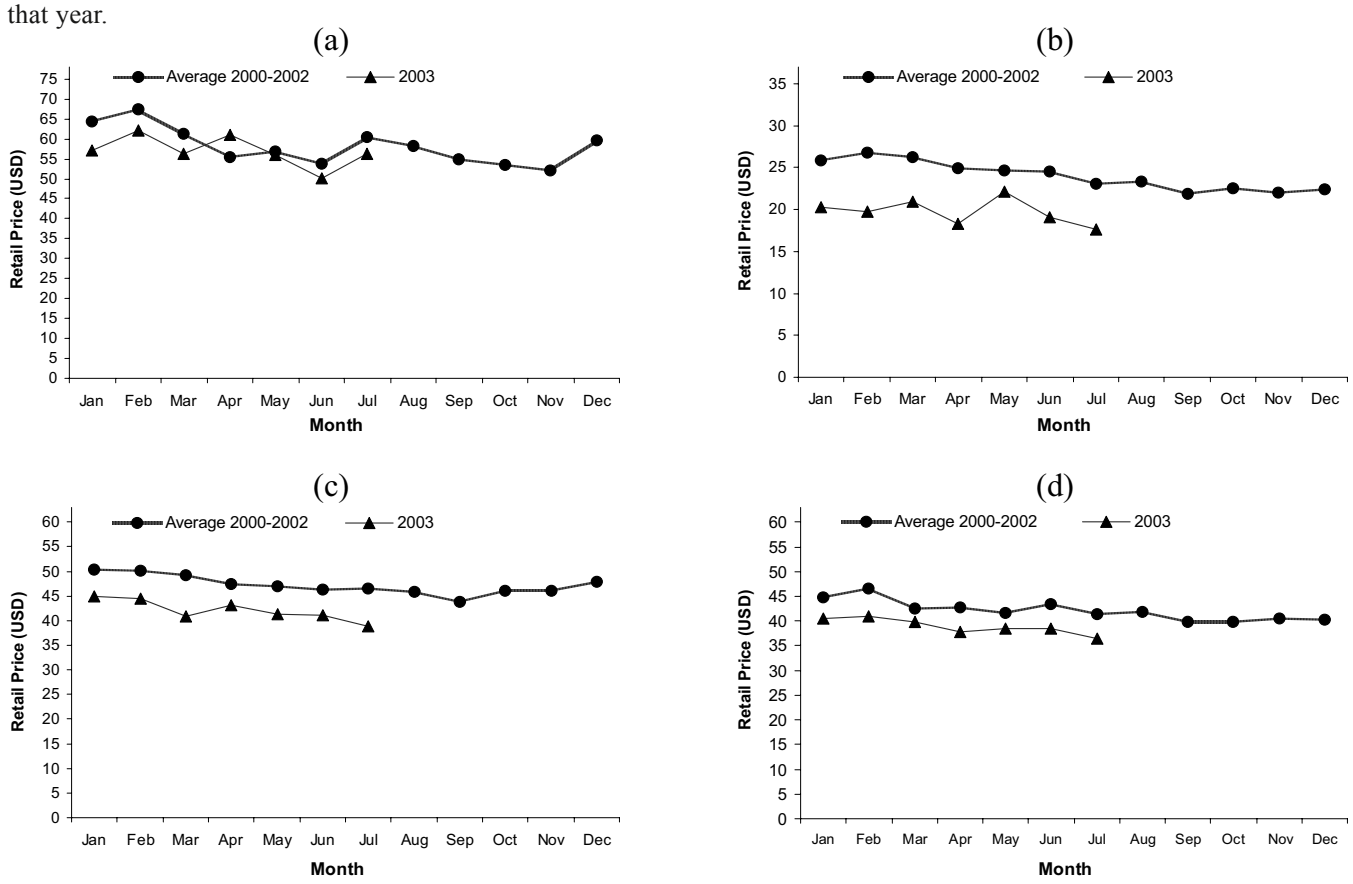
A similar picture emerges for a broader range of species, including mid-value species, such that available data do not provide strong evidence of a SARS impact on price. Figure 4 compares monthly retail prices in 2003 with monthly retail prices averaged across the years 2000-2002 for four species of grouper. Ignoring SARS impacts, what is of interest is that for all species, with the exception of April for the leopard coral grouper, monthly retail prices in 2003 were lower than the corresponding monthly retail prices averaged across 2000-2002. This reinforces the anecdotal evidence provided by traders of a downward trend in prices for the whole trade. Again, discerning whether these price variations may be demand or supply responses is difficult based on available data. While prices in 2003 were lower for all species illustrated, patterns of import volumes were not consistent. For example, leopard coral grouper imports increased relative to the previous year in 2000 (44%) and 2002 (11%) but were stable in 2001, while tiger grouper imports increased in 2000 (36%), 2001 (16%) and 2002 (21%). In contrast, green grouper imports decreased in 2000 (13%), 2001 (5%) and 2002 (20%), as did flowery grouper imports in 2000 (45%), 2001 (7%) and 2002 (12%). A hypothesis that declines in import volumes should lead to price increases is not borne out here. A more likely premise is that the market overall is depressed, as is the Hong Kong economy generally. Further investigation would be required to establish whether the discrepancies in monthly import volumes between years and corresponding price movements are, in general, supply and/or demand responses.

Conclusions

Hong Kong remains the major destination for consumption of LRFF, despite declining import volumes, depressed prices and occasional health-related demand impacts. Of growing interest is the expanding market associated with increased incomes in mainland PRC. This growth is expected to continue into the future, placing increased pressure on supplies of LRFF. It has been observed however, that increases in present yields of high and medium-value LRFF species from the wild are limited by the biological constraints on total grouper production (Sadovy et al. 2004).

Aquaculture has been identified as both an alternative livelihood to engaging in often-destructive fishing practices and as a means of meeting future demand for the "high- and medium-value" grouper species when many fish stocks in Southeast Asia are showing signs of severe depletion. It is estimated that approximately 40 per cent of all LRFF in the trade are

Figure 4. Monthly retail prices in Hong Kong of four major species or species categories: a) leopard coralgrouper, b) green grouper, c) tiger grouper, and d) flowery grouper, imported into Hong Kong, China from 2000 through 2003. Monthly retail prices have been averaged across the years 2000–2002, while monthly retail prices for 2003 are only available until July of that year.



Source: International Marinelife Alliance (Hong Kong).

supplied from aquaculture, although the majority of these fish come from grow-out of wild-caught juveniles to market size. Any benefits from substituting wild-caught with cultured species depend on how successfully the mariculture industry relieves its dependence on wild stocks for juveniles and trash fish for feed through increased hatchery production and development of new diets (Sadovy et al. 2004). Moreover, the market impacts, and specifically price impacts, of this substitution may have significant effects on fisher income.

Footnotes

1. CRC Reef Research Centre Limited, PO Box 772, Townsville QLD 4810, Australia. Email: g.muldoon@impac.org.au
2. Advanced Choice Economics P/L, 30 Dean Road, Bateman WA 6150, Australia. Email: Liz.Petersen@tpg.com.au
3. Asia-Pacific School of Economics and Government, Australian National University. Email: njvj@austarmetro.com.au
4. Hong Kong Census and Statistics Department, Hong Kong Agriculture, Fisheries and Conservation Department
5. Both hatchery produced and wild caught grow-out fish.
6. Johannes and Riepen, 1995; Shakeel and Ahmed, 1997; Yeeting 1999a; 1999b; Johannes and Lam 1999; IMA Hong Kong, unpublished data.
7. Patrick Chan, personal communication.
8. In some regions, primarily juveniles are caught and grown-out locally, and sold when they attain market size.
9. Patrick Chan (Chairman, Hong Kong Chamber of Seafood Merchants), personal communication.
10. Supply constraints in source countries may be related to weather (monsoon, high winds) or seasonal variations in catch rates.
11. Beach prices for frozen and whole fresh fish during April and May of 2003 remained steady at between AUD 16.00 and 19.00 per kilogram, depending on the weight of the fish

References

Cesar, H.S.J., Warren, K.A., Sadovy, Y., Lau, P., Meijer, S. and van Ierland, E. 2000. Marine market transformation of the live reef fish food trade in southeast Asia. p. 137-157 In: H.S.J. Cesar (ed). Collected essays on the economics of coral reefs. Sweden: CORDIO.

Johannes, R.E., and M. Lam. 1999. The Live Reef Food Fish Trade in the Solomon Islands. SPC Live Reef Fish Information Bulletin 6:7–14.

Johannes, R. E. and M. Reipen. 1995. Environmental, Economic and Social Implications of the Live Reef Fish Trade in Asia and the Western Pacific, A study for the Nature Conservancy. Noumea, South Pacific Forum Fisheries Agency.

Pet-Soede, L., Horuodono, H. and Sudarsono. 2004. SARS and the live food fish trade in Indonesia: Some anecdotes. SPC Live Reef Fish Information Bulletin 12:3-9.

Sadovy, Y.J. and Vincent, A.C.J. 2002. Ecological issues and the trades in live reef fishes. p. 391-420 In: P.F. Sale (ed). Coral reef fishes: Dynamics and diversity in a complex ecosystem. San Diego: Academic Press.

Sadovy, Y.J. et al. 2004. While stocks last: The live reef food fish trade. Manila: Asian Development Bank. 147 p.

Shakeel, H., and H. Ahmed. 1997. Exploitation of Reef Resources, Grouper and Other Food Fishes in the Maldives. SPC Live Reef Fish Information Bulletin 2:14–20.

Yeeting, B. 1999a. Live Reef Food Fish Developments in Fiji. SPC Fisheries Newsletter 8:25–36.

Yeeting, B. 1999b. Live Reef Fish Development in Fiji. SPC Live Reef Fish Information Bulletin 6:19–24.

Collaborators

The following organizations and contacts are focal points for communication in the network:

Hong Kong
Dr Jim Chu,
jim_cw_chu@afcd.gov.hk

India
Dr Mohan Joseph Modayil,
mdcmfri@md2.vsnl.net.in

Indonesia
Dr Ketut Sugama,
crifidir@indonet.id
Dr Muhammad Murdjani,
lbapstbd@radnet.id

Iran
Dr Shapour Kakoolaki,
bsh443@yahoo.com

Malaysia
Coastal marine fish culture
Mr Ali bin Awang,
ppbuk@po.jaring.my

Fish quality
Mr Ismail Ishak & Mr Hamdan Jaafar
anasofiah@hotmail.com /
hamdanj@yahoo.com

Low food chain species
Mr Hussin bin Mat Ali
pppil@po.jaring.my

Philippines
Ms Prescilla B. Regaspi,
pregaspi@bfar.da.gov.ph
Ms Marygrace C. Quintero,
mgquintero@bfar.da.gov.ph

Collaborating organisations