Marine finfish section

The Grouper Section has taken on a new and broader name: It has become the Marine Finfish Section to take account of other species. This section is almost wholly based on the Marine Finfish Aquaculture Network which is prepared by Sih Yang Sim (Editor), Michael Phillips (NACA Environment Specialist) and Mike Rimmer (Principal Fisheries Biologist of the Queensland Department of Primary Industries). Visit www.enaca.org/grouper for more information on the network.

News

New Version of Marine Finfish Aquaculture Network Website with New Features

A brand-spanking new version of the Asia-Pacific Marine Finfish Aquaculture Network website is now available with many new and useful features. These include:

- Weekly average wholesale prices for live fish in Hong Kong
- Discussion Forum
- Photo Gallery
- Resource Materials and Articles

If you have a question on marine finfish aquaculture please use the 'Discussion Forum' available from the site. Here you can chat with your colleagues, ask a question and confer with other people involved in marine finfish aquaculture. Have you developed a new technique on your farm that would like to share with others ? Please consider sharing your experience on marine finfish aquaculture with others in the network.

We welcome you to visit the new website at http://www.enaca.org/grouper/ for more information. The website will regularly updated with news, publications and other materials and announcements will continue to be made via the email newsletter. We encourage you to send marine finfish aquaculture information to grouper@enaca.org.

The Asia-Pacific Marine Finfish Aquaculture Network hopes that the new website will serve users better, and your comments, suggestions and input for its further development are most welcome.

DPI Leads Study on Cod Farm Exports

The Australian Department of Primary Industries is spearheading the development of gold-spot cod aquaculture. Gold-spot cod (*Epinephelus coioides*) a popular fish in Asian markets, is in demand as a live export commodity and for frozen fillets. DPI aquaculture biologist Mike Rimmer is head of an international team as part of a $1 million, four-year project to explore the commercialization of the gold-spot cod in Queensland and Southeast Asia. The project has been funded by the Australian Centre for International Agricultural Research. "There has been a lot of interest from existing prawn farmers in the possibilities of diversifying into gold-spot cod aquaculture," Dr Rimmer said. "There are extremely positive signs – the fish are very hardy and can tolerate low salinity, making them ideal for coastal aquaculture. They are also fast growing and reach market size within one year. Our ACIAR-funded project is exploring the technology needed to develop this species commercially, and how to convert existing enterprises to make them suitable for the commercial production of the fish". *Source: Sunday Mail (QLD), March 2, 2003.*

Grouper Aquaculture Workshop, Northern Fisheries Centre, Cairns, 6 March 2003

A grouper aquaculture workshop was held at Northern Fisheries Centre, Cairns, on 6 March 2003, to extend the results of Australian Centre for International Agricultural Research (ACIAR) Project Improved hatchery and grow-out technology for grouper aquaculture in the Asia-Pacific region to the aquaculture industry in northern Australia. Featured speaker at the workshop was Dr Joebert Toledo, who heads the grouper aquaculture research team at the Southeast Asian Fisheries Development Centre's Aquaculture Department at Iloilo in the Philippines. The workshop was attended by 15 finfish and prawn farmers and hatchery operators. Dr Toledo reported the results obtained by SEAFDEC researchers working with gold-spot (estuary) cod *Epinephelus coioides*. As a result of this research, hatchery survival of gold-spot cod has improved from around 3% at the start of the project (1999) to around 30% today. This has resulted in the hatchery production for this species becoming commercially viable.

Workshop participants also heard from Queensland Department of Primary Industries (DPI) researchers with updates on grouper broodstock management and the status of live feeds development for marine finfish hatcheries. In addition, the outcomes of the International Marinelife Alliance / Marine Aquarium Council / The Nature Conservancy project on Developing Industry Standards for the Live Reef Food Fish Trade were presented at the workshop.

Following the workshop, Dr Toledo and Dr Mike Rimmer (project leader for the ACIAR grouper project) visited farms, hatcheries and research institutes in northern Queensland. The field trip provided an opportunity to further discuss with farmers opportunities for the development of grouper aquaculture in Australia, and further on-farm research is planned. Visits to the Australian Institute of Marine Science and James Cook University's Aquaculture Department provided opportunities for the development of future collaborative research projects.

Dr Toledo's visit to Australia was sponsored by ACIAR, DPI and SEAFDEC AQD.

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Prawn Farm Venture Into Marine Fish Hatchery, Singapore

A 20 ha prawn farm on Pulau Ubin, Singapore is setting up Singapore's first commercial fish hatchery. AddPower Ventures, the company that manages the 12-year-old farm, is planning to pump in $3 million to set up a hatchery producing grouper and golden pomfret fry to sell here and abroad. Mr Lawrence Goh, the managing director of AddPower, said: "At the moment, there is a vacuum in the hatchery industry here.

'Farmers buy from Taiwan and Thailand, but from November to April, it is too cold for Taiwanese fish to lay eggs. The climate in Singapore is best for producing fish eggs as it's warm all year round. But to be successful, you need the technology and know-how.'

This is where the Agri-Food and Veterinary Authority of Singapore (AVA), which has a Marine Aquaculture Centre on St John's Island, comes into the picture. It has been carrying out research in the field of hatching fry and is willing to pass on its expertise to farmers. For each type of fish, Mr Goh and his three partners hope to produce about five to six million fry. Mr Goh says the demand for grouper fry last year among local farmers was only one million. The rest of the produce will be exported to neighboring countries such as Malaysia and Indonesia.

Fish farmer Toh Kai Tiok was excited to learn about the new hatchery. He said: 'Now, we can buy our fry from Indonesia but there are sometimes problems because there is more salt in the sea water there. With a local hatchery, it should be easier to rear healthy fish because they are hatched in the same sea water'.

Source: The Straits Times (Singapore), January 12, 2003.

New publications

An Economic Assessment of Current Practice and Methods to Improve feed Management of caged Finfish in Several SE Asia Regions *(Peter J. Blyth and Ross A. Dodd)*

Intensive sea cage aquaculture is in its infancy in SE Asia although there is still significant production of approximately 130,000 tonnes of mixed tropical species (*Epinephelus* sp., *Lutjanus* sp., *Plectropomus* sp., *Cromileptes* sp., *Rachycentron* sp., *Lates* sp., and others) carried out in small wooden systems that are fed manually. This compares to the industrial farming techniques (large cages and automation) found in Europe, America, Australia and Japan (*Salmo* sp., *Seriola* sp., *Pagrus* sp., *Dicentrarchus* sp., and *Sparus* sp.)

In order to grow this sector sustainably in SE Asia, the existing sea cage industry needs to under go certain reforms. These include:

- reliable hatchery supply of disease free fingerlings from disease from broodstock
- trait selection programs targeted at key species for domestication
- modernization of the sea grow-out systems (eg. Larger more durable cage systems – steel/HDPE plastic)
- feed management technology
- cessation of trash fish use for development of suitable dry pelletised diets
- relocation of cage systems from sub-optimal sites to locations with deeper, better quality water
- greater degree of government and private sector co-operation (eg. Government & private sector sea cage research facilities where long term research can occur into nutrition, feed management, disease control, broodstock control and domestication programs)

These reforms will help this sector to become a significant contributor to the regional economy in an environmentally sustainable manner.

A full copy of the report is available in PDF format (885KB) from http://www.enaca.org/Grouper/ResourceMaterials/Grow-out/Feed2003.pdf, or you can contact Mr Peter J. Blyth, SunAqua Pty. Ltd. PO Box 1035, New farm, Qld 4005, Australia, E-mail: pjblyth@bigpond.com.

Prospects and Problems For Mariculture in Hong Kong Associated with Wild-Caught Seed and Feed *(Y.J. Sadovy and P.P.F. Lau Aquaculture Economic and Management, 6 (3&4): 177-190)*

Mariculture has the potential to supplement world seafood supplies and generate livelihoods and income. It can only do this, however, if it is sustainably practiced in relation to the input of natural resources on which much of it continues to depend. There is, therefore, a need to understand the links between inputs from wild sources, such as fish seed and fish feed, and mariculture practices. Such links are often not considered, with mariculture typically viewed in complete isolation from the status of its natural resource inputs. The mariculture industry in Hong Kong is evaluated, as a case study, in terms of fish and feed inputs, some of which continue to be derived from wild sources. It is argued that better use of wild resources, and a clearer understanding of the links between culture and capture, would provide many benefits to the mariculture industry, and, more broadly, to seafood supply through mariculture industry in general. Possible directions of development for the local industry include the widespread adoption of pellet feed and hatchery production of juveniles. While regional economic factors will inevitably determine the operation of the industry in the short-term, the biological constraints identified in this paper must be considered for long-term persistence of mariculture operations at the regional levels as well as to ensure better use of natural resources.

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The Evolution of the Fry Market in the Marine Fish Culture Industry of Hong Kong: An Economic Perspective *(L.W.C. Lai and B. T. Yu)*

This paper documents from an economic perspective the evolution of the fry market as part of the marine fish culture industry in Hong Kong, and related research efforts. The fry market, which involves a division of labor among fry import traders, local fry catchers and local culturists, has helped the adjustment of the industry in the face of foreign competition. Due to the success in artificial breeding of key cultured fish and keen product competition, the prices of fry have been falling. The contribution of the fry breeders to sustaining the culture industry is discussed.

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New Tools for the Detection of Seabass Nodavirus Viral Sources and Virulence for Eggs and The Larvae

Nodaviruses are responsible for a viral disease characterized by the degeneration of the brain and retina in several species of fish, including the seabass. The aim of this work was to study the transmission and virulence of two genetically distinct viral strains of different origins on the eggs and larvae of seabass, using an immunological test (ELISA: Enzyme-Linked Immunosorbent Assay) performed on homogenized larval tissue. The viral strains were isolated from sick seabass taken from farms on the Atlantic coast (Atlantic strain SB1) or on the Mediterranean coast (Mediterranean strain SB2).

The Atlantic strain performed particularly well in the immunological test. The Atlantic viral strain SB1 is more pathogenic for eggs than SB2 when an experimental contamination was carried out at the time of fertilization. Strains SB1 and SB2 are also pathogenic for larvae, and the cerebral lesions that are characteristic of the disease appeared between 4 and 6 days after challenge. This immunological test can be used to detect the virus in larvae before the clinical and behavioural signs of the disease appear.

In conclusion, the development of a test to screen for nodavirus in the tissues of seabass at an early developmental stage of the egg and the larvae complements the panoply of tests recommended by the International Office of Epizootic Disease (IOED) for the detection of viral pathologies in fish. This immunological test on tissues complements the one previously developed for the detection of anti-nodavirus antibodies in the blood of adult seabass and opens up the prospect of early detection and control of contaminated fish in fish farms. Moreover, it provides new data concerning the virulence of two genetically different strains of nodavirus during the larval development of the fish.

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Husbandry and Health Management of Grouper – Vietnamese Version

The manual “Husbandry and Health Management of Grouper” developed by SEAFDEC AQD and APEC is now available in Vietnamese language. The manual is designed to be easily used by farmers, and has been translated into Bahasa, Thai, Mandarin, and Philipino in addition to English version. The Vietnamese translation was conducted by SUMA (Support to Brackish Water and Marine Aquaculture) of DANIDA.

If you would like to get a copy, please contact Mr Le Dinh Buu: Khanh Hoa SUMA Office, 78 Thong Nhat St., Nha Trang, Vietnam, Tel: 84-058 822941, Fax: 84-058 822921. E-mail: lbuu.suma@fsps.com.vn

Poverty and Reefs – A Global Overview *(Emma Whittingham, Jock Campbell and Phil Townsley)*

The aim of the project is to use a livelihoods approach to assess the wider, more qualitative, value of coral reefs to vulnerable coastal communities. This knowledge is intended to contribute to informing DFID’s future policy on support for reefs and coastal communities as a strategy for poverty eradication. It is also hoped that the work will contribute to wider global policy development in the area of coral reefs.

This report is based on a global overview of literature and experience on the value of reef-related benefit flows to poor coastal communities and is illustrated with examples from the case studies. The report is presented in five sections. The first section provides an outline of types of people who depend upon reefs, their global distribution and numbers. It also discusses the global and regional distribution of coral reefs. Section two is the main section of the report and provides an overview of reef-related benefit flows to the poor. This section is based on an analysis of benefit flows using the sustainable livelihoods framework and includes much of the case study results. Section three reviews the changes that are occurring in these benefit flows and why these changes are occurring. Section 4 looks at the array of different interventions that now affect the lives of reef-dependent poor and assesses their impact. Section 5 discusses the finding from the previous 4 sections and evolves some principles for addressing poverty-related reef issues. It also looks at the policy implications of the findings for DFID and suggests some ways forward.

The full report is available for download as a MS Word document (3.11 MB) from the Onefish website: http://www.onefish.org/id/132235.

Discussion Topic - Cobia Larval Nursery in Earthen Pond

Mr Huy from Vietnam has posted a question on the Marine Finfish Discussion Forum on the website and would like to discuss the above topic with people who have experience in this area. Mr Huy working in a marine finfish hatchery in Nghe An province, Vietnam. The hatchery has been successful in seed production of cobia (*Rachycentron canadum*) in intensive system. However, the production cost is high and one alternative approach is to reduce cost and develop low-cost nursery technique with extensive or semi-extensive nursery in earthen pond. He has heard that mass production of cobia in China has been carried out in earthen pond. Therefore, he is going to conduct some experiments this year with this nursery technique. However, he has little experience regarding this nursery technique, so if you have experience in this field please share your experiences with him and send your respond to grouper@enaca.org or post your comment in the discussion forum on the Marine Finfish Aquaculture Network Website, www.enaca.org/grouper.

Status and development of mariculture in Indonesia

Ketut Sugama

Central Research Institute for Aquaculture, Agency for Marine and Fisheries Research of Indonesia

Indonesia is an archipelagic country with the total area calculated around 7.7 million km^2, consisting of 1.9 million km^2 of land 5.8 million km^2 of seawater. Its vast natural resources supported by a favorable climate, has a great potential for aquaculture development. Although aquaculture is considered as a promising activity the rate of utilization of the aquaculture potential in Indonesia is still very low, especially for marine aquaculture (Table 1).

The uneven distribution of population has caused overall development to be concentrated in Java Island and the surroundings. Application of Act No. 22/1999 tends to spread the development to the other parts of the country, including aquaculture development. Local governments are now being actively identified for their potentials and effort to optimize the utilization. The implementation of the Act No.22/1999 usually faces common problems such as lack of accessibility, manpower, and distribution of inputs (seed, feed, etc). In order to guide the development of aquaculture, the Central Government has established 12 centers of aquaculture development (4 centers each for freshwater, brackishwater, and marine culture) located in each of west, middle and eastern part the country. Each province may also have their own centers according to the local potential species. Apart from aquaculture development centers, there are also three National Research Institutes for Aquaculture (marine, brackish and fresh water aquaculture) and several research stations. The location of the development centers and national research institute are shown on the map.

Status of Development

Several research and development centers have been established to develop aquaculture technologies and dissemination. Aquaculture technologies are being developed for at least 25 species including finfish as well as non-finfish to be applicable for farmers. Dissemination of technologies is conducted by training, information, demonstration and supervision. Table 2 lists the species being researched and their status of development.

Production

Aquaculture production by major species of culture is shown in Table 3.

Major Aquaculture Species of Economic Importance

The policy of aquaculture development in Indonesia is directed mainly for (a) empowering fish farmers, especially in rural areas, (b) increasing export earnings from fish commodities, (c) increasing fish consumption for food security, and (d) rehabilitation and conservation of aquaculture resources. In line with the national policy, freshwater aquaculture development is mainly aimed to supply animal protein for local consumption, and to produce fish meal for feed. While marine and brackishwater aquaculture development is more engaged with the effort to increase export earnings. Considering recent technological development and marketing, the main species have been developed and the candidate species with brightest potential for commercial aquaculture development in coastal and offshore areas of Indonesia are the penaeid shrimp (*Penaeus monodon*, *P. merguensis*, *P.indicus*), swimming crab (*Portunus pelagicus*), mud crab (*Scylla paramamosain*), sea bass (*Lates calcarifer*), milkfish (*Chanos chanos*) groupers (*Epinephelus spp.*, *Cromileptes altivelis*, *Plectropomus spp*. etc.), Big-eye trevally (*Caranx sexfasciatus*), Golden trevally (*Gnathonodon speciosus*), Napoleon wrase (*Cheilinus undulatus*), Red snappers (*Lutjanus argentimaculatus*, *L. sebae*), Tunas (*Thunnus spp.*), pearl oyster (*Pinctada maxima*), seaweed (*Euchema* sp., *Gracillaria* sp.).

Ongoing Research

Several projects involving the hatchery and grow-out stages of these species are currently under way. It is foreseen that grouper and snapper species will be raised within the next few years in Indonesia.

Broodstock management

The technology of seed production of some marine finfish have been developed such as milkfish (*Chanos chanos*), sea bass (*Lates calcarifer*), highfin/humpback/mouse grouper (*Cromileptes altivelis*) and tiger grouper

Table 1. Utilization of aquaculture potential area in Indonesia

Type of Aquaculture	Potential Area (1,000 Ha)	Utilization	
		Ha	%
Marine	2,002	0.388	0.17
Brackishwater	913	411.23	45.416
Freshwater Pond	375	68.69	18.317
Freshwater Cage	550	0.051	0.0093
Paddy Field	240	141.27	58.86

Table 2. List of aquaculture species and their status of development

Common Name	Scientific Names	Grow-out	Hatchery
Milkfish	*Chanos chanos*	D	D
Seabass	*Lates calcarifer*	D	D
Red Snapper	*Lutjanus argentimaculatus, L. sebae*	ED	R/D
Siganid	*Siganus* spp.	D	R/D
Highfin Grouper	*Cromileptes altivelis*	LD	D
Tiger Grouper	*Epinephelus fuscoqutatus*	LD	D
Malabar Gouper	*E. malabaricus*	ED	R/D
Flowery Grouper	*E. polyphekadion*	ED	D
Giant Grouper	*E. lanceolatus*	ED	R/D
Estuarine Gouper	*E.coioides*	ED	D
Coral Trout	*Plectrophomus.leopardus*	ED	R/D
Napoleon wrase	*Cheilinus undulatus*	ED	R/D
Tiger Shrimp	*Penaeus monodon*	D	D
Banana Shrimp	*P.merguiensis*	D	D
White Shrimp	*P.indicus*	D	D
Lobster	*Panulirus* sp.	ED	R/D
Mud Crab	*Scylla paramamosain.*	LD	R/D
Swimming Crab	*Portunus pelagicus*	D	D
Sea Horse	*Barracuda* sp.	LD	R/D
Pearl Oyster	*Pinctada maxima*	D	D
Abalone	*Haliotis assinina*	ED	R/D
Sea cucumber	*Holothuria scabra*	LD	D
Squid	*Loligo* sp.	LD	D
Sea weeds	*Euchema sp, Gracillaria sp*	D	D

D: Developed; ED: Early development; LD: Limited development; R/D: Research and development

(*Epinephelus fuscoguttatus*). The basis of every hatchery operation is the maintenance of a healthy group of adult reproductive fish conditioned to spawn year around as cued by environmental variables such as photoperiod, water exchange and water temperature. The consistent supply of large numbers of high-quality fertilized eggs can only be achieved by implementing a rigorous protocol aimed at reducing stress level of fish, from the time of capture through acclimation to captivity and final maturation.

The techniques for capture, transportation, handling, sexing, sampling, and acclimation of marine finfish breeders have been adequately developed. Prophylaxis using antibiotics, antiseptics, medicine and quarantine is necessary before introducing fish into the maturation tanks. A detailed description of quarantine technique for grouper fish is presented in manual (Sugama, et. al., 2001). Recent advances have led to improved transportation, handling, sampling and control of diseases.

Maturation and Spawning

A particular feature of marine finfish breeding in Indonesia is that the broodstock of most, if not all, species are maintained in an outdoor tank. These tanks are up to 200 tons in volume and 2-3 deep. Socking density is usually around 20-30 pairs in a single tank. The broodstock tank is equipped with a drain water pipe, water inlet and outlet (over-flow) pipes and egg collection tank with a fine net (400mm) that is connected with the outlet pipe, and an aeration system. The system is flow-through, achieving 200-300% water exchange daily. The broodstock are fed with fresh or frozen trash fish (mainly *Sardinella* sp) and squid that was mixed with vitamin mix containing Vitamin A, C and E.

Generally, the fish spawn naturally in the tanks. Most marine finfish spawn throughout a year, and for the groupers spawning usually occurs 3-4 days before and after the new moon phase, while milkfish and sea bass are not associated with the moon phase but strongly connected with the rainy season. The peak spawning season generally occurs between October to March.

Larval rearing

Larval rearing and mass seed production techniques of milkfish, sea bass, and highfin and tiger groupers are fully developed and have been adopted by

Table 3. Mariculture production by species of culture

Brackishwater Aquaculture (tonnes)					
Finfish	**1997**	**1998**	**1999**	**2000**	**2001***
Milkfish	142,709	158,666	209,758	222,228	237,720
Sea bass	2,483	2,039	5,251	3,937	4,210
Mullet	12,264	8,386	13,120	10,841	11,600
Tilapia	22,800	21,593	22,581	25,835	27,630
Others	190,003	163,066	162,225	167,176	15,660
Crustacean					
Tiger Shrimp	96,317	74,824	92,726	93,759	100,300
Banana Shrimp	30,609	22,589	28,872	28,965	30,980
Metapenaues	40,191	20,434	19,255	20,453	21,880
Mud Crab	5,176	2,065	5,143	5,322	5,700
Swimming Crab	2,095	866	3,584	3,496	3,740
Others	328	264	93	544	580
Marine Aquaculture (tonnes)					
Groupers	-	-	1,759	6,879	7,670
Sea bass	-	-	490	759	850
Seaweed	-	-	133,720	187,471	209,240
Pearl	-	-	0.5	0.6	0.7
Sea Cucumber	-	-	-	582	650
Lobster	-	-	-	29	32
Others	-	-	-	1,393.4	1,553.3

Source of data: DG of Aquaculture 2001 farmers (backyard hatchery operators). The hatchery managers produce eggs. Some they use to produce their own fry and some they sell to the backyard hatchery operators. Larval rearing is undertaken using indoor methods. This is basically intensive larval rearing undertaken in fiberglass or concrete tank up to 20 ton, usually 10 ton. The rearing tank is circular or rectangular in shape, flat-bottomed and with light blue color. Larval rearing is undertaken using green water (*Nannochloropsis*). The algal density used for green water ranges from 300,000 to 500,000 cells/ml. The eggs are generally added directly to the larval rearing tanks. The major feed for larval rearing are rotifers (SS and S types), artemia, copepods (if available and not so important) and artificial micro diet (Sugama et.al., 2002).

Nursery

The pond culture system is used for the nursery phase of milkfish. The ponds are about 100m^2 in size and 20 cm in depth. Two to three weeks before the ponds are stocked with milkfish larvae (TL: 1.8-2.0cm), the ponds are fertilized with organic and inorganic fertilizers. Maximum stocking density is 25 fish/m^2. After 1.5 months of culture the larvae attain body sizes of 5-6 cm total length (TL). So farmers my purchase fingerlings and stock them in grow-out ponds.

Two culture systems are used for the nursery phase of groupers and sea bass culture, the pond and cages. Before the ponds are stocked with fish (TL 2.0-2.5 cm), copepods, newly hatched artemia and small shrimp (*Palaemon* spp) are stocked to provide prey for the juvenile fish. Chopped small shrimp and trash fish are also supplied as supplementary feed. After two months of rearing the juveniles attained a size of 5-6 cm TL, and ready for grow-out in marine cages or ponds. The small cages (1x1x1.5m) are placed in the sea. Maximum stocking density per cage is 2,000 fingerlings. The fish are fed four to six times a day at the beginning of stocking, but feeding is gradually reduced to twice a day when they reach about 6 cm TL. Growth to 6 cm TL take about 1.5-2 months. Continuous grading at seven-day intervals is necessary during the nursery phase to reduce cannibalism. Estimated annual production of fry and fingerlings of high-value marine finfish is presented in Table 4.

Table 4: Estimated production of seeds from hatcheries

Species	1999	2001
Milkfish, *Chanos chanos*	227, 989, 617	240,000,000*
Sea bass, *Lates calcarifer*	15,000,000	NA
Groupers, *Cromileptes altivelis and Epinephelus spp.*	7,883,800*	15,000,700*

** Personal data from private hatcheries. NA: Not available*

Growout

Of the species being considered in this paper, there are four species such as milkfish, sea bass, highfin and tiger groupers have reached the commercial scale. Preliminary results of highfin grouper (*Cromileptes altivelis*) cultured in cage are only recently available in this part of the world. In growout trials recently conducted by farmers in the Lampung Bay (South Sumatra) very good financial and economic returns have been found. Over 2,500 fingerlings (5-7 cm TL) produced at Gondol Research Institute for Mariculture were stocked in cages (4 units cages 3x3x2 m). Fingerlings were fed trash fish at 3-5 % of total body weight daily. Fish grew from an average weight of 3-5 g to over 500 g in fourteen months, indicating that already reaching a commercial size. Although the survival rate was 50% a high profit was still achieved as the price of live fish at the farm gate was expensive, around US$ 25-30/kg (Trubus, 2001).

Problems and Constraints

Disease outbreaks now frequently occur in grouper hatcheries and grow-out areas especially affected by virus (VNN and Iridovirus) and parasites (*Benedenian* and *Cryptocaryon* sp) (Koesharyani, et. al., 2001). This has resulted in significant economic loss and it would appear to be the major constraint to sustainability of this industry.

Feeding exclusively with trash fish is likely to be undesirable for both economic and environmental reason in the longer term, and cost effective alternatives in the form of moist or dry pellets need to be developed. It has been widely demonstrated that grouper will adapt to both moist and dry pellets, although some training may be required with the latter.

Research Priorities

The development of reliable techniques for mass production of seeds of marine finfish trough artificial propagation in hatcheries is necessary for establishment of a sustainable offshore cage industry in Indonesia. Research should be focused on improving technology in areas of broodstock nutrition, egg quality, live feeds, first feeding, larval, fingerling and grow out nutrition and disease control. At present, the source of broodstock comes from the wild. Domesticated broodstock would be the first priority in increasing capabilities in genetic improvement in growth rate and disease resistance.

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